Roy Hill Iron Ore

Remote MAR Borefield

Reconnaissance Flora and Vegetation Survey

Biologic Environmental Survey Pty Ltd

Roy Hill Holdings Pty Ltd.

September 2018

REMOTE MAR BOREFIELD
RECONNAISSANCE FLORA AND VEGETATION SURVEY

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Executive Summary

Roy Hill Holdings Pty Ltd (Roy Hill) are exploring options of managing future predicted excess groundwater abstracted from their mine pits. A recent update of the Roy Hill mine water balance indicates that by late 2020, pit dewatering at the mine may generate up to 100 ML/d (million litres per day) of water more than what can be used in the mine and processing stream. To manage this potential excess, Roy Hill are investigating potential additional Managed Aquifer Recharge capacity (Remote MAR Borefield) in tenures (E47/1326, E46/586 and L47/735) located to the south of the mine.

Roy Hill commissioned Biologic Environmental Survey Pty Ltd (Biologic) to complete a Reconnaissance Flora and Vegetation Survey of tenures E47/1326 and E46/586. The overarching objective of the flora and vegetation assessment was to identify the environmental values of the Study Area and to determine if there are any conservation significant values or sensitive receptors that may warrant further assessment. The reconnaissance survey was undertaken over six days between 10 and 15 July 2018, with all major vegetation communities visited and sampled. Following the completion of the reconnaissance survey, Biologic was requested to include an additional part tenement to the Study Area, part Miscellaneous tenement L47/642. This additional area was not ground-truthed, with the vegetation units extrapolated from aerial imagery and the existing vegetation unit mapping from the original Study Area.

The vegetation was sampled with 46 relevés and seven mapping points to record the broad vegetation communities and their condition, as well as collecting an inventory of flora species present. A total of 199 vascular flora taxa, from 38 families and 94 genera, including 188 native species and 11 introduced taxa were recorded from the Study Area. The field survey did not record any threatened flora, while the desktop assessment confirmed that it was highly unlikely that any would occur within the Study Area. The field survey identified the presence of three priority listed taxa, *Eremophila pilosa* (P1), *Eremophila youngii* subsp. *lepidota* (P4) and *Goodenia nuda* (P4). An additional priority listed taxon, *Eucalyptus rowleyi* (P3), occurs within the additional area included with the Study Area after the completion of the field survey. The presence of *Eremophila pilosa* in the Study Area is of regional significance due to its restricted distribution. No other flora species recorded from the Study Area are of regional or local significance.

None of the 11 introduced taxa recorded from the Study Area are listed as weeds of national significance or declared plant pests listed under the *Biosecurity and Agriculture Management Act 2007*. The 11 introduced taxa have been previously recorded from the region based on the desktop and literature review and are common species in the Pilbara.

A total of 13 vegetation units and two mapping units were described and delineated from the Study Area. The 13 vegetation units can be grouped into three broad formations: *Triodia* mid open hummock grassland; *Eucalyptus* mid to low isolated trees or sparse woodland; and *Acacia* low isolated trees.

The majority of the vegetation units described and delineated from the Study Area support Mulga (mostly *Acacia aptaneura*) or consisted of a dominant Mulga upper stratum. The Mulga occurred as either isolated low trees or in groves and patches.

The Study Area also incorporated a section of the Fortescue River and associated floodplains and alluvial washplains. The floodplains and washplains consisted of an open upper stratum of *Eucalyptus victrix*, while the Fortescue River supported *Eucalyptus camaldulensis* subsp. *obtusa*. The floodplain and major drainage line were heavily impacted by grazing, trampling and pastoralism which has altered the mid and lower stratums of the vegetation units.

The vegetation units described from the Study Area are not considered to be analogous to the known Threatened Ecological Communities (TECs) occurring in the Pilbara. One Priority Ecological Community (PEC), Narbung LS, is associated with the Narbung land system, which has been mapped as occurring over 24% of the Study Area. A review of the PEC and the land system description suggests that areas dominated by snakewood (*Acacia xiphophylla*) are more consistent with the PEC. Currently there is limited information available on the Narbung LS PEC and its occurrence in the Pilbara. Until further information becomes available it is assumed that the vegetation unit AxTOS, which supports a dominant upper storey of *Acacia xiphophylla*, is most consistent with the Narbung LS PEC. The remaining eight vegetation units (AaAfLIT. AaLIT, AaLW, CP, EvAaLIT, EvAaLSW, EvAaLSWIT and TaTpTsMOHG) that have been mapped in association with the land system are also representative of the PEC, although they do not closely resemble the land system description.

Eleven of the 13 vegetation units are considered to be locally significant as they support, in isolation or a combination of, occurring in association with the Narbung LS PEC, priority listed flora, phreatophytic or potentially phreatophytic vegetation, occur in association with the Fortescue River, are locally restricted landforms or rely on sheet flow.

Vegetation unit TaTpTsMOHG was ranked as having a high local significance. The vegetation unit supports a population of *Eremophila pilosa*, which is a restricted Priority 1 listed species. Vegetation unit AxTOS was ranked as having a moderate local significance as it most closely resembles the Narbung land system description and occurs within the land system mapping. Vegetation unit EcoMIT was ranked as having a moderate local significance. The vegetation unit occurs along the incised channels of Fortescue River and supports phreatophytic flora, namely *Eucalyptus camaldulensis* subsp. *obtusa*, as well as other potential phreatophytic flora including *Eucalyptus victrix* and *Atalaya hemiglauca.*

The remainder of the locally significant vegetation units were ranked as a having a low local significance, as they either support: Priority 4 flora species *Eremophila youngii* subsp. *lepidota* and/ or *Goodenia nuda*, which are widespread in the Fortescue subregion; potential phreatophytic flora species *Eucalyptus victrix*, which may utilise groundwater when available; associated with unique/ unusual and restricted landforms (claypans either bare or vegetated) in the Fortescue subregion; and/ or associated with groved Mulga that may or may not depend on sheet flow across the landscape.

Review of the vegetation units and floristic assemblage indicates that the Fortescue River is a Groundwater Dependent Ecosystem (GDE) due to the presence of the facultative phreatophyte *Eucalyptus camaldulensis* subsp. *obtusa*. In addition, the potential phreatophtye, *Eucalyptus victrix* is present along the incised channels of Fortescue River and across the floodplains. *Eucalyptus victrix* was recorded across the Study Area on the outer edges of vegetated and non-vegetated claypans, alluvial washplains and mulga groves.

The Study Area potentially supports sheet flow dependent Mulga communities. Mulga (represented by *Acacia aptaneura, Acacia fuscaneura* and *Acacia paraneura*) dominated communities or communities with Mulga species present, were mapped within the Narbung, Turee and Warri land systems. The Mulga communities mapped within the Study Area did not display the prominent banding seen in adjacent surrounds that would suggest a reliance on sheet flow. However, some of the Mulga communities were groved in areas of the Narbung, Turee and Warri land systems which indicates a potential dependence on sheet flow.

The condition of the vegetation in the Study Area ranged from Excellent to Completely Degraded, with the majority in a very good condition. The most common impacts to the vegetation were from cattle grazing and trampling, which is evident across the Fortescue River floodplain. The vegetation structure has been substantially altered by cattle grazing and trampling that many of the native understorey species are not present. The understorey mainly consists of an introduced shrub and herb layer dominated by **Vachellia farnesiana* and **Malvastrum americanum*. The remainder of the Study Area was mostly mapped as Very Good, with areas of Excellent, Good and Poor condition vegetation.

1 Introduction

1.1 Background

Roy Hill Holdings Pty Ltd (Roy Hill) are exploring options of managing future predicted excess groundwater abstracted from their mine pits. Currently Roy Hill use the groundwater in the process stream and/or disposed of on the mining tenure (M46/00518) using evaporation ponds and managed aquifer recharge (MAR) techniques (Managed Recharge, 2018). A recent update of the Roy Hill mine water balance indicates that by late 2020, pit dewatering at the mine may generate up to 100 ML/d (million litres per day) of water in excess of what can be used (adapted from Managed Recharge, 2018). To manage this potential excess, Roy Hill are investigating potential additional MAR capacity (Remote MAR Borefield) in tenures (E47/1326, E46/586 and L47/735) located to the south. The Roy Hill mine is located in the Pilbara region of Western Australia, approximately 100 kilometres (km) north of the Newman township (Figure 1.1).

Roy Hill commissioned Biologic Environmental Survey Pty Ltd (Biologic) to complete a Reconnaissance Flora and Vegetation Survey (formerly referred to as a Level 1 Flora and Vegetation Survey) of tenures E47/1326 and E46/586 (the original Study Area; Figure 1.2). The extent of the area is approximately 20,104.85 hectares (ha) in size.

Following the completion of the Reconnaissance Flora and Vegetation Survey of the Study Area, Biologic was requested to incorporate an additional area to the assessment, part tenement L47/642 (hereafter referred to as the Study Area; Figure 1.2). The additional area is approximately 4,265.73 ha in size and extends the overall Study Area to a total of 24,327.99 ha in size. Miscellaneous tenement L47/642 is extensive and covers the majority of the Study Area, while also extending further to the south. The extent of each tenement within the Study Area, as well as the overlap, is:

- E47/1326: 11,169.32 ha;
- E46/586: 8,935.54 ha;
- L47/642: 23,797.54 ha; and
- Overlap: 19,619.20 ha.

Roy Hill is currently seeking approval for Miscellaneous Licences that cover E47/1326 and E46/586 (L47/851, L47/772 and L46/142). The Remote MAR Borefield is located directly north of the Stage 2 Borefield and Southern Expansion. These additional areas have previously been surveyed by Maia (2018) and G&G Environmental (2009), and do not form a part of this document.

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Mackay

Rudall

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Karijini National Park

Hamersley

Fortescue

Trainor

Newman

Ashburton

Augustus

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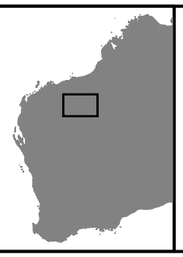
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, © OpenStreetMap contributors, and the GIS User Community

Legend

- Study Area
- RoyHill_Tenements
- Major Roads
- Pilbara Bioregion

IBRA Subregions

- Fortescue
- Other



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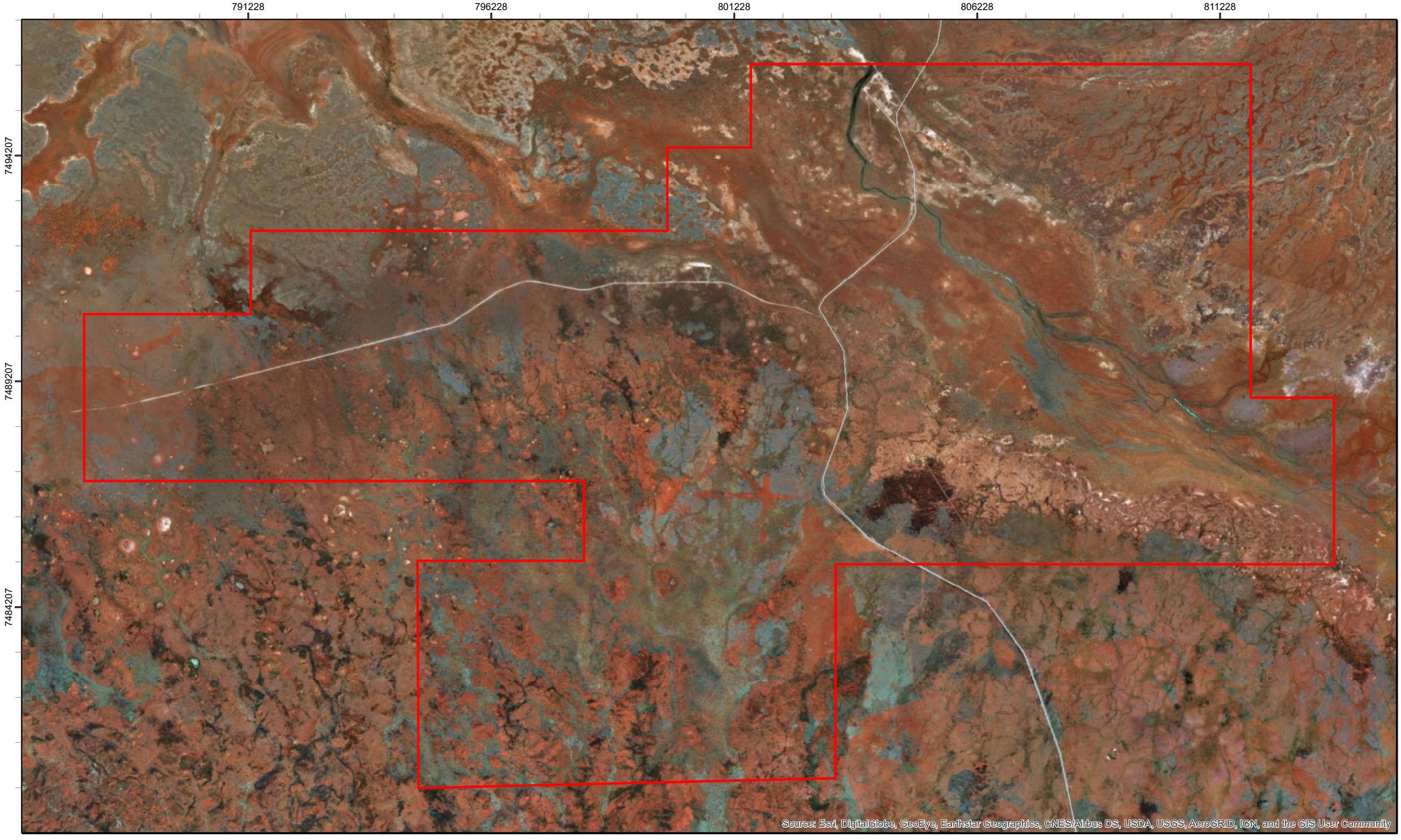
Reconnaissance Flora & Vegetation Survey

Fig. 1.1: Regional location and IBRA

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Size A3. Created 19/09/2018



Legend

- Study Area
- Major Roads

biologic Environmental Survey

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Roy Hill Iron Ore Pty Ltd - Remote MAR Borefield

Reconnaissance Flora & Vegetation Survey

Fig. 1.2: Study Area

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Size A3. Created 20/09/2018

1.2 Objective and Scope of Work

The overarching objective of the flora and vegetation assessment (hereafter referred to as the Survey) was to identify the environmental values of the Study Area and to determine if there are any conservation significant values or sensitive receptors that may warrant further assessment. The overarching objective was achieved via the following scope of works:

- complete a desktop assessment, including review of previous biological surveys and government and non-government databases;
- complete a Reconnaissance Flora and Vegetation Survey across the Study Area;
- review the results of the flora and vegetation assessment to determine if there are any significant environmental values within the Study Area;
- discuss the significant environmental values (and remaining environmental values) from a regional and local context; and
- provide advice and guidance related to any ongoing Project works with respect to any significant flora and vegetation values identified from the Study Area.

2 Existing Environment and Background Context

2.1 Climate

The Pilbara bioregion has a semi-desert to tropical climate, with rainfall occurring sporadically throughout the year, although mostly during summer (Thackway & Cresswell, 1995). Summer rainfall is usually the result of tropical storms in the north or tropical cyclones that impact upon the coast and move inland (Leighton, 2004). The winter rainfall is generally lighter and is the result of cold fronts moving north easterly across the state (Leighton, 2004). The average annual rainfall ranges from 200-350 mm, although there are significant fluctuations between years (BoM, 2017), with up to 1200 mm falling in some locations in some years (McKenzie *et al.*, 2009).

Long-term climatic data is not available for the Study Area itself; however, long term climatic data is available from the Bureau of Meteorology (BoM) weather station at Newman Airport (Station 7176), 80 km south of the Study Area (BoM, 2017). The Newman Airport is expected to provide the most accurate long-term average (LTA) dataset for climatic conditions experienced within the Study Area (Figure 2.1). Although there are several weather stations located closer to the Study Area (i.e. Bonney Downs, Noreena Station, Christmas Creek), the information collected is sporadic with data missing for numerous days.

