2.2 Database searches

A desktop assessment was undertaken before field surveys during February 2018 and updated in May 2018, in order to identify known or potential environmental constraints within or pertaining to the study area and surrounds.

The DBCA database (DPaW 2007-2018) 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 and Energy (**DotEE**) administered EPBC Act Protected Matters Search Tool was also searched for Matters of National Environmental Significance (**MNES**) listed under the EPBC Act including Threatened flora and fauna and TECs (DotEE 2018b).

Spatial data for conservation significant flora and fauna held and maintained by Rio Tinto was also searched as part of the desktop study. Any ESA, Reserves and/or conservation areas within or surrounding the study area were also identified using relevant GIS layers held by Rio Tinto. The search coordinates used (117˚ 59’ 5” E, 22 ˚ 29’ 49” S) were at a central point within the study area. A buffer of 20 km was used for NatureMap and Rio Tinto database searches, and 10 km for the Protected Matters search tool. Results of NatureMap and Protected Matters searches undertaken are presented in Appendix 1.

2.2.1 Summary of NatureMap flora database search

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

Table 2-3: Summary of flora species returned by NatureMap search

Flora group	Number of potential species
Families	54
Genera	168
Species	329
Conservation listed	15
Weeds	15

2.2.2 Summary of NatureMap fauna database search

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

Table 2-4: Summary of terrestrial vertebrate fauna species returned by NatureMap search

Fauna group	Number of potential species
Amphibians	2
Reptiles	59
Avifauna	95
Mammals	21
Conservation listed	6
Total	177

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 prior to the field survey based on the location of database records, availability of potentially suitable habitat and knowledge of the species ecology.

2.3.1 Conservation listed flora returned by desktop study

Twenty six conservation listed flora species were returned by the database searches (Appendix 1); three Priority 1 species; four Priority 2 species; seventeen Priority 3 species; and two Priority 4 flora species.

Two species have previously been recorded from the study area, *Rhagodia* sp. Hamersley (M. Trudgen 17794) (P3) and *Goodenia nuda* (P4). Five species were considered 'likely' to occur, six had the 'potential' to occur, and 13 species were considered 'unlikely' to occur based on the criteria used to assess the pre-field likelihood of occurrence (Table 2-5, Appendix 2).

The likelihood rating of conservation listed flora returned by the database search was later updated post-field assessment (Table 3-4). The post-field assessment was primarily based on validating the presence (and inspection) of suitable habitat present within the study area, and whether the species was likely to have been overlooked during the survey (e.g. a large perennial versus a small annual life form).

Table 2-5: Conservation listed flora species returned by database searches, including pre-field likelihood of occurrence assessment and potential presence via habitat preference and proximity of previous recordings

Species	Status	NM	RT	EPBC	Nearest known locality	Habitat and discussion (pre-field)	Likelihood of occurrence (pre-field)
Calotis squamigera	P1	X	X		9.9 km north east	Small annual herb with pale yellow flowers. In the Pilbara, it is only known from a poorly defined flow line on a plain with pebbly red/brown loam. Elsewhere in central Australia, it is common in grassland and sclerophyll forest (Rio Tinto & DPaW 2014).	Potential
Josephinia sp. Marandoo (M.E. Trudgen 1554)	P1	X	X		0.9 km north west	Large prostrate to erect herb or small shrub with mauve to pink flowers. Favours clay soils. Appears to be indistinct from *J. eugeniae* and impossible to distinguish in the herbarium (Rio Tinto & DPaW 2014).	Likely
Vittadinia sp. Coondewanna Flats (S. van Leeuwen 4684)	P1		X		18.9 km south east	Erect branched herb or sub shrub. Recorded from clay-loams, clays, cracking clays and gilgai usually in association with low open woodland and frequently mulga (Rio Tinto & DPaW 2014).	Potential
Euphorbia australis var. glabra	P2		X		5.2 km north	Small prostrate, much branched herb. Recorded from a sump, low in the landscape on alluvial cracking clay loamy soil, gritty with ironstone fragments (Rio Tinto & DPaW 2014).	Potential
Euphorbia inappendiculata var. *inappendiculata*	P2	X			9km north west	A prostrate much branched diffuse herb. In the Pilbara recorded from hummock grassland of *Triodia epactia* over very open grassland of *Cenchrus ciliaris* on red loamy depressions interspersed with quartzite on plain (Rio Tinto & DPaW 2014).	Potential
Indigofera ixocarpa	P2	X			11 km south east	Small shrub with hooked linear leaves and pink to purple pea flowers. Recorded growing on hills and drainage lines, usually skeletal soils over massive ironstones but also on granite (Rio Tinto & DPaW 2014).	Unlikely
Scaevola sp. Hamersley Range basalts (S. van Leeuwen 3675)	P2		X		19.6 km south west	Shrubs with large toothed leaves and solitary, hand-shaped flowers held in spikes. Known to be very habitat specific, occurring on slopes and hilltops on skeletal brown soils over mostly basaltic volcanic rock (Rio Tinto & DPaW 2014).	Unlikely

Species	Status	NM	RT	EPBC	Nearest known locality	Habitat and discussion (pre-field)	Likelihood of occurrence (pre-field)
Acacia daweana	P3	X			8 km south west	Low spreading shrubs. Recorded from rocky red skeletal loam in spinifex on lower scree slopes and bajada outwash fans of banded rocky ironstone ranges and ridges (Rio Tinto & DPaW 2014).	Potential
Acacia effusa	P3		X		16.8 km south east	Low spreading shrubs. Recorded from rocky red loam with surface strew of rocks in spinifex on low scree slopes of low rocky ranges or on bajada alluvial plain at the base of large banded ironstone mountains and ranges (Rio Tinto & DPaW 2014).	Potential
Astrebla lappacea	P3		X		4.3 km west north west	A tufted perennial grass. Recorded as occurring mainly on gilgais, depressions on cracking clays soils and crabholed plains (Rio Tinto & DPaW 2014).	Unlikely
Calotis latiuscula	P3	X	X		0.74 km south west	Upright herb with yellow flowers. Generally, grows along creek banks, clay plains and cracking clays (Rio Tinto & DPaW 2014).	Likely
Dampiera anonyma	P3	X			0.5 km east	Erect compact perennial shrub. Recorded from hummock grassland on hill slopes and summits above 1000 m in skeletal red brown soil over massive banded ironstone (Rio Tinto & DPaW 2014).	Unlikely
Eremophila magnifica subsp. *velutina*	P3	X			12 km south east	Erect, aromatic shrub. Recorded from growing rocky red brown loams amongst *Triodia* and *Acacia* species on hillslopes and along ephemeral drainage lines (Rio Tinto & DPaW 2014).	Unlikely
Geijera salicifolia	P3		X		18.8 km south	Moderate large rounded trees with large leathery aromatic ovate leaves. Recorded from scree slopes and gorges in the Pilbara (Rio Tinto & DPaW 2014).	Unlikely
Glycine falcata	P3	X	X		4.4 km west north west	Procumbent trailing or ground hugging herb. Recorded as growing on stony loam or cracking clays, typically in grassland in low-lying areas (Rio Tinto & DPaW 2014).	Potential
Goodenia sp. East Pilbara (A.A. Mitchell PRP 727)	P3		X		2.1 km south	Small rosetted herb with spathulate leaves. Recorded from red-brown clay soil with calcrete pebbles on low undulating plain, swampy plains (Rio Tinto & DPaW 2014).	Unlikely