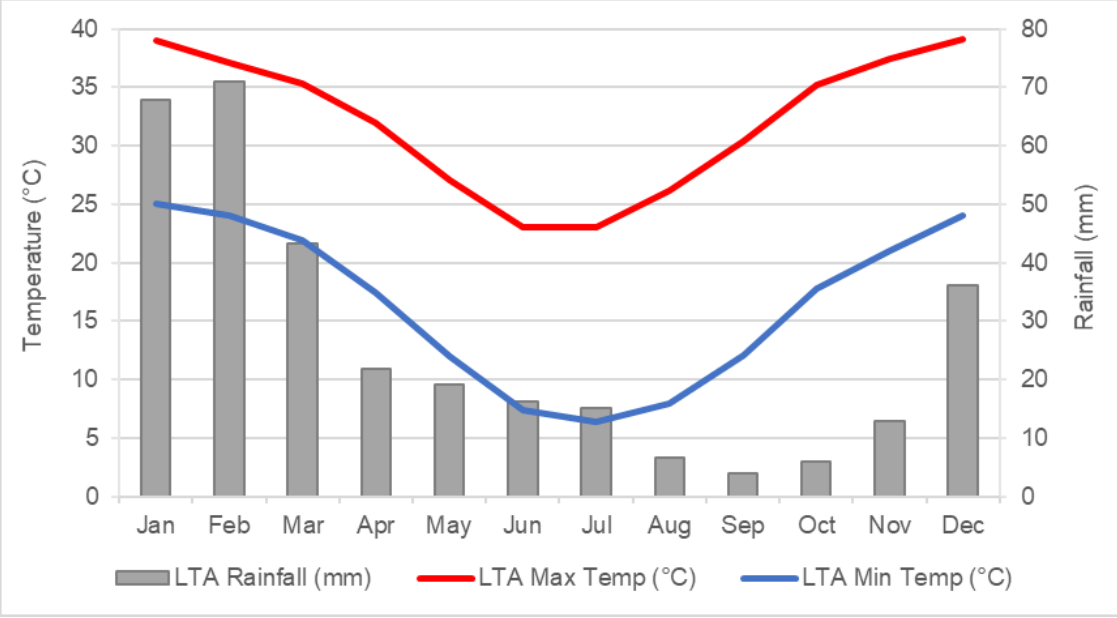

Figure 2.1: Long-term climatic averages (LTA) of monthly rainfall and temperature from Newman Airport (station 07176; BoM, 2017)

2.2 Existing Land Use

The Study Area includes the entirety of exploration tenements E47/1326 and E46/586 and part of miscellaneous tenement L47/642, held by Roy Hill Iron Ore Pty Ltd. The Study Area is wholly located within the Roy Hill pastoral lease, which is actively utilised for the grazing of cattle. The homestead for the Roy Hill pastoral lease is located on the banks of Fortescue River, in the north of the Study Area. Pastoral and public infrastructure, including roads, tracks, fences, cattle yards and high voltage transmission lines, traverse throughout the Study Area.

2.3 Biogeographical Regionalisation of Australia

The Study Area is located within the Pilbara bioregion (Figure 1.1), as defined by the Interim Biogeographic Regionalisation of Australia (IBRA; Thackway & Cresswell, 1995). The Pilbara bioregion is characterised by vast coastal plains and inland mountain ranges with cliffs and deep gorges (Thackway & Cresswell, 1995). Vegetation is predominantly mulga low woodlands or snappy gum over bunch and hummock grasses (Bastin, 2008).

Within the Pilbara bioregion, the Study Area is located within the Fortescue (PIL02) subregion (Figure 1.1). The Fortescue subregion is characterised by alluvial plains and river frontage (Kendrick, 2001). The Fortescue contains extensive salt marsh, mulga-bunch grass, and short grass communities on alluvial plains, and river gum woodlands fringing major drainage lines (Kendrick, 2001). The significant and dominant feature of this subregion is the Fortescue Marsh. This drainage feature, 100 km long, is effectively the terminus of the upper Fortescue River (EPA, 2013). The lower Fortescue River arises from streams draining the Chichester and Hamersley Ranges below the Marsh and west of the Goodiadarrie Hills (McKenzie *et al.*, 2003).

2.4 Soils and Landforms

The Atlas of Australian Soils (Northcote *et al.*, 1960-1968) was compiled by CSIRO (Commonwealth Scientific and Industrial Research Organisation) in the 1960's to provide a consistent national description of Australia's soils. It comprises of a series of ten maps and associated explanatory notes and is published at a scale of 1:2,000,000, but the original compilation was at scales from 1:250,000 to 1:500,000. The broad soil landscape units that have been mapped across the Study Area include Lb12 and Oc71 (Northcote *et al.*, 1960-1968) (Table 2.1).

Soil landscape unit Lb12 occurred in association with Fortescue River and the associated floodplains. Soil landscape unit Oc71 occurred across the remaining areas of the Study Area and was the most extensive unit (67% compared to 33% for Lb12) (Table 2.1).

Table 2.1: Soil landscape units mapped within the Study Area

Code & Description	Study Area		E47/1326		E46/586		L47/642	
	ha	%	ha	%	ha	%	ha	%
Lb12: Valley flats along major drainage lines	8,091	33	2,044	18	6,047	68	7,604	32
Oc71: Outwash plains with much coarse surface gravel: chief soils are hard alkaline red soils	16,237	67	9,125	82	2,889	32	16,194	68
Total	**24,328**	**100**	**11,169**	**100**	**8,936**	**100**	**23,798**	**100**

NB: values have been rounded to the nearest whole number

At a finer scale, the Study Area consisted of calcareous shallow loams (Calcrete land system), deep red/brown non-cracking clays (Coolabah land system), deep red sands and red sandy earths (Divide land system), red deep sandy duplex and red shallow sandy duplex soils (Narbung land system), red loamy earths and self-mulching cracking clays (Fan land system), self-mulching cracking clays and red deep loamy duplex soils (Turee land system) and calcareous shallow loams and red shallow sands (Warri land system) (van Vreeswyk *et al.*, 2004).

2.5 Geology

More than a third of the Pilbara consists of rugged, hills, ranges and plateaus, occurring mostly in the central and southern parts (van Vreeswyk *et al.*, 2004). In the wider geological context, the Study Area lies in the Archean–Proterozoic Hamersley Basin of the Pilbara Craton, in association with the Hamersley Group geological formation (adapted from Markey, 2017). The Study Area is located within the Upper Fortescue Valley, which is a broad, flat, east–west trending valley separating the Chichester and Hamersley Ranges (Markey, 2017) and consists of generalised alluvium and colluvium geology (van Vreeswyk *et al.*, 2004).

2.6 Fortescue Marsh

The Fortescue Marsh is the largest ephemeral wetland in the Pilbara region (EPA, 2013). It is listed on the Australian Heritage Commission Register of the National Estate as an “Indicative Place”, and in the Directory of the Important Wetlands in Australia (Environment Australia, 2001). It is listed in the Directory of Important Wetlands in Australia because it is the only example of this wetland type in the Pilbara; plays an important hydrological and ecological role; is an important drought refuge for wildlife, and is of outstanding historical or cultural significance (Environment Australia, 2001). The Marsh itself extends over approximately 1,048 square kilometres (km^2) (EPA, 2013). It is rich in plant and animal species of high conservation value and is part of an ancient and complex array of alluvial aquifers and groundwater systems (EPA, 2013).

The Fortescue Marsh is a unique wetland formed at the terminus of the Upper Fortescue River as a result of the low permeability of the Goodiadarrie Hills (EPA, 2013). The Marsh extends east from the Goodiadarrie Hills for over 100 km and may be 30 km wide when in flood. The Marsh is flanked to the north by the Chichester Ranges and to the south by the Hamersley Ranges. The catchment area of the wetland, recognised as the Upper Fortescue River catchment, is approximately 30,000 km^2.

As discussed above (Section 2.2), the land use in the Study Area and immediate vicinity of the Fortescue Marsh includes pastoralism and mining (and associated mining infrastructure). The water regime of Fortescue Marsh is dominated by surface water run-off from the catchment and subsequent evaporative loss (EPA, 2013). The Marsh is episodically inundated, predominately as a result of rainfall associated with tropical low-pressure cyclonic weather systems that generally occur between December and April each year.

The Study Area is located within the Fortescue Marsh Management Area, as defined by the EPA (2013). The Study Area is partially located within the Calcrete Flats, Fortescue River Coolibah, Kulbee Alluvial Flank and Marillana Plain management zones (EPA, 2013) (Table 2.2 and Figure 2.2). A portion in the east of the Study Area is not located within the management area, as the Fortescue Marsh Management Area is bounded in the east by an arbitrary line. The extent of each management zone within Roy Hill tenure is detailed in Table 2.4. EPA (2013) have mapped three separate management zones (and subzones), of which the Study Area is located within:

- Zone 2a: Calcrete Flats – Medium Environmental Significance;
- Zone 2c: Fortescue River Coolibah – Medium Environmental Significance;
- Zone 3a: Kulbee Alluvial Flanks – Lowest Environmental Significance; and
- Zone 3b: Marillana Plain – Lowest Environmental Significance.

Zones 1a (Northern Flank) and 1b (Marsh) have the highest environmental significance, which is indicative of the level of sensitivity when regulatory agencies assess impacts arising within Zone 1 (EPA, 2013). Zone 1a and Zone 1b do not occur within the Study Area, with Zone 1b located approximately 1.4 km north of the Study Area at the closest point (Figure 2.2).

787116 792116 797116 802116 807116 812116 817116

7496192 7491192 7486192 7481192

Marsh
Marsh
Kulbee Alluvial Flank
Fortescue River Coolibah
Calcrete Flats
Marillana Plain

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

Legend

- Study Area
- **EPA (2013) Fortescue Marsh Management Zones**
  - Highest
  - Medium
  - Lowest

biologic Environmental Survey

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0 1.25 2.5 5 Kilometers

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Reconnaissance Flora & Vegetation Survey

Fig. 2.2: Fortescue Marsh Management Zones with respect to the Study Area

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Size A3. Created 19/09/2018

Table 2.2: Fortescue Marsh Management Zones located within the Study Area

Zone	Description	Relative Priority	Extent in Study Area	
			ha	%
2a	Calcrete Flats	Medium Environmental Significance	1,388	6
2c	Fortescue River Coolibah	Medium Environmental Significance	6,751	28
3a	Kulbee Alluvial Flanks	Lowest Environmental Significance	2,640	11
3b	Marillana Plain	Lowest Environmental Significance	13,450	55
N/A	Not mapped	Not assessed	99	<1
Total			**24,328**	**100**

NB: values have been rounded to the nearest whole number

Table 2.3: Fortescue Marsh Management Zones extent with Roy Hill Tenure

Description	E47/1326		E46/586		L47/642	
	ha	%	ha	%	ha	%
2a: Calcrete Flats	1,388	12	0	0	1,388	6
2c: Fortescue River Coolibah	2,235	20	4,516	51	6,312	27
3a: Kulbee Alluvial Flanks	60	1	2,580	29	2,592	11
3b: Marillana Plain	7,486	67	1,740	19	13,406	56
Not mapped	0	0	99	1	99	<1
Total	**11,169**	**100**	**8,936**	**100**	**23,798**	**100**

NB: values have been rounded to the nearest whole number

2.6.1 Zone 2a Calcrete Flats

This zone is dominated by the calcrete land system and small adjoining areas which have some conservation significance. The zone is mostly comprised of low calcrete platforms and alluvial floodplain/sandplains and scattered claypans and drainage foci. The zone is considered to be in moderate to good condition. The key environmental values of Zone 2a include: natural water regimes; subterranean fauna; aquatic invertebrates; vegetation communities; and species of conservation significance (*Eremophila spongiocarpa, Goodenia nuda, Myriocephalus scalpellus*) (EPA, 2013).

2.6.2 Zone 2c Fortescue River Coolibah

This zone comprises flood plains representing the major surface water inflow to the Marsh - the Fortescue River. The zone is characterised by a meandering river channel, banks and

associated terraces, surrounded by alluvial and gilgai flood plains which support extensive Coolibah woodlands with a tussock grass understory. The zone has been subjected to extensive pastoral grazing. The key environmental values of Zone 2c include: natural water regimes; riparian vegetation; Bilby habitat; and subterranean fauna (EPA, 2013).

2.6.3 Zone 3a Kulbee Alluvial Flanks

This zone comprises the alluvial flanks on the north-eastern edge of the Marsh, which has an important hydrological contribution to supporting the values in management zone 2c and 1b. The zone incorporates Koolkinbah Creek alluvial fan to recognize the surface water flows from this system into the Marsh. The key environmental values of Zone 3a include: natural water regimes; natural springs and pools; mulga woodlands; species of conservation significance (Bush Stone Curlew, Ghost Bat, *Eremophila youngii* subsp. *lepidota, Goodenia nuda, Rhagodia* sp. Hamersley (M. Trudgen 17794)); and subterranean fauna (EPA, 2013).

2.6.4 Zone 3b Marillana Plain

This zone includes the extensive alluvial fans of Weeli Wolli, Coondiner and Kalgan creeks and the Fortescue River and is dominated by mulga woodlands and mixed Acacia shrublands. The zone comprises gravelly, sandy and gilgai surfaces principally of the Marillana, Fan and Divide land systems. The zone is subject to degradation as a result of grazing, high fire frequency and weed invasion (buffel grass). The key environmental values of Zone 3b include: natural water regimes; land systems; mulga woodlands; species of conservation significance (*Atriplex flabelliformis, Calocephalus beardii, Goodenia nuda*); subterranean fauna; and aquatic invertebrates (EPA, 2013).

2.7 Land Systems

Work undertaken by a joint team from the (former) Department of Agriculture (now Department of Primary Industries and Regional Development) and the (former) Department of Lands Administration (now Department of Planning, Lands and Heritage) attempted to classify the pastoral areas of Western Australia (van Vreeswyk *et al.*, 2004). The purpose of the surveys were to provide a comprehensive description and mapping of the biophysical resources of the pastoral areas, together with an evaluation of the pastoral potential and the condition of the soils and vegetation (van Vreeswyk *et al.*, 2004).

Seven land systems have been mapped as occurring across the Study Area, Calcrete, Coolibah, Divide, Fan, Narbung, Turee and Warri (van Vreeswyk *et al.*, 2004) (Table 2.4 and Figure 2.3). The dominant land systems are the Coolibah and Narbung systems, which covered 31% and 24% of the Study Area, respectively (Table 2.4). The Coolibah and Narbung land systems are floodplains and washplains associated with Fortescue River. The remaining land systems are either calcrete plains (Calcrete and Warri), sandplains (Divide), wash plains (Fan) or alluvial plains (Turee) (Table 2.4).

Table 2.4: Land Systems mapped within the Study Area and their extent

Land System	Land Type	Description	Study Area		E47/1326		E46/586		L47/642	
			ha	%	ha	%	ha	%	ha	%
Calcrete	Calcrete plains with spinifex grasslands	Low calcrete platforms and plains supporting shrubby hard spinifex grasslands.	931	4	931	8	0	0	931	4
Coolibah	River plains with grassy woodlands and tussock grasslands	Flood plains with weakly gilgaied clay soils supporting coolibah woodlands with tussock grass understorey.	7,507	31	2,908	26	4,600	51	7,305	31
Divide	Sandplains and occasional dunes with spinifex grasslands	Sandplains and occasional dunes supporting shrubby hard spinifex grasslands.	4,736	19	2,209	20	674	8	4,728	20
Fan	Wash plains on hardpan with mulga shrublands	Washplains and gilgai plains supporting groved mulga shrublands and minor tussock grasslands.	1,876	8	0	0	0	0	1,869	8
Narbung	Alluvial plains with acacia shrublands	Alluvial washplains with prominent internal drainage foci supporting snakewood and mulga shrublands with halophytic low shrubs.	5,924	24	4,363	39	1,067	12	5,896	25

Land System	Land Type	Description	Study Area		E47/1326		E46/586		L47/642	
			ha	%	ha	%	ha	%	ha	%
Turee	Alluvial plains with tussock grasslands	Stony alluvial plains with gilgaied and non-gilgaied surfaces supporting tussock grasslands and grassy shrublands of mulga and snakewood.	2,356	10	0	0	2,356	26	2,356	10
Warri	Calcrete plains with acacia shrublands	Low calcrete platforms and plains supporting mulga and Senna shrublands and minor halophytic low shrublands.	997	4	758	7	240	3	713	3
Total			**24,328**	**100**	**11,169**	**100**	**8,936**	**100**	**23,798**	**100**

NB: values have been rounded to the nearest whole number

2.8 Vegetation Associations

The Study Area is located in the Austin Botanical District, which is a part of the Eremaean Province. It is predominantly mulga low woodlands (*Acacia aneura)* on plains, reduced to scrub on hills. Tree steppe of *Eucalyptus* spp. and *Triodia basedowii* occur on sand plains within the area (Beard, 1990). The vegetation associations of the Study area was mapped by Beard (1975), in which he classified the following four vegetation associations (Figure 2.4):

- 29: Sparse low woodland; mulga (*Acacia aneura* and close relatives), discontinuous in scattered groups;
- 111: Hummock grasslands, shrub steppe; *Eucalyptus gamophylla* over hard spinifex (*Triodia* spp.);
- 197: Sedgeland; sedges with scattered medium trees; coolabah (*Eucalyptus victrix*) over various sedges and forbs; and
- 676: Succulent steppe; samphire (*Tecticornia* spp.).

Shepherd *et al.* (2002) attempted to reinterpret and update the vegetation association mapping to reflect the National Vegetation Information System (NVIS) standards (ESCAVI, 2003). The update also accounts for extensive clearing since Beard (1975) mapping. Shepherd *et al.* (2002) created a series of 'systems' to assist in removing mosaic vegetation associations originally mapped by Beard (1975); however, some mosaics still occur. The Study Area is located within the Fortescue Valley System, as reinterpreted by Shepherd *et al.* (2002). The dominant vegetation system association is '29: Sparse low woodland', which extends over 55% of the Study Area (Table 2.5).

The current extent remaining of the vegetation system associations exceeds 99% across the four regional scales: State, bioregion (Pilbara), subregion (Fortescue) and Local Government Authority (Shire of East Pilbara) (Government of Western Australia, 2018) (Table 2.6). Reservation of the vegetation system associations is low, with only the Fortescue Valley 29 (less than 1%) and Fortescue Valley 111.1 (approximately 1.5%) vegetation system associations having some part of their extent reserved (Government of Western Australia, 2018) (Table 2.6).

Table 2.5: Extent of vegetation system associations within the Study Area and Roy Hill tenure

Code	Study Area		E47/1326		E46/586		L47/642	
	ha	%	ha	%	ha	%	ha	%
29	13,341	55	7,717	69	3,396	28	12,984	55
111.1	4,316	18	2,092	19	228	3	4,287	18
197.2	6,560	27	1,314	12	5,246	59	6,454	27
676.17	111	<1	46	<1	65	1	73	<1
Total	**24,328**	**100**	**11,169**	**100**	**8,936**	**100**	**23,798**	**100**

NB: area values have been rounded to the nearest whole number.

791617 796617 801617 806617 811617

7494444 7489444 7484444

Calcrete
Marsh
Coolibah
Warri
Turee
Calcrete
Warri
Coolibah
Coolibah
Calcrete
Coolibah
Divide
Brockman
Narbung
Divide
Fan
Divide

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

Legend

Study Area

Land Systems

- Brockman
- Calcrete
- Coolibah
- Divide
- Fan
- Marsh
- Narbung
- Turee
- Warri

biologic Environmental Survey

N

1:75,000

0 1 2 4 Kilometers

Roy Hill Iron Ore Pty Ltd - Remote MAR Borefield

Reconnaissance Flora & Vegetation Survey

Fig. 2.2: Land Systems across the Study Area

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Size A3. Created 19/09/2018

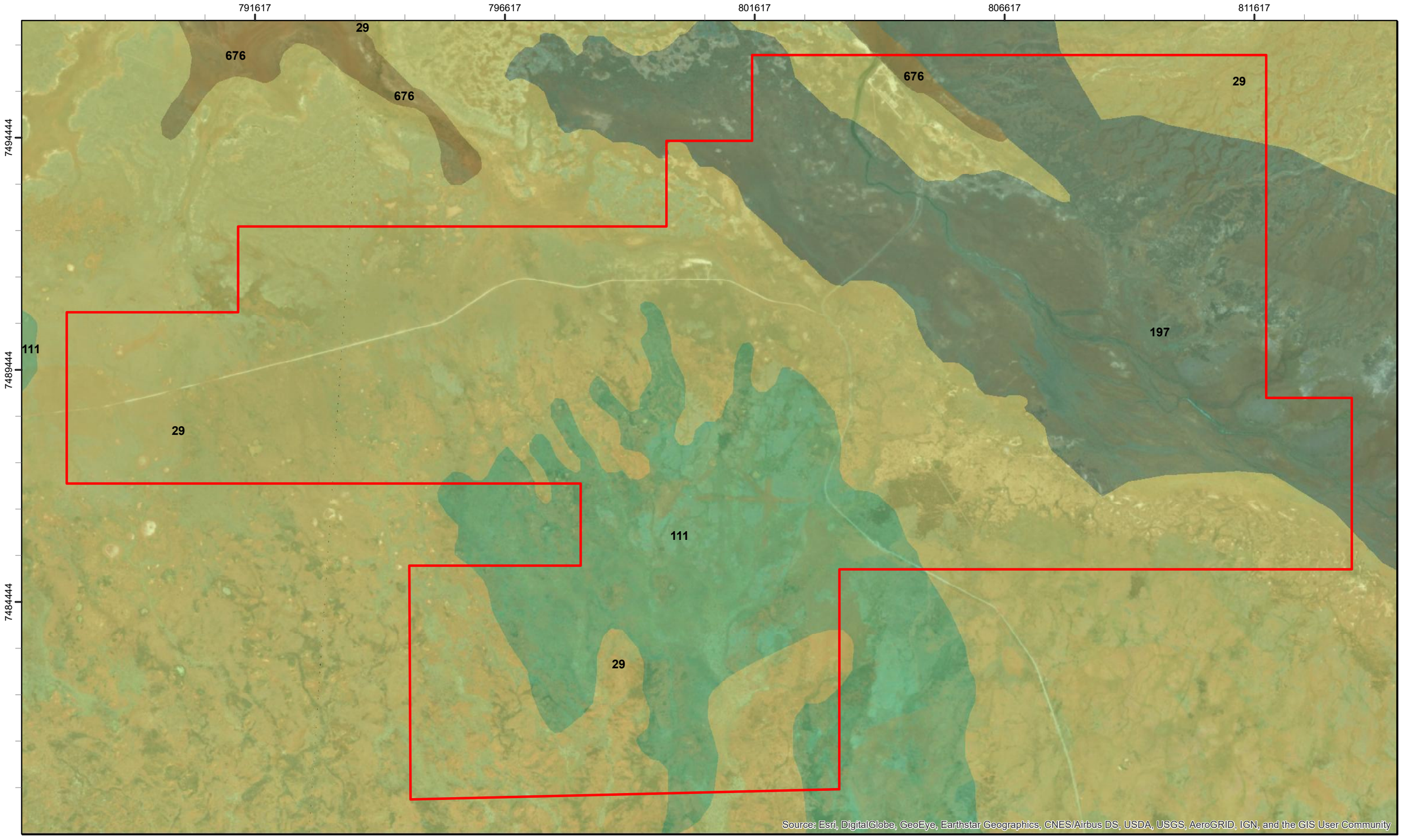
Table 2.6: Regional and local extent of vegetation system associations within the Study Area

Code	Scale	Pre-European extent (ha)	Current extent remaining (ha / %)	Current extent remaining within reserves (ha / %)
29	State	878,058	877,889 / 99.98	2,329 / 0.27
	Bioregion	877,822	877,653 / 99.98	2,329 / 0.27
	Subregion	872,486	872,316 / 99.98	2,304 / 0.26
	LGA	697,400	697,230 / 99.98	0 / 0
111.1	State	430,980	430,925 / 99.99	7,007 / 1.63
	Bioregion	430,961	430,906 / 99.99	7,007 / 1.63
	Subregion	430,135	430,080 / 99.99	6,858 / 1.59
	LGA	364,294	364,294 / 100.00	0 / 0
197.2	State	25,908	25,888 / 99.92	0 / 0
	Bioregion	25,908	25,888 / 99.92	0 / 0
	Subregion	25,906	25,886 / 99.92	0 / 0
	LGA	25,908	25,888 / 99.92	0 / 0
676.17	State	81,984	81,976 / 99.99	0 / 0
	Bioregion	81,984	81,976 / 99.99	0 / 0
	Subregion	81,984	81,976 / 99.99	0 / 0
	LGA	65,527	65,519 / 99.99	0 / 0

NB: Bioregion: Pilbara; Subregion: Fortescue (PIL02); Local Government Authority (LGA): Shire of East Pilbara

Reserves – International Union of Nature Conservation (IUCN) Class I-IV reserves (i.e. National Parks, Strict Nature Reserves)

Source: Government of Western Australia (2018); NB: area values have been rounded to the nearest whole number.



Legend

Study Area

Pre-European Vegetation

29 - Sparse low woodland; mulga, discontinuous in scattered groups

111 - Hummock grasslands, shrub steppe; *Eucalyptus gamophylla* over hard spinifex

197 - Sedgeland; sedges with scattered medium trees; coolabah over various sedges and forbes

676 - Succulent steppe; samphire

biologic Environmental Survey

N

1:75,000

0 1 2 4 Kilometers

Roy Hill Iron Ore Pty Ltd - Remote MAR Borefield

Reconnaissance Flora & Vegetation Survey

Fig. 2.4: Vegetation System Association mapping across the Study Area

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Size A3. Created 19/09/2018

3 Methods and Approach

3.1 Literature Review

Background information on the Study Area and surrounds was compiled prior to, during and after the field survey. Historic vegetation mapping conducted by Beard (1975) and Shepherd *et al.* (2002), land systems mapping (van Vreeswyk *et al.*, 2004), and the IBRA classification system (Kendrick, 2001) were consulted to provide broad contextual knowledge of the vegetation types likely to be encountered within the Study Area. The literature review also considered 11 previous field surveys of relevance to the Study Area (Table 3.1). The 11 previous field surveys that were considered were publicly available, recently conducted and located in close proximity to the Study Area.

Table 3.1: Previous flora and vegetation surveys of relevance to the Study Area

Reference	Title	Proximity to Study Area
ecologia Environment (2009c)	Roy Hill 1 Project Flora and Vegetation Assessment	Partially within
ecologia Environment (2009b)	Roy Hill 1 Infrastructure Flora Assessment	Partially within
Ecoscape (2012)	Newman-Roy Hill transmission line survey	Partially within
Markey (2017)	Floristic survey and mapping of the riparian and halophyte dominated communities on the Fortescue Marsh (*Martuyitha*), Western Australia	~2.5 km N
Maia (2018)	Roy Hill: Southern borefield study area (L47/642 and L47/735) detailed (Level 2) flora and vegetation assessment (2017/2018)	~4.7 km S
G&G Environmental (2009)	Flora and Vegetation Survey of a Proposed Borefield for the Roy Hill 1 Iron Ore Project	~4.7 km S
ENV Australia (2013)	Christmas Creek Life of Mine Flora and Vegetation Assessment - Update	~14.7 km NW
ENV Australia (2010)	Christmas Creek Flora and Vegetation Assessment	~17 km NW
G&G Environmental (2011)	Flora and vegetation surveys of the FerrAus Limited rail corridor options	~19 km SW
ENV Australia (2011)	Christmas Creek Airstrip Flora, Vegetation and Fauna Assessment	~37 km NW

Reference	Title	Proximity to Study Area
ecologia Environment (2009a)	Marillana (E47/1408) vegetation and flora report	~55 km W

3.2 Database Searches

Database searches were undertaken to generate a list of vascular flora taxa previously recorded within, and near, the Study Area, including introduced species and taxa of conservation significance. In most situations the database searches are requested and received prior to the field survey. Due to the tight turnaround between commission and field survey, the results of the database searches were not received until post field survey. The database searches also identified ecological communities/ vegetation types of conservation significance that occur, or may occur, within, and near, the Study Area. Conservation codes for flora and vegetation of conservation significance are provided in Appendix A. Six database searches were conducted around a central coordinate (22°39'58.19"S; 119°56'33.68"E), with varying buffers as deemed appropriate (Table 3.2).

Table 3.2: Databases interrogated during the desktop assessment

Database	Reference	Buffer (km)
Threatened and Priority Ecological Communities	DBCA (2018b)	40
Threatened and Priority Flora	DBCA (2018c)	40
NatureMap	DBCA (2018a)	40
Protected Matters	DoEE (2018)	40
Atlas of Living Australia	ALA (2018)	10
Declared Plants Database (Western Australian Organism List; WAOL)	DPIRD (2018)	#

- search was completed for the Shire of East Pilbara and filtered to only include declared plant pests listed under Section 22 of the *Biosecurity and Agriculture Management Act 2007*.

The conservation significant flora species identified from the database searches were assessed and ranked on the likelihood of occurring within the Study Area (see Section 4.2). The rankings were assigned using the following definitions:

1. **Confirmed**: the presence of the species in the Study Area has been recorded unambiguously during the last 15 years.
2. **Highly Likely**: the Study Area lies within the known distribution of the species, the species has been recorded from within 10 km and within the last 15 years.
3. **Likely**: the Study Area lies within the known distribution of the species and the species has been recorded within 20 km in the last 20 years; however, either:
    a. the Study Area is likely to contain only a small area of suitable habitat, or habitat that is only marginally suitable; or

b. the species is generally rare and patchily distributed in suitable habitat.

4. **Possible**: there is an outside chance of occurrence, because:
    a. the Study Area is just outside the known distribution of the species, but is likely to contain suitable and sufficient habitat (the species may be common, rare, or patchily distributed); or
    b. the Study Area lies within the known distribution of the species, but the species is very rare and/or patchily distributed; or
    c. the Study Area lies on the edge of, or within, the known distribution and is likely to contain suitable habitat, but the species has not been recorded in the area for over 20 years.
5. **Unlikely**: the Study Area lies outside the known distribution of the species, the Study Area is unlikely to contain suitable habitat, and the species has not been recorded in the area for over 20 years.
6. **Highly Unlikely**: the Study Area lies a significant distance outside of the known distribution, for example, greater than 150 km to the nearest record, and has never been recorded from the area.

3.3 Survey Type, Timing and Weather

The field survey was undertaken with due consideration given to:

- Environmental Factor Guideline. Flora and Vegetation (EPA, 2016a).
- Environmental Protection Authority (EPA) Technical Guidance Flora and Vegetation Surveys for Environmental Impact Assessment (EPA, 2016c).

A Reconnaissance Flora and Vegetation Survey was deemed to be the most appropriate survey methodology, considering the extent of the Study Area, the proposed impacts and disturbances (potential minor clearing for tracks and drill holes) and Roy Hill's requirements. The reconnaissance field survey was undertaken over six days, equivalent to 64-person hours, between 10 and 15 July 2018. The field survey was undertaken concurrently with a targeted vertebrate fauna and fauna habitat assessment of the Study Area. The day time climatic conditions during the field survey were adequate to complete the survey with minimal constraints and limitations (Table 3.3).