Species	Status	NM	RT	EPBC	Nearest known locality	Habitat and discussion (pre-field)	Likelihood of occurrence (pre-field)
Iotasperma sessilifolium	P3	X	X		5.2 km north	Pilose annual herb to 35 cm high. Recorded from gilgai, cracking clays and crab hole country in periodically flooded areas (Rio Tinto & DPaW 2014).	Unlikely
Oldenlandia sp. Hamersley Station (A.A. Mitchell PRP 147P39)	P3		X		2.1 km south	A small spreading annual herb. Recorded from seasonally inundated clays on gibber plains (Rio Tinto & DPaW 2014).	Unlikely
Rhagodia sp. Hamersley (M. Trudgen 17794)	P3		X		Previously Recorded	Lax shrub or scrambler with small lanceolate leaves. Recorded from mulga on cracking clays (Rio Tinto & DPaW 2014).	Previously Recorded
Rostellularia adscendens var. *latifolia*	P3		X		0.86 km south	A small shrub with hairy to glabrous leaves, angular stems and small blue flowers. Recorded from protected areas near watercourses, or along shaded rocky ridges, often in dry gullies and gorges (Rio Tinto & DPaW 2014).	Likely
Stylidium weeliwolli	P3		X		19.6 km south west	A flattish, rosetted annual herb with white or pink flowers. Grows in gritty sandy soil along watercourse often wet root masses of *Melaleuca leucadendra* at the edge of permanent pools or in gorges (Rio Tinto & DPaW 2014).	Unlikely
Swainsona thompsoniana	P3	X	X		4.3 km west north west	Small tufted annual herb. Recorded from gibber plains, crabhole plains and gilgai, usually at some elevation and in association with tussock grasses (Rio Tinto & DPaW 2014).	Unlikely
Themeda sp. Hamersley Station (M.E. Trudgen 11431)	P3	X	X		0.1 km north west	Robust tall grass. Recorded from drainage lines, clays flats, crabhole flats and dark, self-mulching clays (Rio Tinto & DPaW 2014).	Likely
Vittadinia pustulata	P3		X		0.91 km north west	Low annual herb. Poorly known.	Likely
Goodenia nuda	P4	X	X		Previously Recorded	Prostrate to erect ascending annual herb. Mostly recorded from seasonally inundated clay soils and drainage lines, often in mulga (Rio Tinto & DPaW 2014).	Previously recorded
Eremophila magnifica subsp. *magnifica*	P4	X	X		10.9 km south west	Erect, aromatic shrub. Recorded growing from rocky slopes in open *Eucalyptus* and *Acacia* shrublands often associated with species of *Triodia, Ptilotus* and *Dodonaea* (Rio Tinto & DPaW 2014).	Unlikely

NM – NatureMap; **RT** –Rio Tinto Priority Fauna Datxabase; **EPBC** – EPBC Act Protected Matters Search Tool.

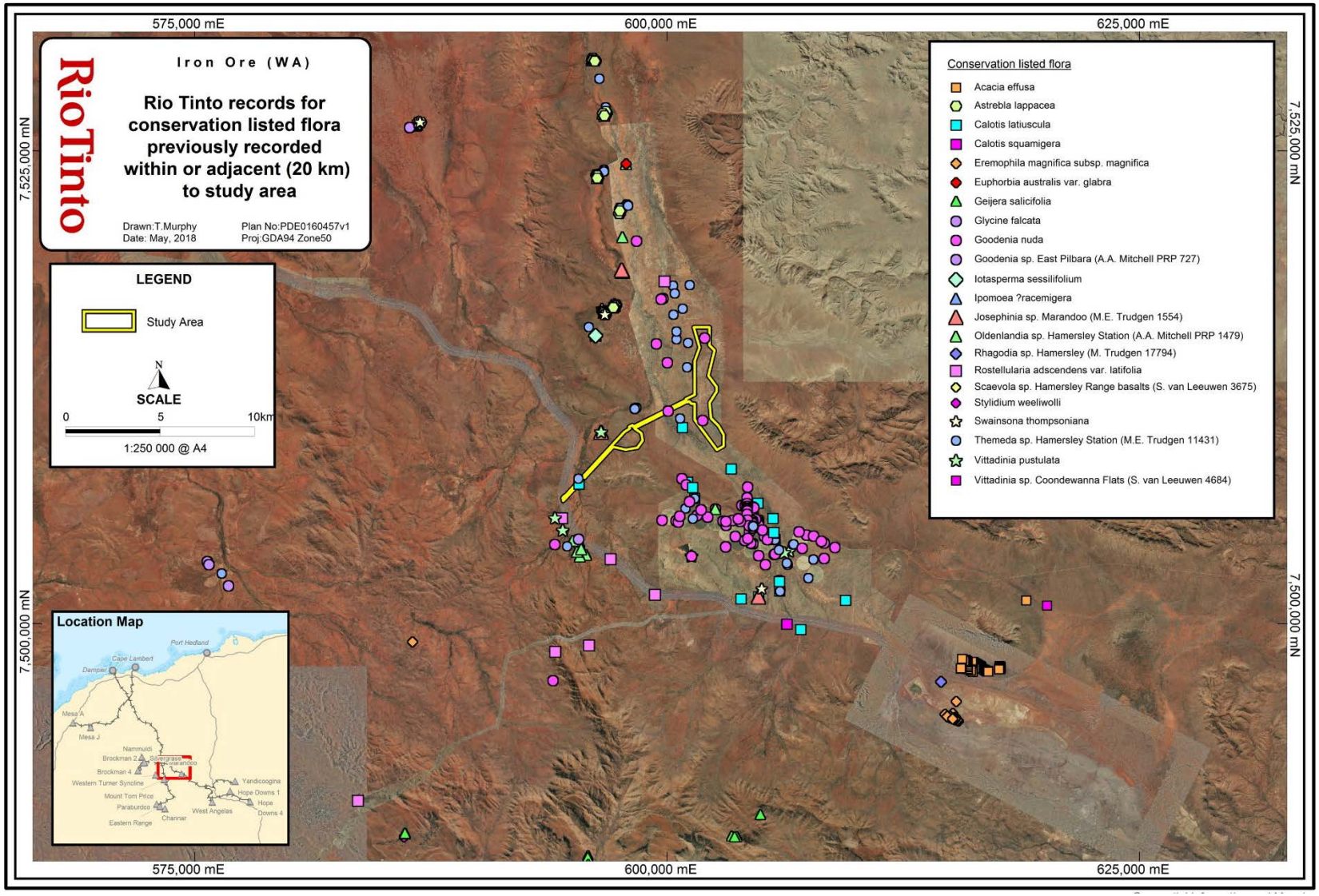

Figure 2-3: Rio Tinto records for conservation listed flora previously recorded within or adjacent (<20 km) to study area

2.3.2 Conservation listed fauna returned by desktop study

Ten conservation listed fauna species were returned by the database search (Appendix 1). One species is listed as Schedule 1 under the WC Act and Endangered under the EPBC Act, one species is listed as Schedule 2 under the WC Act and Endangered under the EPBC Act, three species are listed as Schedule 3 under the WC Act and Vulnerable under the EPBC Act, and two are species listed as Schedule 5 under the WC Act and on Migratory agreements. Furthermore, three species are listed as Priority 4 by the DBCA.

Two species were considered ‘likely’ to occur within the study area and eight species were considered ‘unlikely’ to occur, based on the criteria used to assess the pre-field likelihood of occurrence (Table 2-6, Appendix 2).