Table 3.3: Climatic conditions during the field survey

Date	Min. temp	Max. temp	Rainfall	RH at 9 am	RH at 3 pm
10/07/2018	5.1**°C**	25.0**°C**	0.0 mm	25%	17%
11/07/2018	4.4**°C**	24.6**°C**	0.0 mm	30%	14%
12/07/2018	4.1**°C**	25.8**°C**	0.0 mm	29%	13%
13/07/2018	5.4**°C**	26.4**°C**	0.0 mm	26%	13%
14/07/2018	6.4**°C**	25.6**°C**	0.0 mm	38%	20%
15/07/2018	6.3**°C**	26.2**°C**	0.0 mm	37%	16%

The field survey was undertaken following a summer, autumn and winter season of large fluctuations. The month of January 2018 received above average rainfall (84.2 mm compared to 67.9 mm; Figure 3.1). The months of February to May received well below average rainfall (50.6 mm compared to 155.2 mm; Figure 3.1). The month of June, preceding the field survey, received well above average rainfall (54.8 mm compared to 16.2 mm; Figure 3.1). As a result of the above average rainfall in June, surface water was present in many of the claypans, while soil moisture was noted as being moist below the surface across the majority of the Study Area. The presence of soil moisture was further emphasised by the presence of annual and ephemeral taxa, although in lower numbers and diversity than what would be expected following sufficient summer and autumn rainfall.

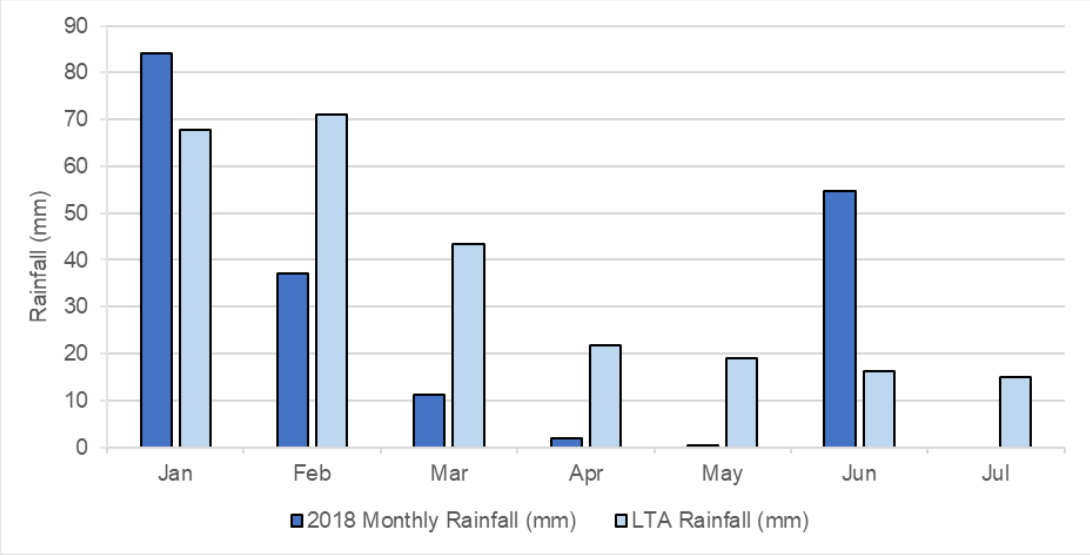


Figure 3.1: 2018 monthly rainfall and long-term average (LTA) rainfall for Newman Airport (BoM, 2018)

Although the survey was undertaken during a time considered to be sub-optimal (optimal timing is considered to be between March and June, EPA, 2016c), the climatic conditions prevailing the survey allowed for the germination and proliferation of annual and ephemeral taxa. In addition, flowering and fruiting of perennial taxa was present, including the Mulga present within the Study Area. This ensured the confidence and identification of the perennial taxa was high in most situations. The survey type (Reconnaissance Survey) is not considered to be as constrained by climate and seasonal conditions (compared to a Detailed Survey) (EPA, 2016c). Therefore, the seasonal and prevailing climatic conditions are not considered to be a constraint to the survey.

3.4 Survey Team and Licencing

The field survey was led by Mr Clinton van den Bergh, an experienced botanist with over 11 years' of experience. Clinton was assisted by senior ecologist Ms Talitha Moyle during the field survey. Clinton meets the minimum requirements (5+ years' of experience in the bioregion) to lead and manage a flora survey in Pilbara bioregion, as prescribed by the EPA (EPA, 2016c). The collection of flora specimens was taken under a flora collecting permit (SL012369)

pursuant to the WC Act Section 23C and 23F. Clinton also holds a Permit to Take Declared Rare Flora for identification purposes (167-1718)

3.5 Flora and Vegetation Survey Design

Aerial photography (Scale 1:15,000) of the Study Area and Google Earth Pro©, were used with previous vegetation mapping (Beard, 1975; ecologia Environment, 2009c; G&G Environmental, 2009; Maia, 2018; Shepherd *et al.*, 2002), land systems mapping (van Vreeswyk *et al.*, 2004) and soil landscape mapping (Northcote *et al.*, 1960-1968), to determine broad preliminary vegetation unit boundaries prior to the field survey. Reconnaissance surveys are traditionally sampled at a low intensity via relevés (unmarked area within which data is collected, EPA, 2016c) and mapping points (unmarked area within which the vegetation unit and condition is broadly described). Relevés and mapping points were sampled within the Study Area. Where practical, at least one sampling site (relevé) was established in each of the preliminary vegetation unit areas, to ensure that each vegetation unit occurring within the Study Area was captured by the survey and described appropriately and in accordance with EPA (2016c).

A total of 53 relevés and mapping points were sampled across the Study Area during the current assessment (Figure 3.2; Appendix B). Of the 53 sample sites, 46 of the sites were relevés, while the remaining seven sites were mapping points. As the Study Area is large and extensive with minimal access over substantial portions, the sampling of vegetation was limited to accessible areas (i.e. walks away from the vehicle was limited to 2 km one-way). To further assist with the mapping of vegetation, a Remotely Piloted Aircraft (RPA; a drone) was utilised to expand upon walked traverses (see Section 3.6).

791617 796617 801617 806617 811617

7494444 7489444 7484444

RH11 E4 RH12 HS03 RH16 RH24 RH13 HS15 RH23 E3 RH22 RH21 HS16 RH14 E6 E5 RH05 HS02 RH27 RH25 HS04 RH26 HS13 RH04 RH28 HS01 RH10 RH06 HS10 RH02 HS14 RH15 RH30 RH31 RH17 RH32 RH03 RH07 RH20 RH33 RH34 HS11 HS05 RH18 RH08 RH09 RH19 RH09 HS07 HS08

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

Legend

- Study Area
- SamplingLocations
- Tracks
- Drone Flights

biologic Environmental Survey

N

1:75,000

0 1 2 4 Kilometers

Roy Hill Iron Ore Pty Ltd - Remote MAR Borefield

Reconnaissance Flora & Vegetation Survey

Fig. 3.1: Sampling intensity

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Size A3. Created 19/09/2018

Dominant vascular flora taxa within each relevé were recorded, with their corresponding height. Taxa not yet recorded from relevés or during site traverses, were also recorded to document a comprehensive species list for the Study Area. A brief summary of the vegetation assemblage at each site was also recorded to aid in producing vegetation unit descriptions (ESCAVI, 2003) (Appendix C). The data collected from the mapping points was similar to the relevés, however, the list of flora species recorded was limited to just the dominants. In addition, the following information was recorded at each flora sampling site:

- relevé (or mapping point) number;
- date of survey;
- personnel;
- a central GPS coordinate (GDA 94) was taken;
- site photograph of the representative vegetation unit being recorded – generally taken facing south-east;
- soil characteristics (texture and colour);
- geology (type, size and nature of any rocks, stones, gravel, or outcropping);
- topography (landform type and aspect);
- vegetation condition (based on Trudgen, 1988) (Appendix D);
- vegetation structure, including the dominant flora species in the three traditional strata, upper, mid and lower. See Section 3.9 for further information.
- disturbance (if present); and
- approximate time since last fire.

Any flora taxa observed opportunistically near relevés, or while traversing the Study Area were also recorded. For any populations of taxa known to be conservation significant or introduced flora observed, a GPS location and a count of the individuals present, or percentage foliar cover for a given area, were recorded.

Prior to the survey, a list of conservation significant flora with the likelihood or potential to occur within the Study Area was compiled. Due to the timing of the field survey, a complete list of conservation significant flora was obtained. Database searches from the DBCA were not received until post field survey. Field personnel familiarised themselves with photographs, reference samples and descriptions of likely conservation significant taxa before conducting the survey and once on the ground actively searched, while traversing the Study Area and in known locations or preferred habitat encountered in the field.

3.6 RPA Searches

A DJI Phantom 4 RPA (drone) was used to conduct searches and further refine vegetation unit mapping across the Study Area. The drone searches were also utilised to search for unique landform features (i.e. vegetated claypans, calcrete rises) that may not have been already identified and sampled during the field survey. Where unique landforms were identified from the drone, on-foot searches were undertaken as a follow-up to sample the vegetation units.

Drone flights were conducted in areas of limited accessibility and while sites were being sampled in some situations. Approximately 3 hours and 50 minutes of drone flight time was undertaken across 21 flights (Figure 3.2). The drone was flown at a height ranging from approximately 15 m to 45 m giving a resolution between 2-10 cm per pixel. All flights were undertaken in accordance with CASA's (Civil Aviation Safety Authority) Standard Operating Conditions.

3.7 Targeted Searching

Targeted searching was undertaken for flora of conservation significance as identified prior to, and during, the field survey. Given that the Project has not defined impact footprints, targeted searching was centred on known occurrences and the immediate surrounds and habitat considered likely to support conservation significant flora (i.e. claypans, drainage lines).

In addition to targeted searching for specific Priority Listed flora taxa in particular habitats, personnel actively searched for all Priority Listed flora taxa and opportunistic flora taxa while completing relevés and traversing the Study Area. Personnel also identified suitable habitat for targeted searches while travelling within the Study Area.

When a conservation significant taxon was identified, a GPS coordinate of the individual was taken, when occurring in isolation, or a central coordinate for a small population was taken (central coordinate with an approximate 20 m radius). Generalised information was collected for each occurrence, including an estimate of individuals, reproductive status, condition and broad vegetation community and condition. *Rare Flora Report Forms* will be provided to the Parks and Wildlife Service of DBCA, as required under the flora collecting permits.

3.8 Identification of Flora Specimens

Plant taxa that could not be easily identifiable during the field survey were collected and pressed for subsequent identification. Identifications were carried out by Biologic's taxonomist, Mrs Sharnya Yates, utilising her personal reference collections, taxonomic keys and reference material. All taxa were checked against Florabase© (version 2.9.31; WAH, 1998-) to ensure their currency and validity. Any conservation significant flora taxa, including potential threatened and priority species, range extensions and potential new taxa have been verified and vouchered (if appropriate) at the Western Australian Herbarium (WAH).

3.9 Vegetation Unit Mapping

Broad vegetation mapping was conducted in the field, with vegetation boundaries delineated over aerial photography. Following the completion of the relevé (and mapping point) sampling and taxonomic identifications, the broad vegetation units were refined based on the review of the floristic data collected from the relevés and the results of flora and vegetation surveys that occur in close proximity to the Study Area. The vegetation type mapping was then digitised using geographic information systems (GIS) software.

Vegetation units were delineated and described from aerial imagery utilising the flora sampling site data. The vegetation structure information collected from the relevés and mapping points was reviewed to describe the vegetation units based on the dominant taxa, foliar cover and height of the three traditional strata (upper, mid and lower/ground). This method of vegetation type determination is consistent with EPA (2016c). As the survey did not involve the systematic sampling of vegetation units via quadrats, statistical analysis was not undertaken on the dataset.

The vegetation types have been described to Level V (Vegetation Association), where possible, in the NVIS hierarchical structure (ESCAVI, 2003) and have been coded (for example AaLW) in accordance with standard practice. The vegetation unit determination has been undertaken from a broad context and it is highly likely that further systematic sampling would split and further refine the mapping undertaken for this Survey. The mapping reliability is moderate across the Study Area due to the limited sampling (53 sample sites across 20,104.85 ha), survey type (reconnaissance), extent of Study Area traversed, the complexity associated with the vegetation units (sandplains, Mulga plains, riverine, floodplains, calcrete rises etc.) and the disturbances recorded across the Study Area (pastoralism, grazing, fire and weeds) (Section 3.12).

3.10 Extrapolation Mapping

Part tenement L47/642 was included in the assessment at the completion of the field component of the Project. As a result, this section of the Study Area was not ground-truthed. The vegetation units within the section of the Study Area was extrapolated from existing vegetation mapping completed to the north (current assessment) and south (Maia, 2018). Details on the methodology and limitations of the extrapolation exercise is provided in Appendix E.

3.11 Vegetation Condition Mapping

Vegetation condition was defined within the Study Area using the Trudgen (1988) Vegetation Condition Scale as detailed in EPA (2016c) (Appendix D) based on the level of disturbance observed in an area. Condition was recorded at each relevé and mapping point, while additional notes were taken while traversing the Study Area to broadly map vegetation condition boundaries. The vegetation condition mapping was then digitised using GIS software.

The condition of the vegetation within the additional area included at the completion of the field survey component of the Project was not determined via ground-truthing. The condition of the vegetation in the additional area determined based on the vegetation condition mapping located immediately to the north (current assessment) and the south (Maia, 2018) (see Appendix E for additional information).

3.12 Potential limitations and constraints

There are a number of possible limitations and constraints that can impinge on the adequacy of vegetation and flora surveys (EPA, 2016c). The limitations of the current assessment are presented in accordance with the Technical Guidance (EPA, 2016c) (Table 3.4).

Table 3.4: Botanical survey limitations and constraints

Limitation	Constraint	Comment
Availability of contextual information at a regional and local scale	No	Sufficient contextual information was available for the Study Area, including broad information on land systems and vegetation associations. The Study Area is located to the south of the Roy Hill mine, which has been extensively surveyed previously, as has the Stage 2 Borefield Project and Southern Expansion.
Competency/experience of the team carrying out the survey, including experience in the bioregion surveyed	No	The survey was led by an experienced botanist with over 11 years' of experience. The lead botanist met the minimum requirements to manage a flora and vegetation field survey in the Pilbara bioregion (EPA, 2016c)
Proportion of flora recorded and/or collected, any identification issues	Yes Minor	The survey intensity (Reconnaissance) is not designed to capture all flora within the Study Area. In addition, the seasonal conditions prior to the survey was considered sub-optimal (i.e. out of season but following above average rainfall in June 2018) to capture all flora within the Study Area. The key flora groups that may have been under sampled include annuals and ephemerals. Perennial flora may also have been missed due to the large Study Area and low accessibility.
Was the appropriate area fully surveyed (effort and extent)	No	The Study Area was traversed and surveyed either on foot or via vehicle, with all major vegetation units visited. The Study Area is more than 20,000 ha in size and it was not feasible to traverse the entire Study Area. As the survey intensity was set as a Reconnaissance Survey, this is not considered to be a constraint. Following the completion of the field survey component, an additional part tenement (L47/642) was included in the Study Area. The portion of the Study Area was not ground-truthed, with the vegetation units extrapolated from aerial imagery and existing vegetation mapping. Although this portion of the Study Area was not ground-truthed, the survey is not constrained by the extrapolation mapping.

Limitation	Constraint	Comment
Access restrictions within the survey area	No	The Study Area was accessed via the Marble Bar Road and the Munjina-Roy Hill Road. Pastoral tracks were utilised to further access the vegetation. As the Study Area was extensive with minimal pastoral track, access restrictions were evident. However, this is not considered to be a constraint due to the survey type (Reconnaissance) employed for the Survey.
Survey timing, rainfall, season of survey	Yes Minor	The survey was undertaken during a period which is considered to be sub-optimal, with the optimal survey period designated to be between March and June for the Eremaean region (EPA, 2016c). Rainfall preceding the Survey was well below average, with only the month of January 2018 recording average rainfall or above (see Section 3.3). The month of June 2018 received above average rainfall, with surface water present in the claypans, while soil moisture was evident underneath the soil surface. The June 2018 rainfall ensured that some annual and ephemeral taxa were present and flowering, while perennial taxa was recorded as flowering and fruiting, in particular the Mulga species, which are difficult to identify without mature fruits. Although the survey was undertaken during sub-optimal conditions, the intensity and scope of the survey (Reconnaissance Survey) is not hampered by seasons and can occur at any time during the year (EPA, 2016c). As a result, the survey was constrained by the survey timing, but it is only considered to be a minor constraint and is not substantial with respect to the Project.
Disturbance that may have affected the results of survey such as fire, flood or clearing	No	The Study Area is located within active pastoral leases and current mining exploration/miscellaneous tenements. The vegetation was noted as being altered, however not to a point that limited the results of the flora and vegetation survey. Disturbances recorded during the Survey included fire, grazing, minor clearing and weeds. Grazing and weed impacts were magnified along the banks of Fortescue River due to the high density of cattle.

3.13 Assessment of species conservation significance

Within Western Australia, all native flora is protected under the *Wildlife Conservation Act 1950 (*WC Act*)* and any action that has the potential to impact on native flora needs to be approved by relevant State and/ or Federal departments as dictated by the Western Australian *Environmental Protection Act 1986* (EP Act) and the Federal *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Current listings for conservation significant flora were checked against the latest (January 2018) Western Australian Government Gazette (Western Australian Government, 2018) and the *EPBC Act* list of threatened species (available online at http://www.environment.gov.au/cgi-bin/sprat/public/publicthreatenedlist.pl).

Some species of flora that are determined to be at risk of extinction or decline are afforded extra protection under these Acts. For the purposes of this report, these species are called conservation significant species. A summary of applicable legislation and status codes is provided in Table 3.5. Additional information on conservation status codes is provided in Appendix A.

The *EPBC Act* identifies Threatened Ecological Communities (TECs), ecological communities at risk of extinction. Currently, there are no statutory processes to list threatened ecological communities in Western Australia. The Minister for the Environment may list an ecological community as being threatened through a non-statutory process if the community is presumed to be totally destroyed or at risk of becoming totally destroyed. The *Biodiversity Conservation Act 2016* (BC Act) will provide for the statutory listing of TECs by the Minister when the relevant Parts of the Act are proclaimed following the preparation of enabling Regulations (due to be enacted 1 January 2019).

For some species and ecological communities there is insufficient information to determine their status. These species are generally considered by the EPA/ DBCA as ‘conservation significant’ for all development related approvals and are listed on a ‘Priority List’, which is regularly reviewed and maintained by DBCA. Possible TECs that do not meet the criteria for non-statutory listing by the Minister for the Environment are added to DBCA’s ‘Priority Ecological Communities’ (PECs) lists under Priorities 1, 2, 3, 4 (near threatened) or 5 (conservation dependent).

The determination of local significance for vegetation units is based on whether the vegetation units support conservation significant taxa or ecological communities, are in association with drainage lines or support unique or unusual flora assemblages, to name a few differentiators (Table 3.5).

Table 3.5: Conservation significance assessment guidelines

Agreement, Act or List	Status Codes
FEDERAL	
Environment Protection and Biodiversity Conservation Act 1999 (*EPBC Act*) DoEE lists threatened flora, which are determined by the Threatened Species Scientific Committee (TSSC) according to criteria set out in the Act. The Act lists flora that are considered to be of conservation significance under one of eight categories (listed under 'Status Codes'). Threatened Ecological Communities (TECs) are those that are at risk of extinction.	• Extinct (EX) • Extinct in the Wild (EW) • Critically Endangered (CE) • Endangered (EN) • Vulnerable (VU) • Conservation Dependent (CD) Critically Endangered Endangered Vulnerable
Agreement, Act or List	**Status Codes**
STATE[#]	
Wildlife Conservation Act 1950 (*WC Act*) At a state level, native flora are protected under the *Wildlife Conservation Act 1950*. Species in need of conservation are given a ranking ranging from Critically Endangered to Vulnerable.	• Schedule 1 (Critically Endangered) (S1 or CR) • Schedule 2 (Endangered) (S2 or EN) • Schedule 3 (Vulnerable) (S3 or VU) • Schedule 4 (Extinct) (S4 or EX)
DBCA Priority list (DBCA) DBCA produces a list of Priority species and ecological communities (*e.g.* Priority Ecological Communities (PECs) or Threatened Ecological Communities (TECs)) that have not been assigned statutory protection under the *Wildlife Conservation Act 1950*. This system gives a ranking from Priority 1 to Priority 5.	• Priority 1 (P1) • Priority 2 (P2) • Priority 3 (P3) • Priority 4 (P4) • Priority 5 (P5)
LOCALLY SIGNIFICANT VEGETATION UNITS	
Supports threatened flora taxa/ threatened ecological community or supports a unique or regionally significant population of Priority 1 or Priority 2 taxa/ ecological communities or occurs in association with a regionally significant river or creek	• High
Supports a population of Priority 1 or Priority 2 taxa/ ecological community or occurs in association with a major river or creek or supports a unique/ unusual floral assemblage not recognised by Parks and Wildlife as a PEC	• Moderate
Supports a population of Priority 3 or Priority 4 taxa/ ecological community or occurs in association with a minor ephemeral river or creek with phreatophytic or potential phreatophytic species or supports a unique/ unusual floral assemblage or occurs in association with a unique/ unusual landform not common in the subregion	• Low

Agreement, Act or List	Status Codes
Supports a population of Priority 3 or Priority 4 taxa/ ecological community along an ecotone between vegetation units or the population occurs in degraded/ altered habitats or is associated with man-made environments (i.e. rehabilitation)	• Negligible

- The *Biodiversity Conservation Act 2016* was enacted in 2016, however only several parts of the new Act were proclaimed by the State Governor in the *Government Gazette*. Provisions that replace those existing under the WC Act (including threatened species listings and controls over the taking and keeping of native species) and their associated Regulations cannot be brought into effect until the necessary *Biodiversity Conservation Regulations* have been made. It is expected that the relevant regulations and the BC Act will come into effect on 1 January 2019.

4 Results

4.1 Literature review

The results and outcomes of the review of 11 flora and vegetation reports identified from the literature review are presented in Table 4.1. The literature review identified that 21 conservation flora species (Priority 1, Priority 3 and Priority 4 taxa) and numerous vegetation communities of significance (including PECs, and regionally/ locally significant communities) have previously been recorded in close proximity to the Study Area (Table 4.1). This includes two priority flora, *Eremophila youngii* subsp. *lepidota* (P4) and *Rhagodia* sp. Hamersley (M. Trudgen 17794) (P3), previously recorded from the Study Area (Ecoscape, 2012). (Ecoscape, 2012) indicate that the confirmation of *Rhagodia* sp. Hamersley (M. Trudgen 17794) is not certain, however it is considered highly likely to almost certain. As a result, the occurrence of *Rhagodia* sp. Hamersley (M. Trudgen 17794) in the Study Area is highly likely, not confirmed.

4.2 Database Search Results

4.2.1 Flora of Conservation Significance

A total of 60 conservation significant flora taxa (those listed under the EPBC Act, WC Act, or DBCA's Priority List) were identified from the database searches (Appendix F). None of the 60 taxa are listed as Threatened under the EPBC Act or the WC Act. There are three threatened flora taxa, *Aluta quadrata, Pityrodia* sp. Marble Bar (G. Woodman & D. Coultas GWDC Opp 4) and *Thryptomene wittweri*, known to occur within the Pilbara bioregion (WAH, 1998-). Each of the three are considered highly unlikely to occur in the Study Area, as they are known from summits of ranges (*Aluta quadrata* and *Thryptomene wittweri*) or isolated in the central Pilbara on steep slopes (*Pityrodia* sp. Marble Bar (G. Woodman & D. Coultas GWDC Opp 4)).

Of the 60 priority listed taxa, 24 are listed as Priority 1, six are listed as Priority 2, 26 are listed as Priority 3, and the remaining four taxa are listed as Priority 4. Flora taxa of conservation significance identified by the desktop assessment were assessed and ranked on the likelihood of occurring within the Study Area.

Based on the results of the database searches, two priority listed taxon have previously been recorded from the Study Area (Figure 4.1), while an additional two taxa were confirmed during the Survey (see Section 4.5). Two priority taxa were considered highly likely to occur, seven were considered likely to occur and nine were considered to possibly occur within the Study Area (Table 4.2). The remaining 38 taxa were considered unlikely or highly unlikely to occur within the Study Area (Appendix G). Two taxa (*Acacia microneura*, *Triodia triticoides*) identified from the database searches are not known to occur in the Pilbara and may be erroneous records.

Table 4.1: Key findings from the literature review

Study details	Methods	Results	Significant findings	Limitations
ecologia Environment (2009c) **Client**: Hancock Prospecting Pty Ltd **Type**: Level 2[1] flora and vegetation survey **Location**: Roy Hill mine site **Timing**: Oct 2005, May 2006 & Mar 2008	• Desktop assessment • Three phase quadrat sampling	• 477 flora species from 53 families and 170 genera. • 19 weed species. • Four major vegetation associations • 18 sub-associations.	• Six priority listed flora: ○ *Rhagodia* sp. Hamersley (M. Trudgen 17794) (P3) ○ *Acacia glaucocaesia* (P3)[2] ○ *Goodenia nuda* (P4) ○ *Polymeria* sp. Hamersley (M.E. Trudgen 11353) (P3)[3] ○ *Rostellularia adscendens* var. *latifolia* (P3) ○ *Eremophila youngii* subsp. *lepidota* (P4) • **Parkinsonia aculeata* listed as a WoNS. • **Argemone ochroleuca* and **Heliotropium europaeum* listed as DPP.	• Phase 1 survey compromised by seasonal influence. • Limited regional context

[1] Level 2 flora and vegetation surveys are now termed “Detailed” flora and vegetation surveys (EPA, 2016c)

[2] No longer considered a priority taxon (WAH, 1998-)

[3] More recently known as *Polymeria longifolia* and is no longer listed as a priority taxon (WAH, 1998-)

Study details	Methods	Results	Significant findings	Limitations
ecologia Environment (2009b) **Client**: Hancock Prospecting Pty Ltd **Type**: Targeted flora survey and supplementary Level 2 flora and vegetation survey **Location**: Roy Hill mine site **Timing**: Oct 2008, Apr and Jun 2009	• Targeted flora survey. • Quadrat sampling • Transects	• 264 flora species from 41 families and 115 genera. • Thirteen vegetation types described.	• Four priority flora: ○ *Rhagodia* sp. Hamersley (M. Trudgen 17794) (P3) ○ *Polymeria* sp. Hamersley (M.E. Trudgen 11353) (P3) ○ *Rostellularia adscendens* var. *latifolia* (P3) ○ *Eremophila youngii* subsp. *lepidota* (P4)	• No limitations discussed in report
Ecoscape (2012) **Client**: Alinta Energy **Type**: Level 2 flora and vegetation survey **Location**: transmission line between Newman and Roy Hill mine site **Timing**: Aug 2012	• Desktop assessment • Quadrat sampling • Targeted traverses	• 264 vascular flora taxa. • Eight introduced flora taxa • 13 vegetation types	• Five priority flora taxa: ○ *Eremophila pilosa* (P1) ○ *Eremophila youngii* subsp. *lepidota* (P4) ○ *Goodenia* ? *nuda* (P4) ○ *Rhagodia* sp. Hamersley (M. Trudgen 17794) (P3) ○ *Themeda* sp. Hamersley Station (M.E. Trudgen 11431) (P3) • Locally significant vegetation supporting groundwater dependent vegetation and *Eremophila pilosa* (P1) populations	• Season and timing of the survey

Study details	Methods	Results	Significant findings	Limitations
Markey (2017) **Client**: Department of Biodiversity, Conservation and Attractions **Type**: Flora survey **Location**: Fortescue Marsh **Timing**: Winter 2013 & Winter 2014	• 128 permanent plots • Statistical analysis	• 352 vascular flora taxa from 49 families. • 12 major floristic groups, with eight further divided, totalling 21 community units	• 14 priority listed taxa: ○ *Atriplex flabelliformis* (P3) ○ *Calotis squamigera (P1)* ○ *Dysphania congestiflora* (P4) ○ *Eragrostis crateriformis* (P3) ○ *Eremophila youngii* subsp. *lepidota* (P4) ○ *Eucalyptus rowleyi* (P3) ○ *Eleocharis papillosa* (P3) ○ *Eremophila spongiocarpa* (P1) ○ *Goodenia* sp. East Pilbara (A.A. Mitchell PRP 727) (P3) ○ *Nicotiana heterantha* (P1) ○ *Samolus* sp. Fortescue Marsh (A. Markey & R. Coppen 9702) (P1) ○ *Tecticornia globulifera* (P3) ○ *Tecticornia medusa* (P3) ○ *Tecticornia* sp. Christmas Creek (K.A. Shepherd & T. Colmer et al. KS 1063) (P1) • 18 new taxa for the Fortescue Marsh. • 11 significant range extensions	• No limitations discussed

Study details	Methods	Results	Significant findings	Limitations
Maia (2018) **Client**: Roy Hill Iron Ore **Type**: Detailed Flora and Vegetation Survey **Location**: Stage 2 Borefield **Timing**: Oct 2017 & Apr 2018	• Desktop assessment • Quadrat sampling • Statistical analysis • Targeted traverses	• 253 vascular flora taxa from 34 families and 106 genera • Nine weed taxa • Nine vegetation types • Vegetation condition mostly very good	• One priority taxon, *Goodenia nuda* (P4) • 13 range extensions • Small drainage foci • Sheetflow dependent mulga communities • Nine vegetation types considered to be of moderate local significance	• No regional contextual information available for the Pilbara. • Limited accessibility
G&G Environmental (2009) **Client**: Hancock Prospecting Pty Ltd **Type**: Level 2 flora and vegetation (single phase) survey **Location**: Stage 2 Borefield **Timing**: Jul/ Aug 2009	• Desktop assessment • Quadrat sampling • Traverses	• 131 vascular flora taxa • Six weed taxa • 11 vegetation types from three associations	• One priority taxon, *Goodenia nuda* (P4)	• No limitations discussed

Study details	Methods	Results	Significant findings	Limitations

ENV Australia (2013)
Client: Fortescue Metals Group Ltd
Type: Compilation, analysis and Level 2 flora and vegetation survey
Location: Christmas Creek mine site
Timing: Mar/ Apr 2011, Apr/ May 2012, June 2012 & May 2013
	• Desktop assessment
	• Quadrat sampling
	• Analysis
	• compilation
		• 485 vascular flora taxa
		• 17 introduced flora taxa
		• 15 broad vegetation types and 11 vegetation associations mapped
		• 16 vegetation groups at 30% similarity
		• Vegetation condition ranged from excellent to completely degraded
			• 14 priority listed flora:
			  ○ *Atriplex flabelliformis* (P3)
			  ○ *Calotis squamigera (P1)*
			  ○ *Vigna* sp. Central (M.E. Trudgen 1626) (P2)[4]
			  ○ *Phyllanthus aridus* (P3)
			  ○ *Eremophila youngii* subsp. *lepidota* (P4)
			  ○ *Rhagodia* sp. Hamersley (M. Trudgen 17794) (P3)
			  ○ *Eleocharis papillosa* (P3)
			  ○ *Eremophila spongiocarpa* (P1)
			  ○ *Goodenia nuda* (P4)
			  ○ *Nicotiana heterantha* (P1)
			  ○ *Rostellularia adscendens* var. *latifolia* (P3)
			  ○ *Tecticornia globulifera* (P3)
			  ○ *Tecticornia medusa* (P3)
			  ○ *Tecticornia* sp. Christmas Creek (K.A. Shepherd & T. Colmer et al. KS 1063) (P1)
			• One PEC, Fortescue Marsh, recorded.
			• Potential groundwater dependent ecosystems
			• Locally significant mulga communities
				• No limitations discussed

Study details	Methods	Results	Significant findings	Limitations
ENV Australia (2010) **Client**: Fortescue Metals Group Ltd **Type**: Level 2 flora and vegetation survey **Location**: Christmas Creek mine site **Timing**: Jul 2010 & Aug 2010	• Desktop assessment • Quadrat sampling • Targeted traverses	• 73 vascular flora taxa from 20 families and 33 genera • 17 vegetation types mapped • Vegetation condition ranged from Excellent to Good	• Six priority listed flora: ○ *Eremophila spongiocarpa* (P1) ○ *Tecticornia* sp. Christmas Creek (K.A. Shepherd & T. Colmer et. Al. KS 1063) (1) ○ *Tecticornia* sp. Fortescue Marsh (K.A. Shepherd et. Al. KS 1055) (1)[5] ○ *Atriplex flabelliformis* (P3) ○ *Tecticornia* sp. Roy Hill (H. Pringle 62) (P3)[6] ○ *Rhagodia* sp. Hamersley (M. Trudgen 17794) (P3) • Six vegetation types locally significant	• Substantial portion burnt • Sub-optimal timing

[4] Informal synonym of Vigna sp. Hamersley Clay (A.A. Mitchell PRP 113) which is not listed as a priority taxon.