The likelihood rating of conservation listed fauna returned by the database search was later updated post field assessment (Table 3-7) including factors such as if there was suitable habitat present within the study area or if the species may not have been present (e.g. the study area was not surveyed at a suitable time).

Table 2-6: Conservation listed fauna species returned by database searches, including pre-field likelihood of occurrence assessment and potential presence via habitat preference and proximity of previous recordings

Species	Common name	Status	NM	RT	EPBC	Distance to nearest record	Habitat and discussion (pre-field)	Likelihood of occurrence (pre-field)
Pezoporus occidentalis	Night Parrot	En, S1			X	>100 km	This species inhabits treeless or sparsely wooded spinifex near water. This cryptic species is not known to occur from the area.	Unlikely
Dasyurus hallucatus	Northern Quoll	En, S2	X		X	10 km	The northern quoll occurs in Northern Australia from the North-west Cape in Western Australia to south-east Queensland, but has declined in recent years. Its distribution is now restricted to six main areas including the northwest Kimberley and Pilbara regions of Western Australia (Braithwaite and Griffiths 1994). In the Pilbara region, the species tends to prefer the Rocklea, Macroy and Robe land systems (Biota 2008) and occurs within gorges, breakaways and major drainage lines with large Eucalyptus trees.	Unlikely
Rhinonicteris aurantia	Pilbara Leaf-nosed Bat	Vu, S3			X	28 south west	This species inhabits abandoned mine shafts, granite rock pile terrain of the east Pilbara and caves formed in gorges that dissect sedimentary geology in the west Pilbara (van Dyck and Strahan 2008). This species is more influenced by the availability of suitable roost caves than by habitat type and high humidity is particularly important to this species (Churchill 1998).	Unlikely
Macrotis lagotis	Greater Bilby	Vu, S3			X	15 km south east	The Bilby prefers tall shrublands and open woodlands on sandy plain habitats (van Dyck and Strahan 2008).	Unlikely
Liasis olivaceus barronii	Pilbara Olive Python	Vu, S3			X	17 km south east	Regarded as a Pilbara endemic, Olive Python (Pilbara subspecies) is restricted to ranges within the Pilbara region and islands of the Dampier Archipelago (DotEE 2018c). This species typically shelters in logs, flood debris, caves, tree hollows and thick vegetation close to water and rock outcrops (Burbidge 2004).	Unlikely
Hirundo rustica	Barn Swallow	Mi, S5			X	> 200 km	In Australia, this species can be recorded in open country in coastal lowlands, often near water, towns and cities. Birds are often sighted perched on overhead wires (Pizzey& Knight 2007; Blakers et al. 1984), and also in or over freshwater wetlands, paperbark Melaleuca woodland, mesophyll shrub thickets and tussock grassland (Schodde & Mason 1999).	Unlikely

Species	Common name	Status	NM	RT	EPBC	Distance to nearest record	Habitat and discussion (pre-field)	Likelihood of occurrence (pre-field)
Apus pacificus	Fork-tailed Swift	Mi, S5			X	40 km north	This species is entirely aerial on the Pilbara mainland and thus does not utilise the terrestrial surface (DotEE 2018d). This species may overfly the study area however is unlikely to land within the study area	Likely
Pseudomys chapmani	Western Pebble-mound mouse	P4	X	X	-	4.5 km south	The Western pebble-mound mouse is endemic to the Pilbara region of Western Australia and occurs west to the McKay Range and south to the Collier Range (Menkhorst and Knight 2001). The species is patchily distributed on gentle colluvial slopes of rocky, hummock grassland with little or no soil and sparse shrub layer.	Likely
Leggadina lakedownensis	Short-tailed Mouse	P4	X			10 km south west	In the Pilbara region this species occurs mainly on black-soil plains especially on calcareous clays (Gibson and McKenzie 2009)	Unlikely
Notoscincus butleri	Line soil-crevice skink	P4	X			10 km south west	Arid, rocky, near coastal areas associated with spinifex, particularly areas near creeks and river margins (Wilson & Swan 2008).	Unlikely

NM – NatureMap; **RT** –Rio Tinto Priority Fauna Database; **EPBC** – EPBC Act Protected Matters Search Tool.

2.4 Flora and vegetation field survey

The study area was surveyed by Rio Tinto botanists Hayden Ajduk and Natalie Murdock between 6 and 9 March 2018. The study area was assessed in accordance with the relevant Factor Guidelines (EPA 2016a and 2016b) and Technical Guidance (EPA 2016c and 2016d).

Relevé (unpegged) survey sites, typically 50 x 50 m in size (to represent an approximate 2,500 m^2) were established in representative areas of all vegetation associations within the study area. A botanical relevé is described as a vegetation sample that describes the structure and floristics, and associated physical attributes, flora and opportunistic fauna sightings. A total of 26 relevés were surveyed in representative vegetation associations. The location and co-ordinates of each relevé from the study are presented in Figure 2-4 and Appendix 4.

At each relevé site, a location was recorded with a handheld GPS and photographs were taken. Data was collected on the flora species present, including: percentage cover; average height of each vegetation stratum; site slope; aspect; topography; soil texture and colour; and landform type and habitat features.

Recent orthorectified aerial photography covering the study area was reviewed whilst in the field to determine boundaries of vegetation communities. The location of each site where a vegetation record was taken was determined based on interpretation of aerial photography and a visit to the site for ground truthing. Determination of boundaries between vegetation associations was also undertaken using aerial photography and ground truthing whilst in the field. The mapping data gathered in the field was used to prepare a draft map of vegetation, utilising rectified 1:5,000 scale colour digital air photography as the background. The vegetation boundaries were digitised on-screen using MapInfo 11.0.

Locations of flora of conservation significance, flora of special interest, unknown flora, weeds and other observations including opportunistic fauna sightings were recorded using a hand-held GPS (WGS 84 datum). Where populations of conservation significant flora were encountered; estimates of density or numbers of individuals, habitats and associated flora were recorded. Density or numbers of individuals of introduced flora species were also recorded.

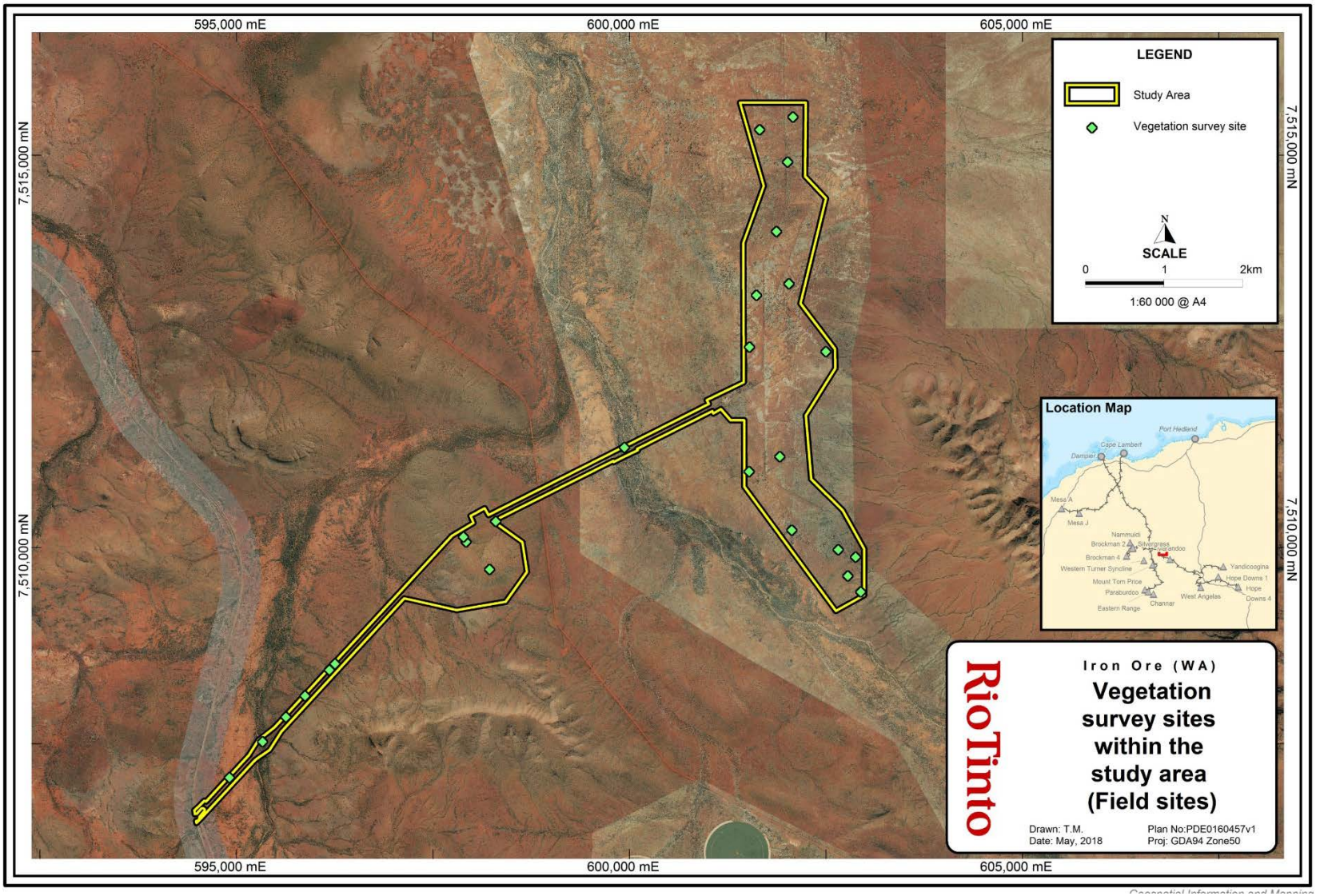

Figure 2-4: Vegetation survey sites within the study area

2.5 Vegetation, descriptions, condition assessment and mapping

Vegetation descriptions for the study area were based on Specht (1970) with modification by Aplin (1979) (Appendix 3). Descriptions were taken at relevés and during traverses where changes in the vegetation structure were observed. A photograph of each vegetation association, and a location using a hand-held GPS (WGS84 datum) was taken. Assessment of the overall condition of each vegetation association was made based on Trudgen (1988) (Appendix 3).

The mapping notes gathered in the field were used to prepare a draft map of vegetation, utilising rectified colour digital air photography as the background. The vegetation boundaries were digitised on-screen using MapInfo 11.0.

The resulting polygons were attributed with the relevant information including the vegetation association, description and condition. Point locations of each relevé recorded were also uploaded into MapInfo, together with visual photographs which were used to assist with the finalising of vegetation boundaries.

2.6 Flora identification

An interim species list was compiled in the field covering common species identified with confidence by the botanists. Voucher samples of unknown and Priority flora were taken and pressed and dried in the field. Each sample was assigned a unique reference identification sample number.

Flora samples collected in the field were identified using relevant taxonomic publications and compared to collections at the Western Australian Herbarium (**WAH**). Sample identifications were conducted by DBCA taxonomist Steven Dillon (WAH). Voucher quality specimens will be lodged with the Western Australian Herbarium in the future. Nomenclature was cross-checked using the DBCA FloraBase (WAH 2018) website, and updated where required.

2.7 Fauna habitat assessment

Broad fauna habitats were identified and mapped based on landforms and vegetation associations identified during the current survey. Habitats were then assessed for their potential to support species of conservation significance, taking into account relevant State and Commonwealth Guidelines to support identification of ‘potential’ habitat. Supporting evidence such as sightings, the presence of microhabitats including caves, water holes, tree hollows and burrows were recorded throughout the study area. Representative traverses were also completed throughout all habitats present within the study area.

Further assessment on the ‘likelihood’ of the study area supporting fauna of conservation significance was undertaken based on the quality of habitat for fauna, and to a wider suite of fauna assemblages. Data was collected opportunistically throughout the study area and habitats were rated based on the likelihood of supporting conservation significant fauna species. Habitats were rated based on the likelihood of supporting conservation significant fauna species as ‘likely’, ‘potential’ or ‘unlikely’ (Appendix 2). Based on this assessment, significant areas for fauna were also mapped and described if required.

Fauna habitats were assessed and mapped as per EPA Factor Guideline for terrestrial fauna (EPA 2016b) and Technical Guidance (EPA 2016d).

2.8 Opportunistic fauna records

Opportunistic fauna sightings were recorded whilst traversing the study area with a focus on conservation significant species and supporting evidence (i.e. scats). A location of each opportunistic fauna record was taken in the field using a hand-held GPS (WGS84 datum).

Potential fauna assemblages were based on the desktop review of previous surveys in the area and database searches.

2.9 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 dependant 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.

2.10 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 (GIS system) 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 system is used as part of the Approvals Coordination System when reviewing the Proposal, thereby ensuring appropriate management conditions are in place.

3. Results

3.1 Vegetation of the study area

Twelve vegetation units were identified across four major landforms over the study area. The vegetation associations are summarised in Table 3-1 and are described in detail on the following pages, accompanied by vegetation mapping (Figure 3-1 and Figure 3-2)

One vegetation unit was described from low hills and slope, one unit from gullies, seven units from plains and three units from drainage lines. The most widespread vegetation association was P4 (329.01 ha covering 43.8% of the study area). The least widespread vegetation association was MD1 (0.84 ha covering 0.11% of the study area).

Table 3-1: Vegetation associations of the study area

Unit	Vegetation description	Extent (ha) within study area	Proportion (%) within study area
Vegetation of low hills and slopes			
HS1	Scattered low trees to low open woodland of *Eucalyptus leucophloia* subsp. *leucophloia* over open shrubland of *Acacia atkinsiana and* A*. maitlandii* over hummock grassland of *Triodia wiseana*	66.71	8.88
	Total	**66.71**	**8.88**
Vegetation of plains			
P1	Low open woodland of *Acacia aptaneura* over open shrubland of *Acacia sclerosperma* subsp. *sclerosperma, A. synchronicia* and **Vachellia farnesiana* over low open shrubland of *Sclerolaena cuneata* and *S. cornishiana* over very open tussock grassland **Cenchrus ciliaris* and *Dactyloctenium radulans*	10.47	1.39
P2	Tall open shrubland of *Acacia ancistrocarpa*, *A. pruinocarpa* and *A. atkinsiana* over hummock grassland of Triodia wiseana	71.18	9.48
P3	Low open woodland *Acacia aptaneura* and *A. pruinocarpa* over *Acacia aptaneura* open shrubland over low scattered shrubs of *Senna artemisioides* subsp*. helmsii* and *Ptilotus obovatus* over open tussock grassland of *Chrysopogon fallax* and *Themeda triandra* over a very open mixed herbland	152.51	20.30
P4	Tall open shrubland *of Acacia ancistrocarpa, A. pruinocarpa*, *A. aptaneura* and *A. atkinsiana* over open hummock grassland of *Triodia melvillei*	335.03	43.80
P5	Low open woodland of *Acacia aptaneura* (+*-Acacia citrinoviridis)* over tussock grassland *Chrysopogon fallax, Themeda triandra* and *Eulalia aurea* over open mixed herbland	65.87	8.77
P6	Low open woodland of *Acacia aptaneura, A. pruinocarpa* and *Corymbia deserticola* subsp. *deserticola* over scattered tall shrubs of *Acacia ancistrocarpa* over hummock grassland of *Triodia melvillei*	16.99	2.26
P7	Tall open shrubland of *Acacia pruinocarpa, A. pteraneura and A. aptaneura* over scattered shrubs of *A. aneura* over open hummock grassland of *Triodia wiseana* and *T. melvillei*	5.04	0.67
	Total	**651.07**	**86.68**
Vegetation of drainage lines			
CL	Woodland of *Eucalyptus victrix* and *Acacia citrinoviridis* over closed grassland of **Cenchrus ciliaris* and **C. setiger*	6.76	0.9