[5] Informal synonym of *Tecticornia globulifera* which is listed as a Priority 1 taxon.

[6] Informal synonym of *Tecticornia medusa* which is listed as a Priority 3 taxon.

Study details	Methods	Results	Significant findings	Limitations
G&G Environmental (2011) **Client**: FerrAus Ltd **Type**: Desktop, Level 1[7] & Level 2 flora and vegetation surveys **Location**: rail corridor and borrow pits along the FerrAus rail corridor **Timing**: Oct 2010, Nov 2010 & Mar 2011	• Desktop assessment • Relevé sampling • Quadrat sampling	• 460 vascular flora taxa • 58 vegetation types • Eight weeds • Vegetation condition ranged from excellent to completely degraded	• Two priority taxa: ○ *Goodenia nuda* (P4) ○ *Olearia mucronata* (P3) • 14 flora species with range extensions	• No substantial limitations
ENV Australia (2011) **Client**: Fortescue Metals Group Ltd **Type**: Level 1 flora and vegetation survey **Location**: Christmas Creek mine site **Timing**: Feb 2011	• Desktop survey • Quadrat and Relevé sampling	• 116 vascular flora taxa from 29 families and 62 genera • Six introduced flora • Eight broad floristic formations and ten vegetation associations mapped • Vegetation condition ranged from excellent to completely degraded	• No conservation significant flora identified • Mulga communities locally significant	• No substantial limitations

[7] Level 1 flora and vegetation surveys now termed “Reconnaissance” flora and vegetation surveys (EPA, 2016c)

Study details	Methods	Results	Significant findings	Limitations
ecologia Environment (2009a) **Client**: Brockman Resources Ltd **Type**: Two phase Level 2 flora and vegetation survey **Location**: tenement E47/1408 **Timing**: Jun 2008 & Sep 2008	• Desktop assessment • Quadrat sampling • Targeted traverses	• 302 vascular flora taxa from 42 families and 116 genera • Eight vegetation units	• One priority taxon, *Goodenia nuda* (P4), recorded • One PEC, Sand Dunes of the Fortescue Valley, recorded	• Small portion impacted by fire

747227 762227 777227 792227 807227 822227 837227

7514257
7499257
7484257
7469257

Legend

- Study Area
- Marsh Land System (P1)
- Vegetation of sand dunes of the Hamersley Range/Fortescue Valley (P3)
- Narbung Land System (P3)
- Stony saline plains of the Mosquito Land System (P3)

DBCA TPFL Database

- *Eremophila pilosa*
- *Eremophila spongiocarpa*
- *Goodenia nuda*
- *Nicotiana heterantha*

DBCA WA Herbarium Database

- *Cardamine paucijuga*
- *Eleocharis papillosa*
- *Eremophila pilosa*
- *Eremophila spongiocarpa*
- *Eremophila youngii* subsp. *lepidota*
- *Eucalyptus rowleyi*
- *Goodenia nuda*
- *Goodenia* sp. East Pilbara (A.A. Mitchell PRP 727)
- *Helichrysum oligochaetum*
- *Myriocephalus scalpellus*
- *Nicotiana heterantha*
- *Rhagodia* sp. Hamersley (M. Trudgen 17794)
- *Samolus* sp. Fortescue Marsh (A. Markey and R. Coppen FM 9702)
- *Stemodia* sp. Battle Hill (A.L. Payne 1006)
- *Tecticornia globulifera*
- *Tecticornia medusa*
- *Tecticornia* sp. Christmas Creek (K.A. Shepherd and T. Colmer et al. KS 1063)

biologic Environmental Survey

N

1:300,000

0 4 8 16 Kilometers

Roy Hill Iron Ore Pty Ltd - Remote MAR Borefield

Reconnaissance Flora & Vegetation Survey

Fig. 4.1: Threatened and Priority Flora and Ecological Communities database search results

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Size A3. Created 19/09/2018

Table 4.2: Conservation significant flora taxa known to occur near the Study Area based on the desktop assessment.

Taxon	Description (WAH, 1998-)	Location
Confirmed		
Eremophila pilosa	Shrub, ca 0.8 m high. Fl. purple, Sep	Recorded within
Eremophila youngii subsp. *lepidota*	Dense, spreading shrub, (0.2-)1-3 m high. Fl. purple-red-pink, Jan or Mar or Jun or Aug to Sep. Stony red sandy loam. Flats plains, floodplains, sometimes semi-saline, clay flats	Recorded within
Goodenia nuda	Erect to ascending herb, to 0.5 m high. Fl. yellow, Apr to Aug	Recorded within
Eucalyptus rowleyi	Lignotuberous mallee 3-5 m tall. Fl. white, Nov-Jun. Restricted to the plains of the upper De Grey River system	Recorded within (DBCA, 2018c)
Highly Likely		
Helichrysum oligochaetum	Erect annual, herb, to ca 0.25 m high. Fl. yellow, Aug to Nov. Red clay. Alluvial plains	>6.5 km W
Rhagodia sp. Hamersley (M. Trudgen 17794)	Shrub, sometimes scrambling to 4 m high. Recorded from mulga on cracking clays.	5.5 km S
Likely		
Eleocharis papillosa	Annual, herb. Fl. brown, Nov. Red clay over granite, open clay flats. Claypans	>18 km NW
Glycine falcata	Mat-forming perennial, herb, to 0.2 m high. Fl. blue-purple, May or Jul. Black clayey sand. Along drainage depressions in crabhole plains on river floodplains	>9.5 km W
Iotasperma sessilifolium	Erect herb. Fl. pink. Cracking clay, black loam. Edges of waterholes, plains	>17 km SE
Myriocephalus scalpellus	Semi-erect herb, 0.03-0.08 m high. Clay. Depression on flood plain	>50 km WSW
Nicotiana heterantha	Decumbent, short-lived annual or perennial, herb, to 0.5 m high, forming low, spreading colonies. Fl. white-cream, Mar to Jun or Sep. Black clay. Seasonally wet flats	>7 km NW
Samolus sp. Fortescue Marsh (A. Markey & R. Coppen FM 9702)	Erect perennial herb 0.3-1.0 m high. Flat flood-out area alongside freshwater pool and channel of upper Fortescue River. Channel and water hole landform of Marsh Land system	0.6 km W
Stemodia sp. Battle Hill (A.L. Payne 1006)	Low shrub. Cracking clay. Floodplain	>5.5 km E
Possible		
Amaranthus centralis	Annual herb, decumbent or erect to 0.6 m high. Grows in red sand in ephemeral watercourses, sandy to clayey loam on river banks and edges of permanent pools in eucalypt lined channels, or acacia shrubland.	>30 km SSE

Taxon	Description (WAH, 1998-)	Location
Aristida jerichoensis var. *subspinulifera*	Compactly tufted perennial, grass-like or herb, 0.3-0.8 m high, lemma groove muricate. Hardpan plains	>60 Km SW
Atriplex flabelliformis	Monoecious, erect, rounded perennial, herb, to 0.35 m high. Clay loam, loam. Saline flats or marshes	>30 km W
Calotis squamigera	Procumbent annual, herb, to 0.21 m high. Fl. yellow, Jul. Pebbly loam	>37 km
Cardamine paucijuga	Slender erect annual, herb, to 0.4 m high. Fl. white, Sep to Oct. In moist to dry habitats	15 km W
Crotalaria smithiana	Annual, herb, to 0.4 m high. Fl. yellow, Jun. Regeneration site on floodplain	>36 km S
Ipomoea racemigera	Creeping annual, herb or climber. Fl. white	>55 km SE
Swainsona thompsoniana	Prostrate, annual herb to 10 cm high. Fl. Mauve, Jan-Dec. Gibber plains, crabhole plains and gilgai.	>40 km N
Themeda sp. Hamersley Station (M.E. Trudgen 11431)	Tussocky perennial, grass-like or herb, 0.9-1.8 m high. Fl. Aug. Red clay. Clay pan, grass plain	>26 km NW

4.2.2 Vegetation of Conservation Significance

Two Threatened Ecological Community (TEC), Themeda Grasslands and Ethel Gorge, are recognised in the Pilbara region of Western Australia. The two TECs are restricted to unique landforms, of which none occur in the Study Area. The two TECs were not identified as occurring within 40 km of the Study Area during the database search request. The Parks and Wildlife TEC and Priority Ecological Community (PEC) database search (DBCA, 2018b) identified four PECs within the 40 km database search buffer (Figure 4.1; Table 4.3). Of the four PECs identified from the database, one overlaps the north-western side of the Study Area (Figure 4.1). The overlap is related to the buffer (5 km) applied to the PEC. The PEC is related to the Fortescue Marsh, which occurs approximately 3.5 km to the north-west of the Study Area. Two of the remaining three PECs are not expected to occur in the Study Area due to their restrictions in landforms (Mosquito Land System and Fortescue Valley Sand Dunes).

The remaining PEC is related to the Narbung Land System, which occurs extensively within the Study Area (24% of the total area). The entire mapped land system is the PEC (pers. com. Val English, DBCA), while not all occurrences have been mapped and stored by DBCA. This is discussed further in Section 4.9.1.

Table 4.3: Priority Ecological Communities known to occur within, and surrounding, the Study Area

Community ID	Community Name and Description	Location
Fortescue Marsh	**Fortescue Marsh (Land System) – Priority 1** Fortescue Marsh is an extensive, episodically inundated samphire marsh at the upper terminus of the Fortescue River and the western end of Goodiadarrie Hills. It is regarded as the largest ephemeral wetland in the Pilbara. It is a highly diverse ecosystem with fringing mulga woodlands (on the northern side), samphire shrublands and groundwater dependant riparian ecosystems. It is an arid wetland utilised by waterbirds and supports a rich diversity of restricted aquatic and terrestrial invertebrates. Recorded locality for night parrot and bilby and several other threatened vertebrate fauna. Endemic *Eremophila* species, populations of priority flora and several near endemic and new to science samphires.	Overlaps (buffer) the Study Area
Fortescue Valley Sand Dunes	**Vegetation of sand dunes of the Hamersley Range/Fortescue Valley – Priority 3** These red linear iron-rich sand dunes lie on the Divide Land system at the junction of the Hamersley Range and Fortescue Valley, between Weeli Wolli Creek and the low hills to the west. A small number are vegetated with *Acacia dictyophleba* scattered tall shrubs over *Crotalaria cunninghamii, Trichodesma zeylanicum* var. *grandiflorum* open shrubland. They are regionally rare, small and fragile and highly susceptible to threatening processes.	~22 km SW of the Study Area
Mosquito Land System	**Stony saline clay plains of the Mosquito Land System – Priority 3** Described as saltbush community of the duplex plains 3(iii) - Mosquito Creek series (Nullagine). Includes patchy hummock grassland of *Triodia longiceps* with scattered *Maireana* and *Sclerolaena* spp. dissected by drainage lines typically dominated by shrubs including *Melaleuca eleuterostachya* and *Acacia bivenosa* occurring on saline red brown non-cracking clays with a mantle of quartz gravel and neutral subsurface soil material on level to undulating plains.	~31 km NE of the Study Area
Narbung LS	**Narbung Land System – Priority 3** Alluvial washplains with prominent internal drainage foci supporting snakewood and mulga shrublands with halophytic low shrubs	Located within the Study Area

4.2.3 Introduced Taxa

The NatureMap (DBCA, 2018a), Protected Matters (DoEE, 2018), ALA (ALA, 2018) and WAOL (DPIRD, 2018) database searches identified a list of 56 introduced taxa that may potentially occur within the Study Area. The list of introduced taxa known to occur or potentially occur within the Study Area (Appendix H) was reviewed to identify Weeds of National Significance (WoNS) and Declared Plant Pests (DPP).

Weeds of National Significance

The Commonwealth of Australia, in collaboration with the states and territories, has identified 32 WoNS based on an assessment process that prioritises these weeds according to their invasiveness, potential for spread and environmental, social and economic impacts. A list of 20 WoNS was endorsed in 1999 and a further 12 were added in 2012.

Landowners and land managers at all levels are responsible for managing WoNS. State and territory governments are responsible for legislation, regulation and administration of weeds. The WoNS were selected as they require coordination among all levels of government, organisations and individuals with weed management responsibilities.

Of the list of introduced taxa identified during the desktop assessment as occurring in or near the Study Area, 27 are listed as WoNS (Appendix H). The 27 WoNS were identified from the WAOL database search for the entire Shire of East Pilbara and occur or may potentially occur within the shire boundaries. No other database search or literature review identified any WoNS. The 27 taxa include numerous *Opuntia*, *Austrocylindropuntia* and *Cylindropuntia* species that are grouped together in the WoNS listing.

Declared Plant Pests

To protect Western Australian agriculture the Department of Primary Industries and Regional Development (DPIRD) (formerly the Department of Agriculture and Food Western Australia, DAFWA) regulates harmful plants under the *Biosecurity and Agriculture Management Act* 2007 (BAM Act). Plants that are prevented entry into the state or have control or keeping requirements within the state are known as declared pests. The main purposes of the BAM Act and its regulations related to DPP are to prevent new plant pests (weeds) from entering Western Australia, manage the impact and spread of those pests already present in the state and safely manage the use of agricultural chemicals.

The BAM Act has categorised the weeds of Western Australia into four main classifications:

- Declared Pests (under Section 22 of the Act);
- Permitted (under Section 11 of the Act);
- Prohibited (under Section 12 of the Act); and
- Permitted requiring a permit (Section 73, BAM Regulations 2013).

Under the BAM Act all declared plant pests are placed in one of three categories:

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

or density or moving from an area in which it is established into an area which currently is free of that pest.

The desktop assessment identified 45 DPPs (including numerous cacti species that are all listed as DPPs, Appendix H), previously recorded or potentially located within the Shire of East Pilbara. The desktop assessment did not identify any DPPs as occurring within, or immediately adjacent to, the Study Area.

The Environmental Weed Strategy of Western Australia (CALM, 1999) provided a ranking of weed species on a state-wide basis against three criteria; invasiveness, distribution and environmental impacts. The state-wide ratings from the Strategy are deemed too broad to be of use from an on-ground operational perspective and are now out of date. In addition to these factors, the strategy was meant to have developed an integrated approach to environmental weed management that included site and resource led control (CALM, 1999). However, due to funding constraints, it did not carry out an assessment and ranking of weed species against the biodiversity assets they threaten, nor did it consider feasibility of control.

To address these issues and implement an integrated approach to weed management on Parks and Wildlife-managed lands in WA, the Weed Prioritisation Process for Parks and Wildlife was developed in 2008. It was updated in 2013 and further revised in 2016. Parks and Wildlife prioritised weeds in each region, based on their:

- Invasiveness;
- Ecological impact;
- Potential and current distribution; and
- Feasibility of control.

The resulting priorities focus on weeds considered to be high impact, rapidly invasive and still at a population size that can feasibly be eradicated or contained to a manageable size. This means that weed species that are already widespread may not be ranked as a high priority. The weed prioritisation for the Pilbara bioregion has recently been revised by Parks and Wildlife. The key priorities are now centred on ‘Priority Alert’ weeds and weeds that receive a rating for ‘Ecological Impact” and “Invasiveness’.

Fifteen introduced taxa have been identified by Parks and Wildlife as ‘Priority Alerts’ for the Pilbara region, including **Azadirachta indica, *Calotropis procera, *Chloris gayana, *Clitoria ternatea, *Cryptostegia grandiflora, *Cylindropuntia* spp.*, *Euphorbia tirucalli, *Jatropha gossypifolia, *Lantana camara, *Moringa oleifera, *Ricinus communis, *Schinus molle* var. *areira, *Vachellia nilotica, *Washingtonia robusta* and **Xanthium strumarium*. None of these introduced ‘Priority Alerts’ taxa are expected to occur in the Study Area.