Unit	Vegetation description	Extent (ha) within study area	Proportion (%) within study area
MD1	Tall open scrub of *Acacia atkinsiana*, *Acacia monticola* and *Gossypium robinsonii* over open shrubland of *Acacia pruinocarpa* and *Acacia bivenosa* over open tussock grassland of *Themeda triandra* over very open hummock grassland of *Triodia melvillei*	0.84	0.11
MD2	Tall shrubland of *Acacia citrinoviridis* over open shrubland of *Gossypium robinsonii*, *Acacia bivenosa* and *Androcalva luteiflora* over open tussock grassland of *Themeda triandra* and **Cenchrus setiger* over very open hummock grassland of *Triodia longiceps* and *T. wiseana*	6.51	0.87
	Total	**14.11**	**1.88**
Vegetation of Gullies			
G1	Low open woodland of *Eucalyptus leucophloia* subsp. leucophloia over tall shrubland of *Gossypium robinsonii* and *Ficus brachypoda* over low open shrubland of *Indigofera monophylla*, *Achyranthes aspera, Acacia maitlandii* and *Abutilon dioicum* over open hummock grassland of *Triodia epactia* over very open tussock grassland of *Themeda triandra*	0.96	0.13
	Total	**0.96**	**0.13**
Other			
CL	Previously cleared areas (e.g. tracks)	18.34	2.43
	Total	**18.34**	**2.43**
	Grand Total	**751.13**	**100.0**

3.1.1 Detailed vegetation descriptions

Vegetation of plains

P1	**Low open woodland of *Acacia aptaneura* over open shrubland of *Acacia sclerosperma* subsp. *sclerosperma, A. synchronicia* and **Vachellia farnesiana* over low open shrubland of *Sclerolaena cuneata* and *S. cornishiana* over very open tussock grassland **Cenchrus ciliaris* and *Dactyloctenium radulans***
Landform and soils	This unit was recorded from red brown clayey loams with scattered ironstone pebble cover from low lying plains within the Paraburdoo Land System.
Distribution	This unit was limited to the western end and comprised 10.47 ha (1.39%) of the study area
Associated species	Trees: *Acacia aptaneura* Tall shrubs: *Acacia tetragonophylla, Acacia citrinoviridis* Shrubs: *Acacia sclerosperma* subsp. *sclerosperma, A. synchronicia* and **Vachellia farnesiana* Low shrubs: *Sclerolaena cuneata*, *S. cornishiana and Rhagodia eremaea* Grasses: **Cenchrus ciliaris*, *Dactyloctenium radulans, Sporobolus australasicus and Chloris pectinata, Chrysopogon fallax, Enneapogon polyphyllus, Aristida contorta* Herbs: **Portulaca pilosa, Goodenia muelleriana, Tribulus astrocarpus, Dysphania rhadinostachya* subsp. *rhadinostachya, *Bidens bipinnata, Ptilotus nobilis*
Conservation listed flora	None recorded
Weeds	**Portulaca pilosa, *Cenchrus ciliaris, *Vachellia farnesiana*
Condition	Poor
Sampling sites	Relevé: SF26
Fire and disturbance	Significant disturbance associated with historic clearing, erosion and grazing were observed in this unit. The fire age was old (8-12 years)
Photo	Plate 1

Plate 1: Representative photo of vegetation unit P1 (from Site: SF26)

Vegetation of plains

P2	**Tall open shrubland of *Acacia ancistrocarpa, A. pruinocarpa* and *A. atkinsiana* over hummock grassland of *Triodia wiseana***
Landform and soils	This unit was recorded from red brown sandy loams with ironstone pebble cover on the lower slope and plains at the base of hills within the Boolgeeda Land System
Distribution	This unit was limited to the western end and comprised 71.18 ha (9.48%) of the study area
Associated species	Trees: *Eucalyptus leucophloia* subsp. *leucophloia* Tall shrubs: *Acacia ancistrocarpa, A. pruinocarpa* and *A. atkinsiana* Shrubs: *Senna glutinosa* subsp. *glutinosa* and *S. glutinosa* subsp. *pruinosa* Low shrubs: *Solanum lasiophyllum* and *Indigofera monophylla,* Grasses: *Amphipogon sericeus, Paraneurachne muelleri, Aristida contorta* Herbs: *Goodenia microptera, G. stobbsiana* and *Ptilotus calostachyus*
Conservation listed flora	None recorded
Weeds	None recorded
Condition	Very Good
Sampling sites	Relevés: SF18, SF22
Fire and disturbance	Minor disturbance associated with historic clearing and nearby tracks. The fire age was considered very old (>12 years)
Photo	Plate 2

Plate 2: Representative photo of vegetation unit P1 (from Site: SF18)

Vegetation of Plains

P3	**Low open woodland *Acacia aptaneura* and *A. pruinocarpa* over *Acacia aptaneura* open shrubland over low scattered shrubs of *Senna artemisioides* subsp. *helmsii* and *Ptilotus obovatus* over open tussock grassland of *Chrysopogon fallax* and *Themeda triandra* over a very open mixed herbland**
Landform and soils	This unit was recorded from red brown clayey loams with fine ironstone pebbles, on plains within the Boolgeeda Land System
Distribution	This unit was recorded in the central section and comprised 152.51 ha (20.30%) of the study area
Associated species	Trees: *Acacia aptaneura, A. pruinocarpa* Tall shrubs: *Hakea lorea* subsp. *lorea* Shrubs: *Acacia aptaneura, Eremophila fraseri* subsp. *fraseri, Eremophila latrobei* subsp. *filiformis, Solanum piceum* Low shrubs: *Senna artemisioides* subsp. *helmsii, Ptilotus obovatus, Abutilon lepidum, Sclerolaena cornishiana, Sida fibulifera, Eremophila lanceolata* Grasses: *Chrysopogon fallax, Themeda triandra, Aristida contorta, A. pruinosa, Digitaria brownii, Dactyloctenium radulans* Herbs: *Ipomoea muelleri, Polycarpaea corymbosa, Portulaca oleracea, Roebuckiella similis, Rostellularia adscendens* var. *clementii, Spermacoce brachystema, Dysphania kalpari*
Conservation listed flora	*Aristida jerichoensis* var. *subspinulifera* (P3), *Goodenia nuda* (P4)
Weeds	**Citrullus lanatus, *Portulaca pilosa, * Bidens bipinnata*
Condition	Good
Sampling sites	Relevés: SF05, SF07, SF14
Fire and disturbance	Moderate disturbance associated with grazing, weeds and nearby tracks. The average fire age was old (8-12 years)
Photo	Plate 3

Plate 3: Representative photo of vegetation unit P3 (from Site: SF05)

P4	**Tall open shrubland *of Acacia ancistrocarpa, A. pruinocarpa*, *A. aptaneura* and *A. atkinsiana* over open hummock grassland of *Triodia melvillei***
Landform and soils	This unit was recorded from red brown clayey and sandy loams with ironstone pebbles. This unit was recorded om plains, from the Boolgeeda Land System.
Distribution	This unit was recorded in the central section and comprised 329.01 ha (43.80%) of the study area
Associated species	Trees: *Corymbia deserticola* subsp. *deserticola* Tall shrubs: *Acacia ancistrocarpa, A. pruinocarpa, A. aptaneura and A. atkinsiana* Shrubs: *Senna glutinosa subsp. glutinosa, Solanum piceum, Ptilotus rotundifolius* Low shrubs: *Ptilotus obovatus* var. *obovatus, Hibiscus sturtii, Senna notabilis, Indigofera monophylla, Sida fibulifera, Hibiscus burtonii* Grasses: *Triodia melvillei, Aristida contorta, Eriachne pulchella, Digitaria brownii, Chrysopogon fallax* Herbs: *Evolvulus alsinoides* var. *villosicalyx, Polycarpaea corymbosa, Euphorbia australis var. hispidula, Boerhavia coccinea*
Conservation listed flora	*Goodenia nuda* (P4)
Weeds	**Bidens bipinnata*
Condition	Very Good
Sampling sites	Relevés: SF01, SF02, SF03, SF08, SF10, SF11
Fire and disturbance	Common minor disturbance associated with this unit include tracks and infrastructure. Fire age ranged from recent (<2 years) to old (8-12 years)
Photo	Plate 4

Plate 4: Representative photo of vegetation unit P4 (from Site: SF08)

P5	**Low open woodland of *Acacia aptaneura* (+-*Acacia citrinoviridis)* over tussock grassland *Chrysopogon fallax, Themeda triandra* and *Eulalia aurea* over open mixed herbland**
Landform and soils	This unit was recorded from red brown clayey loams. This unit was recorded lower lying areas on plains, from the Boolgeeda Land System.
Distribution	This unit was recorded in the central section of the study area. It was recorded from 65.87ha (8.77 %)
Associated species	Trees: *Acacia aptaneura, A. citrinoviridis* Tall shrubs: *Hakea lorea* subsp. *lorea* Low shrubs: *Ptilotus obovatus* var. *obovatus, Abutilon otocarpum, *Malvastrum americanum*, Grasses: *Chrysopogon fallax, Themeda triandra, Eulalia aurea, Perotis rara, Enneapogon polyphyllus, Eragrostis cumingii, Urochloa occidentalis* Herbs: *Ipomoea muelleri, Bidens bipinnata, Cleome viscosa, Boerhavia coccinea, Alysicarpus muelleri, Polycarpaea corymbosa, Pterocaulon sphacelatum, Cheilanthes sieberi* subsp. *Sieberi, Portulaca oleracea*
Conservation listed flora	*Goodenia nuda* (P4)
Weeds	**Bidens bipinnata, *Malvastrum americanum, *Flaveria trinervia*
Condition	Good
Sampling sites	Relevés: SF04, SF06
Fire and disturbance	Moderate disturbance associated with grazing, weeds and nearby tracks. The average fire age was considered old (8-12 years).
Photo	Plate 5

Plate 5: Representative photo of vegetation unit P5 (from Site: SF06)

P6	**Low open woodland of *Acacia aptaneura, A. pruinocarpa* and *Corymbia deserticola* subsp. *deserticola* over scattered tall shrubs of *Acacia ancistrocarpa* over hummock grassland of *Triodia melvillei***
Landform and soils	This unit was recorded from red brown clayey loams on plains, within the Boolgeeda Land System.
Distribution	This unit was recorded in the central section and comprised 16.99 ha (2.26 %) of the study area
Associated species	Trees: *Acacia aptaneura, A. pruinocarpa and Corymbia deserticola* subsp. *deserticola* Tall shrubs: *Acacia ancistrocarpa, A. ayersiana* Shrubs: *Senna glutinosa* subsp. *glutinosa* Low shrubs: *Hibiscus burtonii, Solanum lasiophyllum, S. ferocissimum,* Grasses: *Perotis rara*, *Aristida obscura*, *Paspalidium rarum*, *Chrysopogon fallax*, *Eriachne mucronata*, *Themeda triandra* Herbs: *Evolvulus alsinoides* var. *villosicalyx*, **Bidens bipinnata*, *Rhyncharrhena linearis*, *Spermacoce brachystema, Duperreya commixta*, *Euphorbia boophthona*
Conservation listed flora	None recorded
Weeds	**Biden bipinnata*
Condition	Very Good
Sampling sites	Relevés: SF13, SF12
Fire and disturbance	Minor disturbance associated with nearby tracks. The average fire age was old (8-12 years).
Photo	Plate 6

Plate 6: Representative photo of vegetation unit P6 (from Site: SF12)

P7	**Tall open shrubland of *Acacia pruinocarpa, A. pteraneura and A. aptaneura* over scattered shrubs of *A. aneura* over open hummock grassland of *Triodia wiseana* and *T. melvillei***
Landform and soils	This unit was recorded from red brown sandy loams with fine ironstone mantle on stony plains, within the Boolgeeda Land System.
Distribution	This unit was recorded in the western section and comprised 5.04 ha (0.67 %) of the study area
Associated species	Trees: *Eucalyptus leucophloia subsp. leucophloia* and *Corymbia hamersleyana* Tall shrubs: *Acacia pruinocarpa, A. pteraneura* and *A. aptaneura* Shrubs: *Acacia aneura, Senna* spp., Low shrubs: *Eremophila forrestii* subsp. *forrestii, E. latrobei* subsp. *latrobei, Hibiscus* sp. Gardneri (A.L. Payne PRP 1435*), E. cuneifolia, Sida* sp. dark green fruits (S. van Leeuwen 2260) Grasses: *Triodia wiseana, T. melvillei, Eriachne mucronata, Chrysopogon fallax*, Herbs: *Bidens bipinnata, Cheilanthes sieberi* subsp. *Sieberi, Ptilotus nobilis*
Conservation listed flora	None Recorded
Weeds	**Biden bipinnata*
Condition	Very Good
Sampling sites	Relevé: SF24
Fire and disturbance	Minor disturbance associated with nearby tracks. The average fire age was old (8-12 years)
Photo	Plate 7

Plate 7: Representative photo of vegetation unit P6 (from Site: SF24)