4.3 Flora Composition

The current assessment of the Study Area recorded a total of 199 vascular flora taxa, from 38 families and 94 genera (Appendix I). The vascular flora taxa recorded from the Study Area included 188 native species and 11 introduced taxa. The dominant families were Poaceae (39 taxa), Fabaceae (35 taxa) and Chenopodiaceae (17 taxa), which equates to 46% of the total

vascular taxa recorded. Of the 38 families, 16 were represented by one taxon. The most represented genera were *Acacia* (18 taxa), *Ptilotus* (9 taxa) and *Senna* (nine taxa), which equates to 18% of the total vascular taxa recorded. Of the 94 genera, 60 were represented by one taxon.

The total flora taxa and the floristic assemblage recorded from the Study Area is consistent with the expected assemblage from the Fortescue subregion (Kendrick, 2001). The floristic diversity is consistent with the varied landscapes and vegetation units occurring in the Study Area (i.e. sandplains, major drainage lines, floodplains, mulga plains to name a few).

4.4 Survey Adequacy

The Survey is considered to be adequate for the purposes of the scope and objectives of the Project. Although the Study Area is extensive (24,327.99 ha) with limited access, the major vegetation units were sampled with at least one relevé, while additional relevés were sampled within large, extensive vegetation units. The Study Area would have benefited from additional sampling, however, the survey intensity, type and objectives limited the sampling. In consideration of this, the adequacy of the survey is still considered appropriate for meeting the scope and objectives.

The number of flora taxa recorded from the Study Area (199) is consistent with the surveys reviewed during the desktop assessment (Table 4.1). It is anticipated that additional flora taxa would be recorded following a more systematic sampling survey, during optimal survey conditions, and across several phases (or seasons).

4.5 Flora of Conservation Significance

4.5.1 Federal and State Listing

The desktop assessment did not identify any federal or state listed threatened (declared rare) flora species as occurring in, or near, the Study Area. The field survey confirmed that there were no threatened flora occurring, or likely to occur within the Study Area. The vegetation and habitats present within the Study Area and the known locations of threatened flora confirm that it is unlikely that any threatened flora would occur within the Study Area.

The field survey identified the presence of three priority listed taxa (Figure 4.2). Of the three priority listed taxa recorded, one, *Eremophila youngii* subsp. *lepidota*, was known to already occur in the Study Area (Figure 4.1). The three priority listed taxa recorded from the Study Area include:

- *Eremophila pilosa* – Priority 1;
- *Eremophila youngii* subsp. *lepidota* – Priority 4; and
- *Goodenia nuda* – Priority 4;

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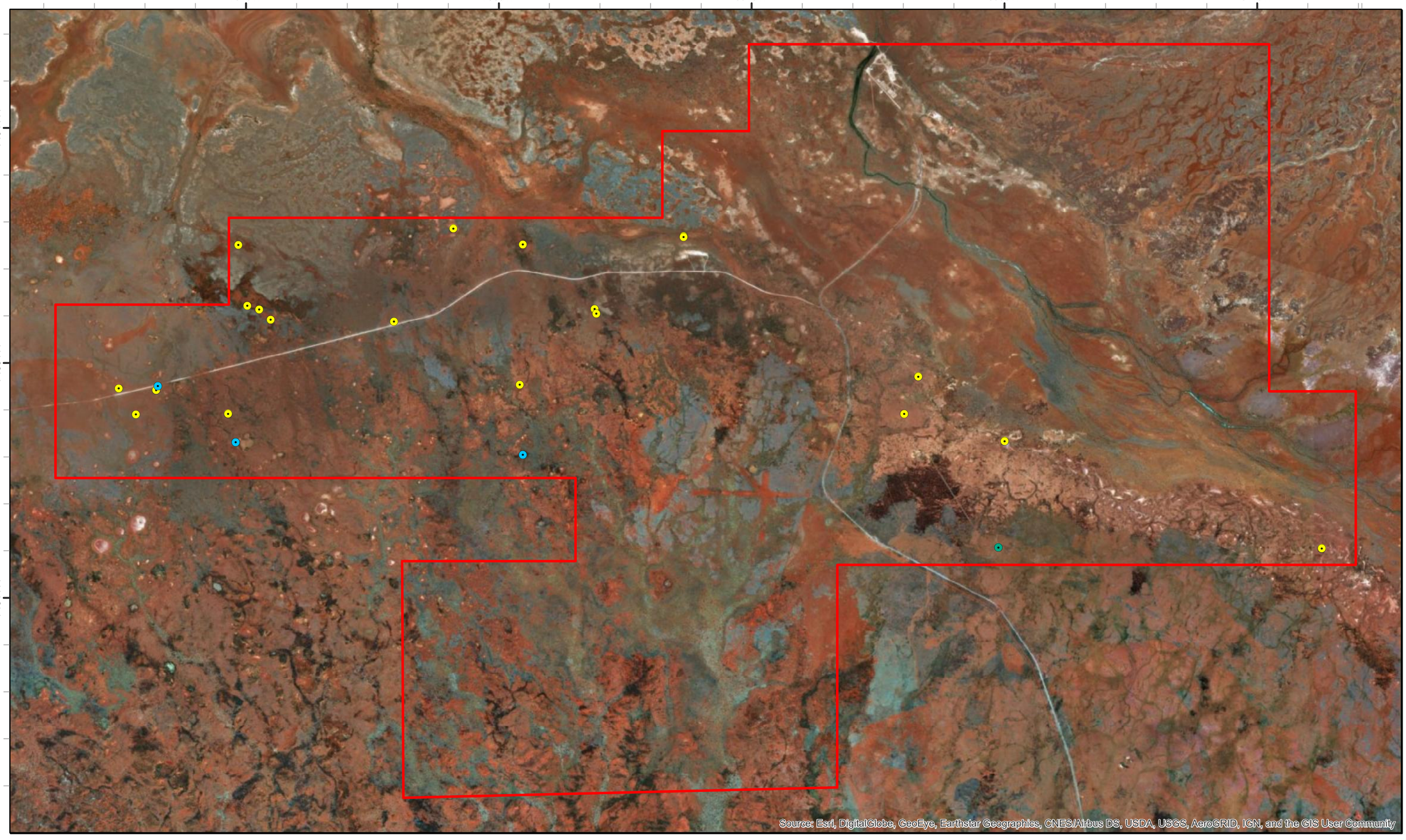

Legend

Study Area

Priority Flora

- *Eremophila pilosa*
- *Eremophila youngii* subsp. *lepidota*
- *Goodenia nuda*

biologic Environmental Survey

N

1:75,000

0 1 2 4 Kilometers

Roy Hill Iron Ore Pty Ltd - Remote MAR Borefield

Reconnaissance Flora & Vegetation Survey

Fig. 4.2: Location of Priority Flora identified from the Study Area

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Size A3. Created 19/09/2018

Eremophila pilosa

Eremophila pilosa is described as an erect intricate shrub to 1.5 m tall, with branches and leaves clothed in a fine grey glandular-dendritic tomentum, overtopped by long prominently segmented stiff pilose hairs, with many shorter ones gland-tipped (Chinnock, 2007). It is known to occur in a relatively small area south-southeast of Roy Hill where it grows in very sparse mulga or mallee woodlands over a scattered mixed shrub layer of *Acacia, Eremophila* and/ or *Senna* species over hummock grassland on red-brown clay loams on sandy plains (Brown & Buirchell, 2011; Chinnock, 2007). *Eremophila pilosa* is listed as a Priority 1 taxon due to the limited knowledge on its known range and extent. The WAH has only five records (WAH, 1998-) (Table 4.4), while it is noted as being very restricted, with large populations occurring at known sites (Chinnock, 2007)

Due to the uncertainly of the collection made during the Survey, the number of individuals and the extent of the population was not determined. It was recorded as common in the location the collection was made (sample site HS07, Appendix J). The specimen collected was flowering, with other individuals noted as flowering at the time of the Survey.

Ecoscape (2012) recorded *Eremophila pilosa* from two populations approximately 6 km to the south of the Study Area. Several hundred individuals were recorded by Ecoscape (2012), with the majority of the individuals recorded from a mid/ low open hummock grassland dominated by *Triodia basedowii*.

Eremophila youngii subsp. lepidota

Eremophila youngii subsp. *lepidota* is described as a shrub with branches and leaves clothed with persistent often lucid scales, growing to a height of 4 m (Chinnock, 2007), It is known to favour areas or depressions subject to periodic flooding on red-brown clay or sandy loams. It usually occurs in Acacia woodland (mainly mulga) associated with other species of *Eremophila* or *Senna* (Brown & Buirchell, 2011; Chinnock, 2007). *Eremophila youngii* subsp. *lepidota* is listed as a Priority 4 taxon due to the current state of knowledge (well surveyed and understood, while not currently considered to be under threat, but in need of ongoing monitoring). The WAH has 46 records for this species (WAH, 1998-) (Table 4.4), while Chinnock (2007) considered it to not be at risk, however Chinnock (2007) does not consider the State or DBCA threatened and priority listing criteria.

Eremophila youngii subsp. *lepidota* was recorded on numerous occasions within the Study Area, ranging from isolated individuals to large populations in excess of 100 individuals (Appendix J). Point locations were recorded from most of the vegetation units within the Study Area, with a higher proportion from open Acacia woodlands/ shrublands and near areas that are periodically inundated (claypans). Individuals recorded in the Study Area were noted as flowering, with both white and pink flowering forms present. Early fruit formation was also noted on some individuals. Due to the size of the Study Area and the limited access, not all populations/ occurrences would have been recorded. The Study Area and the surrounding landscape represents important habitat for the species, confirmed by the extensive populations.

Eremophila youngii subsp. *lepidota* has been recorded from the general area (ecologia Environment, 2009b, 2009c; Ecoscape, 2012; ENV Australia, 2013; Markey, 2017) in numbers exceeding the hundreds. The Fortescue Marsh and adjacent landscapes, floodplains and alluvial washplains represent a hotspot for the occurrence of the priority taxon. Further populations are known to occur north of Carnarvon, through to Exmouth, around Paraburdoo and along the Fortescue Marsh (ALA, 2018; Rio Tinto & WAH, 2015; WAH, 1998-).

Goodenia nuda

Goodenia nuda is described as an prostrate or erect ascending annual herb, with basal leaves prominently three veined from the base and produce yellow flowers with maroon centres (Rio Tinto & WAH, 2015; WAH, 1998-). *Goodenia nuda* has mostly been recorded from seasonally inundated clay soils and drainage lines, often in mulga (*Acacia aneura* and close relatives), however it has also been recorded from sand in scoured river beds, hillsides and a variety of other habitats (Rio Tinto & WAH, 2015; WAH, 1998-). *Goodenia nuda* is listed as a Priority 4 taxon due to the current state of knowledge (well surveyed and understood, while not currently considered to be under threat, but in need of ongoing monitoring). The WAH has 96 records for this species (WAH, 1998-) (Table 4.4) spread over the Pilbara, with some records from the Gascoyne and the Little Sandy Desert bioregions.

Goodenia nuda was recorded from three point locations, totalling in excess of 100 individuals (Appendix J). The three point locations were recorded in varying habitats, including one located on the managed and graded verge of the Munjina-Roy Hill Road. The remaining two records were from Mulga woodlands/ shrublands. Individuals observed in the Study Area were flowering, with some individuals retaining dehisced fruits. Due to the size of the Study Area and the limited access, not all potential populations/ occurrences would have been recorded.

Goodenia nuda has previously been recorded from the general area (ecologia Environment, 2009a, 2009c; Ecoscape, 2012; ENV Australia, 2013; G&G Environmental, 2009, 2011; Maia, 2018) in varying densities. The presence and number of individuals is likely to fluctuate from year to year as a result of rainfall and seasonal conditions.

4.5.2 Review of Significant Flora with Potential to Occur in the Study Area

The desktop assessment identified 19 priority listed taxa that are highly likely (*Eucalyptus rowleyi*, *Helichrysum oligochaetum* and *Rhagodia* sp. Hamersley (M. Trudgen 17794)), likely (*Eleocharis papillosa, Glycine falcata, Iotasperma sessilifolium, Myriocephalus scalpellus*, *Nicotiana heterantha, Samolus* sp. Fortescue Marsh (A. Markey & R. Coppen FM 9702) and *Stemodia* sp. Battle Hill (A.L. Payne 1006)) or possible (*Amaranthus centralis, Aristida jerichoensis* var. *subspinulifera, Atriplex flabelliformis, Calotis squamigera, Cardamine paucijuga, Crotalaria smithiana, Ipomoea racemigera, Swainsona thompsoniana* and *Themeda* sp. Hamersley Station (M.E. Trudgen 11431)) to occur within the Study Area (Table 4.2). These 19 priority listed taxa were not recorded during the Survey, however this does not discount them from occurring.

Table 4.4: Regional and Local extent of priority listed flora recorded from the Study Area

Taxon	Comment	Extent in Study Area		Bioregional extent	Subregional extent	Herbarium specimens' records
		Point locations	Individuals			
Eremophila pilosa (Priority 1)  	One specimen collected from hummock grassland. Exact numbers not known due to uncertainty during collection. It was noted as being common in the location of collection (sample site HS07).	1	Unknown	• Pilbara	• Fortescue	Five

Taxon	Comment	Extent in Study Area		Bioregional extent	Subregional extent	Herbarium specimens' records
		Point locations	Individuals			
Eremophila youngii subsp. *lepidota* (Priority 4)  	The dominant Eremophila in the Study Area, with large extents present across most habitats (excluding the Fortescue River and floodplain). White and pink flowering forms present. Occurred on sand, hardpans and clay-based soil types.	24	>1,000	• Carnarvon • Gascoyne • Little Sandy Desert • Pilbara	• Ashburton • Cape Range • Fortescue • Hamersley • Trainor • Wooramel	46

Taxon	Comment	Extent in Study Area		Bioregional extent	Subregional extent	Herbarium specimens' records
		Point locations	Individuals			
Goodenia nuda (Priority 4)  	Identified from three locations, including the road verge along Munjina-Roy Hill Road. Expected to occur across a larger extent within the Study Area. Individuals were noted as flowering at the time of the survey.	3	100+	• Gascoyne • Little Sandy Desert • Pilbara	• Augustus • Carnegie • Chichester • Fortescue • Hamersley • Roebourne • Trainor	96

All images taken by Biologic excluding image of *Eremophila pilosa*. *Eremophila pilosa* photography by A.P. Brown. Image used with the permission of the Western Australian Herbarium, Department of Biodiversity, Conservation and Attractions (https://florabase.dpaw.wa.gov.au/help/copyright). Accessed on Friday, 31 August 2018

The Study Area is extensive, with restricted accessibility, so was not comprehensively traversed. In addition, due to timing constraints, a comprehensive conservation significant flora list was not obtained prior to the Survey. This resulted in limited knowledge of known occurrences of priority taxa. For example, *Eucalyptus rowleyi* (P3) is known to occur in the south of the Study Area (located within the addition to the Study Area following the completion of the field survey component) (Figure 4.1). The location of the priority taxon was not actively traversed, potentially limiting the identification of *Eucalyptus rowleyi* (P3), if it occurred in the Study Area.

Rhagodia sp. Hamersley (M. trudgen 17794) (P3) was recorded by Ecoscape (2012) as occurring in the north of the Study Area along the transmission line. The identification was considered highly likely to almost certain (Ecoscape, 2012). Several *Rhagodia* specimens were collected during the Survey, however all specimens retained the distinctive 'fishy' smell of *Rhagodia eremaea*, while the leaf length and shape were consistent with *Rhagodia eremaea*, not *Rhagodia* sp. Hamersley (M. Trudgen 17794). The presence of *Rhagodia* sp. Hamersley (M. Trudgen 17794) can not be discounted as the location of Ecoscape (2012) record was not actively traversed.

The remaining 17 priority listed taxa are considered to potentially occur in the Study Area. Further survey work during optimal survey conditions (following sufficient rainfall and time to allow germination, growth, flowering and/or fruiting) would be required to confirm their presence or absence.