Vegetation of Drainage Lines

CL	**Woodland of *Eucalyptus victrix* and *Acacia citrinoviridis* over closed grassland of **Cenchrus ciliaris* and **C. setiger***
Landform and soils	This unit was recorded from red brown sandy clay loams and loamy clays with river stone in the creek beds, from creek systems within the Paraburdoo and Jurrawarrina Land Systems.
Distribution	This unit was recorded in isolated areas in the western section and comprised 6.76 ha (0.90%) of the study area
Associated species	Trees: *Eucalyptus victrix* and *Acacia citrinoviridis* Tall shrubs: *Acacia sclerosperma* subsp. *sclerosperma* Shrubs: *Santalum lanceolatum, Gossypium robinsonii, Acacia aptaneura, Atalaya hemiglauca, *Vachellia farnesiana* Low shrubs: *Acacia bivenosa, Melhania oblongifolia, *Malvastrum americanum* Grasses: **Cenchrus setiger, *Cenchrus ciliaris, *Echinochloa colona, Themeda triandra*
Conservation listed flora	None recorded
Weeds	**Cenchrus setiger, *Cenchrus ciliaris, *Echinochloa colona, *Malvastrum americanum, *Vachellia farnesiana, *Sonchus oleraceus*
Condition	Poor
Sampling sites	Relevés: SF16, SF17
Fire and disturbance	Significant disturbance associated with grazing and high weed cover were observed in this unit. The average fire age was old (8-12 years)
Photo	Plate 8

Plate 8: Representative photo of vegetation unit P1 (from Site: SF16)

MD1	**Tall open scrub of *Acacia atkinsiana*, *Acacia monticola* and *Gossypium robinsonii* over open shrubland of *Acacia pruinocarpa* and *Acacia bivenosa* over open tussock grassland of *Themeda triandra* over very open hummock grassland of *Triodia melvillei***
Landform and soils	This unit was recorded from red brown sandy and/or clay loams with mixed rocks and pebbles in minor drainage lines on the Boolgeeda Land System
Distribution	This unit was recorded in isolated areas in the western section and comprised 0.84 ha (0.11 %) of the study area
Associated species	Trees: *Corymbia deserticola* subsp. *deserticola* Tall shrubs: *Acacia atkinsiana, A. monticola, Gossypium robinsonii, A. citrinoviridis* Shrubs: *Acacia pruinocarpa, A. bivenosa, Codonocarpus cotinifolius* Low shrubs: *Indigofera monophylla, Sida fibulifera*, Grasses: *Triodia melvillei*, *Paraneurachne muelleri, Themeda triandra, Eriachne mucronata, Aristida contorta, Panicum effusum, Chrysopogon fallax* Herbs: *Gomphrena canescens subsp. canescens, Duperreya commixta, Cleome viscosa*
Conservation listed flora	None recorded.
Weeds	**Malvastrum americanum, *Setaria verticillata, *Bidens bipinnata*
Condition	Very Good
Sampling sites	Relevé: SF09
Fire and disturbance	Minor disturbance associated with grazing and weeds were observed in this unit. The fire age ranged from recent (<2 years) to old (8-12 years).
Photo	Plate 9

Plate 9: Representative photo of vegetation unit MD1 (from Site: SF09)

MD2	**Tall shrubland of *Acacia citrinoviridis* over open shrubland of *Gossypium robinsonii*, *Acacia bivenosa* and *Androcalva luteiflora* over open tussock grassland of *Themeda triandra* and **Cenchrus setiger* over very open hummock grassland of *Triodia longiceps* and *T. wiseana***
Landform and soils	This unit was recorded from red brown clay loams and skeletal soils with ironstone rocks from minor drainage lines within the Boolgeeda Land System.
Distribution	This unit was recorded in small areas in the western section and comprised 6.51 ha (0.87%) of the study area
Associated species	Trees: *Corymbia hamersleyana* Tall shrubs: *Acacia citrinoviridis* Shrubs: *Gossypium robinsonii*, *Acacia bivenosa*, *Androcalva luteiflora* Low shrubs: *Ptilotus obovatus* var. *obovatus*, *Corchorus tridens* Grasses: *Themeda triandra, *Cenchrus setiger, Enneapogon lindleyanus, Paraneurachne muelleri* Herbs: *Notoleptopus decaisnei, * Bidens bipinnata, Evolvulus alsinoides* var. *villosicalyx*
Conservation listed flora	None recorded
Weeds	**Bidens bipinnata, *Cenchrus setiger, *Cenchrus ciliaris, *Vachellia farnesiana, *Malvastrum americanum*
Condition	Very Good
Sampling sites	Relevés: SF23, SF25
Fire and disturbance	Common minor disturbance associated with grazing and minor weeds were observed in this unit. The average fire age was old (8-12 years).
Photo	Plate 10

Plate 10: Representative photo of vegetation unit MD1 (from Site: SF23)

Vegetation of Hilltops and Slopes

HS1	**Scattered low trees to low open woodland of *Eucalyptus leucophloia* subsp. *leucophloia* over open shrubland of *Acacia atkinsiana and* A. *maitlandii* over hummock grassland of *Triodia wiseana***
Landform and soils	This unit was recorded from red brown shallow loams with occasional small ironstone outcropping on upper slope and hilltops, within the Newman Land System
Distribution	This unit was recorded in the western section and comprised 66.71 ha (8.88%) of the study area
Associated species	Trees: *Eucalyptus leucophloia* subsp. *leucophloia* Tall shrubs: *Hakea chordophylla* Shrubs: *Acacia atkinsiana, A. maitlandii, Senna glutinosa subsp. glutinosa, Acacia pyrifolia* Low shrubs: *Indigofera monophylla* Grasses: *Triodia epactia*
Conservation listed flora	None recorded.
Weeds	None recorded
Condition	Very Good
Sampling sites	Relevés: SF19, SF21
Fire and disturbance	Fire had recently impacted large sections of this unit. Minor disturbance associated with nearby tracks was observed in this unit.
Photo	Plate 11

Plate 11: Representative photo of vegetation unit HS1 (from Site: SF 19)

Vegetation of Gullies

G1	**Low open woodland of *Eucalyptus leucophloia* subsp. leucophloia over tall shrubland of *Gossypium robinsonii* and *Ficus brachypoda* over low open shrubland of *Indigofera monophylla*, *Achyranthes aspera, Acacia maitlandii* and *Abutilon dioicum* over open hummock grassland of *Triodia epactia* over very open tussock grassland of *Themeda triandra***
Landform and soils	This unit was recorded from red brown sandy loams with ironstone rocks and boulders, from gullies within the Newman Land System.
Distribution	This unit was recorded in the western section and comprised 0.96 ha (0.13 %) of the study area
Associated species	Trees: *Eucalyptus leucophloia* subsp. *leucophloia* Tall shrubs: *Gossypium robinsonii* and *Ficus brachypoda* Shrubs: *Acacia atkinsiana, A. maitlandii, Senna glutinosa* subsp*. glutinosa, Acacia pyrifolia* Low shrubs: *Indigofera monophylla* Grasses: *Triodia epactia*
Conservation listed flora	None recorded.
Weeds	None recorded
Condition	Excellent
Sampling sites	Relevé: SF20
Fire and disturbance	Fire had recently impacted large sections of this unit. No other disturbance was associated with this unit
Photo	Plate 12

Plate 12: Representative photo of vegetation unit HS1 (from Site: SF 19)

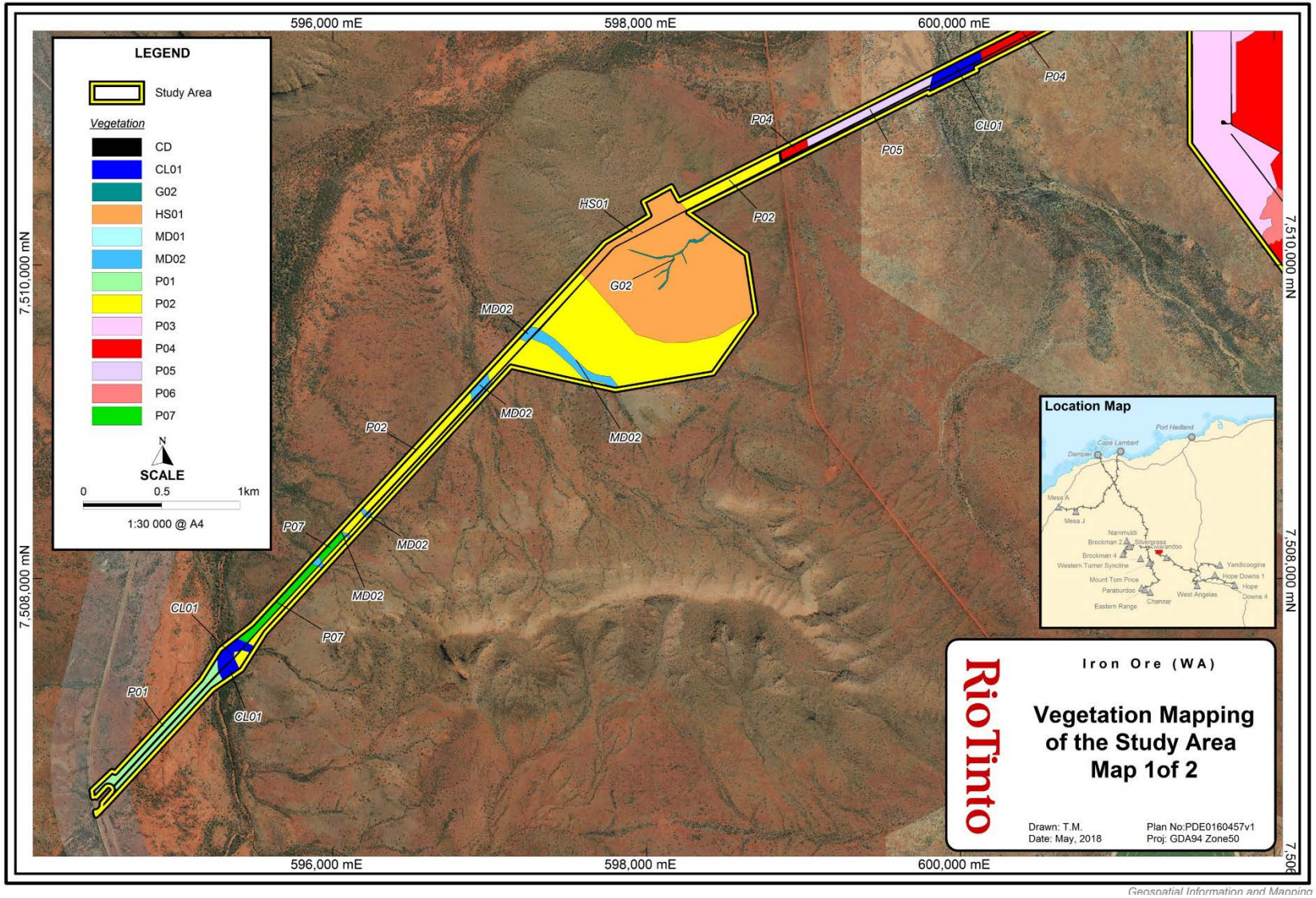

Figure 3-1 *Vegetation within the Study Area (Map 1 of 2)*

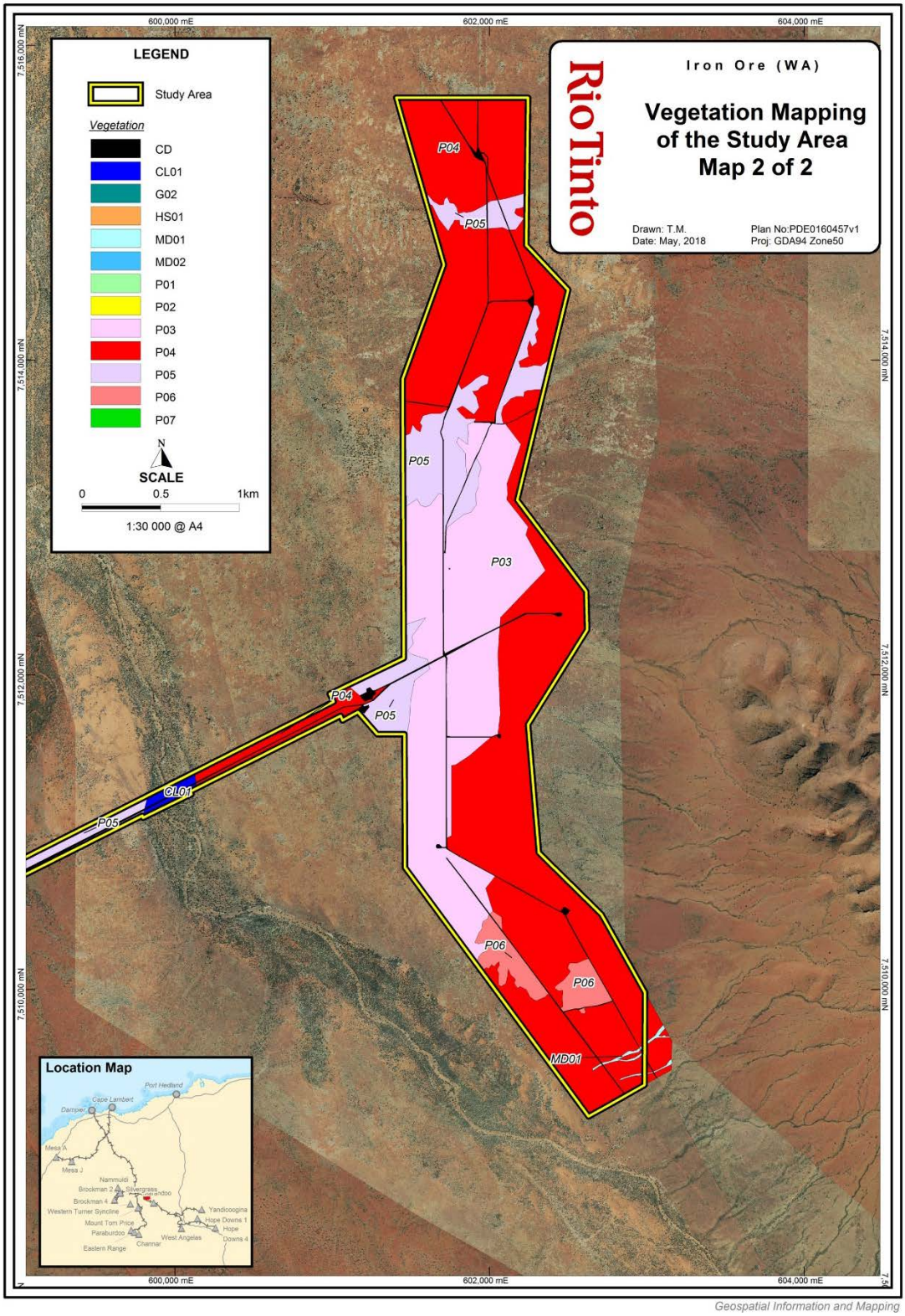

Figure 3-2 Vegetation within the Study Area (Map 2 of 2)