4.5.3 Flora of "Other" Significance

The EPA (2004) advises that flora species, subspecies, varieties, hybrids and ecotypes may be considered significant for reasons other than listing as a Threatened or Priority Flora taxa. This may include, but is not limited to, range extensions, keystone species, relic status, local endemism and anomalous features.

Based on these features, no taxa recorded from the Study Area during the current assessment is considered to be flora of "other" significance.

4.6 Unknown Flora Taxa

Seventeen (17) flora specimens collected from, and taxa left *in situ*, within the Study Area could not be confidently identified to species level (Appendix I), due to a lack of reproductive material and/or poor flora specimen availability at the time of the survey. The taxa that were left *in situ* did not have sufficient vegetative and/or flowering material present at the time of the field survey or were of poor quality that would hinder a positive identification beyond genera or species level. As a result, the taxa were not collected and were identified in the field to the highest taxonomic level possible.

The unknown flora taxa represent approximately 8% of the total taxa recorded from the Study Area. Of the 17 specimens, eight could not be identified to species level, while the remaining nine specimens were tentatively identified to species level (Appendix I), with confirmation

limited due to the quality of the material available and collected. None of the unknown flora taxa collected are analogous to DBCA listed Threatened or Priority flora taxa, nor are they likely to represent flora of other significance.

4.7 Introduced Flora Taxa

Eleven (11) introduced flora taxa were recorded from the Study Area during the current assessment (Figure 4.3, Table 4.5, Appendix I). The introduced flora taxa recorded from the Study Area were recorded from large populations (i.e. the floodplains of Fortescue River were dominated by **Malvastrum americanum*) to isolated occurrences (**Tribulus terrestris*). The introduced taxa were generally recorded from areas within the Study Area that are subjected to more cattle visitation (i.e. Fortescue River floodplains, mulga plains and claypans), which results in more disturbances (i.e. cattle trampling) impacting the native understorey.

The introduced flora taxa recorded from the Study Area are common taxa occurring in the Pilbara bioregion and are not ranked as high priority alerts for the DBCA (see Section 4.2.3). Each of the 11 introduced taxa were identified as previously been recorded in the region during the desktop and literature review (ecologia Environment, 2009b, 2009c; ENV Australia, 2010, 2013; Maia, 2018). The ecological impact of the 11 introduced flora taxa is High for the majority (Table 4.5), while two are unknown and one has not been assessed for the Pilbara region. The invasiveness of each of the 11 introduced flora is categorised as rapid, moderate or not assessed (Table 4.5).

The introduced flora taxa identified from the Study Area during the current assessment are not considered to be significant environmental weeds. No Weeds of National Significance or Declared Plant Pests listed under Section 22 of the BAM Act were recorded.

791617 796617 801617 806617 811617

7494444 7489444 7484444

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

Legend

Study Area

Introduced Flora

**Aerva javanica*
**Bidens bipinnata*
**Cenchrus ciliaris*
**Cenchrus setiger*
**Chloris virgata*
**Echinochloa colona*
**Malvastrum americanum*
**Senna occidentalis*
**Setaria verticillata*
**Tribulus terrestris*
**Vachellia farnesiana*

biologic Environmental Survey

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1:75,000

0 1 2 4 Kilometers

Roy Hill Iron Ore Pty Ltd - Remote MAR Borefield

Reconnaissance Flora & Vegetation Survey

Fig. 4.3: Introduced (weed) flora locations in the Study Area

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Size A3. Created 19/09/2018

Table 4.5: Introduced flora recorded from the Study Area

Family	Taxon	Common Name	Ecological	Invasiveness
Amaranthaceae	**Aerva javanica*	Kapok bush	High	Rapid
Asteraceae	**Bidens bipinnata*	Bipinnate beggar's tick	Unknown	Rapid
Fabaceae	**Senna occidentalis*	Wild coffee	Not assessed	Not assessed
	**Vachellia farnesiana*	Mimosa bush	High	Rapid
Malvaceae	**Malvastrum americanum*	Spiked malvastrum	High	Rapid
Poaceae	**Cenchrus ciliaris*	Buffel grass	High	Rapid
	**Cenchrus setiger*	Birdwood grass	High	Rapid
	**Chloris virgata*	Feathertop Rhodes grass	High	Rapid
	**Echinochloa colona*	Awnless barnyard grass	High	Rapid
	**Setaria verticillata*	Whorled pigeon grass	High	Rapid
Zygophyllaceae	**Tribulus terrestris*	Caltrop	Unknown	Moderate

4.8 Vegetation Units

A total of 13 vegetation units and two mapping units were described (Table 4.6) and delineated (Figure 4.4) from the Study Area following the sampling completed during the current assessment. The extent of each vegetation unit within the Roy Hill tenure is detailed in Appendix K. The Study Area can be grouped into three broad formations:

- *Triodia* mid open hummock grassland;
- *Eucalyptus* mid to low isolated trees or sparse woodland; and
- *Acacia* low isolated trees.

The *Triodia* dominated vegetation units occurred in the west and south of the Study Area, associated with the sandplains. The *Eucalyptus* dominated vegetation units occurred in association with Fortescue River, vegetated claypans and the floodplains flowing towards the Fortescue Marsh to the north-west. The Acacia dominated vegetation units occurred through the north-east and central portions of the Study Area, and were variously dominated by *Acacia aptaneura, Acacia synchronicia, Acacia xiphophylla* and *Acacia sclerosperma* subsp. *sclerosperma*.

Table 4.6: Vegetation units described and delineated from the Study Area

Vegetation code and description	Sample sites	Priority flora	Extent (ha / %)	Condition	Representative photo
AaAfLIT *Acacia ? aptaneura* and/ or *Acacia ? fuscaneura* low isolated trees over *Acacia synchronicia, Acacia sclerosperma* subsp. *sclerosperma* and *Eremophila cuneifolia* mid to tall sparse shrubland over *Triodia angusta* and *Triodia pungens* mid sparse hummock grassland with pockets of bare areas dominated by tussock grasses and herbs.	HS05, HS10, HS14, RH06	*Eremophila youngii* subsp. *lepidota* (P4)	3,667 / 15	Excellent, Very Good and Good	
AaLIT *Acacia aptaneura* with occasional *Eucalyptus gamophylla* and *Acacia pruinocarpa* low isolated to isolated patches of trees over *Acacia sclerosperma* subsp. *sclerosperma* and other *Acacia* and *Eremophila* species mid to tall isolated shrubs over *Triodia angusta* and occasional *Triodia pungens* mid open hummock grassland.	HS13, RH04, RH08, RH09, RH20	*Eremophila youngii* subsp. *lepidota* (P4)	6,375 / 26	Excellent, Very Good	

Vegetation code and description	Sample sites	Priority flora	Extent (ha / %)	Condition	Representative photo
AaLSW *Acacia aptaneura* low sparse woodland to isolated patches of trees over *Acacia tetragonophylla, Acacia sclerosperma* subsp. *sclerosperma* and *Acacia synchronicia* mid to tall isolated shrubs over **Cenchrus ciliaris* and **Cenchrus setiger* low open to sparse tussock grassland.	HS15	None recorded	454 / 2	Degraded	
AaLW *Acacia aptaneura* with occasional *Eucalyptus victrix* low woodland to open woodland over *Acacia sclerosperma* subsp. *sclerosperma, Psydrax latifolia* and *Acacia tetragonophylla* mid to tall isolated shrubs over *Triodia angusta* patches of mid hummock grasses over open tussock grassland and herbland.	HS02, RH07, RH18, RH26, RH27	*Eremophila youngii* subsp. *lepidota* (P4) *Goodenia nuda* (P4)	558 / 2	Very Good, Good, Poor	

Vegetation code and description	Sample sites	Priority flora	Extent (ha / %)	Condition	Representative photo
AsTSS *Acacia synchronicia* tall to mid sparse shrubland, with occasional **Vachellia farnesiana* over *Eragrostis xerophila*, **Cenchrus ciliaris* and *Dactyloctenium radulans* isolated patches of low tussock grasses and isolated patches of *Sclerolaena cuneata, Sclerolaena costata* and *Sclerolaena diacantha* low chenopod shrubs.	HS04, RH13, RH14, RH16	None recorded	2,903 / 12	Good, Poor	
AxTOS *Acacia xiphophylla* (and occasional *Acacia synchronicia*) tall open shrubland over *Eremophila youngii* subsp. *lepidota*, *Senna* sp. Meekatharra (E. Bailey 1-26) and *Eremophila cuneata* mid to low sparse shrubland over isolated tussock grasses and herbs.	HS11, RH02, RH10, RH28, RH32	*Goodenia nuda* (P4)	1,637 / 7	Excellent, Very Good	

Vegetation code and description	Sample sites	Priority flora	Extent (ha / %)	Condition	Representative photo
CP Bare, open claypans, with occasional tussock grasses and shrubs, dominated by *Eragrostis australasica, Diplachne fusca* subsp. *fusca* and *Sesbania cannabina*.	RH17	*Eremophila youngii* subsp. *lepidota* (P4) occurred on the vegetated edges	118 / <1	Very Good	
EcoMIT *Eucalyptus camaldulensis* subsp. *obtusa* mid isolated trees over *Eucalyptus victrix, Atalaya hemiglauca* and *Acacia coriacea* subsp. *pendens* low isolated trees over disturbed understorey dominated by **Vachellia farnesiana*.	E3, RH12, RH15, RH24	None recorded	226 / 1	Completely Degraded	

Vegetation code and description	Sample sites	Priority flora	Extent (ha / %)	Condition	Representative photo
EvAaLIT Occasional *Eucalyptus victrix* low isolated trees over *Acacia aptaneura* low isolated trees over *Acacia sclerosperma* subsp. *sclerosperma, Acacia pyrifolia* var. *pyrifolia* and *Senna glutinosa* subsp. x *luerssenii* mid to tall isolated shrubs over *Triodia angusta* mid sparse hummock grassland.	E5, E6, RH05, RH22	*Eremophila youngii* subsp. *lepidota* (P4)	615 / 3	Excellent, Very Good	
EvAaLSW *Eucalyptus victrix* and occasionally *Acacia aptaneura* low sparse woodland over mid to tall shrubland dominated by *Acacia* (*Acacia ancistrocarpa, Acacia tetragonophylla* and *Acacia sclerosperma* subsp. *sclerosperma*) and *Eremophila* (*Eremophila longifolia*) species over *Eulalia aurea, Chrysopogon fallax* and *Eriachne* spp. mid to low open tussock grassland.	RH03, RH09a, RH33, RH34	None recorded	76 / <1	Very Good	

Vegetation code and description	Sample sites	Priority flora	Extent (ha / %)	Condition	Representative photo
EvAaLSWIT *Eucalyptus victrix* and *Acacia aptaneura* low sparse woodland to isolated trees over *Acacia sclerosperma* subsp. *sclerosperma*, *Acacia tetragonophylla* and *Eremophila youngii* subsp. *lepidota* mid to tall isolated shrubs over **Malvastrum americanum* low isolated patches of herbs and occasional patches of *Triodia angusta* mid hummock grasses.	RH21, RH25	*Eremophila youngii* subsp. *lepidota* (P4)	1,194 / 5	Very Good, Good	
EvLIT *Eucalyptus victrix* and occasional patches of *Acacia aptaneura* low isolated trees over *Acacia sclerosperma* subsp. *sclerosperma, *Vachellia farnesiana* and *Acacia tetragonophylla* mid to tall isolated shrubs over disturbed understorey dominated by **Malvastrum americanum* and **Cenchrus ciliaris*.	E1R, E4, HS03, HS16, RH11, RH23	None recorded	4,422 / 18	Good, Poor, Degraded, Completely Degraded	

Vegetation code and description	Sample sites	Priority flora	Extent (ha / %)	Condition	Representative photo
TaTpTsMOHG *Triodia angusta* and/ or *Triodia pungens* and/ or *Triodia schinzii* mid open hummock grassland with isolated mid to tall shrubs dominated by *Stylobasium spathulatum*, *Acacia sclerosperma* subsp. *sclerosperma* and *Acacia synchronicia*.	HS01, HS07, HS08, RH01, RH19, RH29, RH30, RH31	*Eremophila pilosa* (P1) *Eremophila youngii* subsp. *lepidota* (P4) *Goodenia nuda* (P4)	1,907 / 8	Excellent, Very Good	
Cl/D Cleared and disturbed areas associated with pastoralism.	None	None recorded	80 / <1	Completely Degraded	
Cleared Area Gazetted public roads.	None	None recorded	96 / <1	Completely Degraded	

NB: Area values have been rounded to the nearest whole number.

782714 787714 792714 797714 802714 807714 812714

7492708

7487708

7482708

Veg Code	Vegetation Unit Description
AaAfLIT	*Acacia ? aptaneura* and/ or *Acacia ? fuscaneura* low isolated trees over *Acacia synchronicia, Acacia sclerosperma* subsp. *sclerosperma* and *Eremophila cuneifolia* mid to tall sparse shrubland over *Triodia angusta* and *Triodia pungens* mid sparse hummock grassland with pockets of bare areas dominated by
AaLIT	*Acacia aptaneura* with occasional *Eucalyptus gamophylla* and *Acacia pruinocarpa* low isolated to isolated patches of trees over *Acacia sclerosperma* subsp. *sclerosperma* and other *Acacia* and *Eremophila* species mid to tall isolated shrubs over *Triodia angusta* and occasional *Triodia pungens* mid open
AaLSW	*Acacia aptaneura* low sparse woodland to isolated patches of trees over *Acacia tetragonophylla, Acacia sclerosperma* subsp. *sclerosperma* and *Acacia synchronicia* mid to tall isolated shrubs over **Cenchrus*
AaLW	*Acacia aptaneura* with occasional *Eucalyptus victrix* low woodland to open woodland over *Acacia sclerosperma* subsp. *sclerosperma, Psydrax latifolia* and *Acacia tetragonophylla* mid to tall isolated
AsTSS	*Acacia synchronicia* tall to mid sparse shrubland, with occasional **Vachellia farnesiana* over *Eragrostis xerophila* , **Cenchrus ciliaris* and *Dactyloctenium radulans* isolated patches of low tussock grasses and
AxTOS	*Acacia xiphophylla* (and occasional *Acacia synchronicia*) tall open shrubland over *Eremophila youngii* subsp. *lepidota* , *Senna* sp. Meekatharra (E. Bailey 1-26) and *Eremophila cuneata* mid to low sparse
CP	Bare, open claypans, with occasional tussock grasses and shrubs, dominated by *Eragrostis australasica,*
EcoMIT	*Eucalyptus camaldulensis* subsp. *obtusa* mid isolated trees over *Eucalyptus victrix, Atalaya hemiglauca* and *Acacia coriacea* subsp. *pendens* low isolated trees over disturbed understorey dominated by **Vachellia*
EvAaLIT	Occasional *Eucalyptus victrix* low isolated trees over *Acacia aptaneura* low isolated trees over *Acacia sclerosperma* subsp. *sclerosperma, Acacia pyrifolia* var. *pyrifolia* and *Senna glutinosa* subsp. x *luerssenii*
EvAaLSW	*Eucalyptus victrix* and occasionally *Acacia aptaneura* low sparse woodland over mid to tall shrubland dominated by *Acacia* (*Acacia ancistrocarpa, Acacia tetragonophylla* and *Acacia sclerosperma* subsp. *sclerosperma*) and *Eremophila* (*Eremophila longifolia*) species over *Eulalia aurea, Chrysopogon fallax* and
EvAaLSWIT	*Eucalyptus victrix* and *Acacia aptaneura* low sparse woodland to isolated trees over *Acacia sclerosperma* subsp. *sclerosperma* , *Acacia tetragonophylla* and *Eremophila youngii* subsp. *lepidota* mid to tall isolated shrubs over **Malvastrum americanum* low isolated patches of herbs and occasional patches of *Triodia*
EvLIT	*Eucalyptus victrix* and occasional patches of *Acacia aptaneura* low isolated trees over *Acacia sclerosperma* subsp. *sclerosperma, *Vachellia farnesiana* and *Acacia tetragonophylla* mid to tall isolated
TaTpTsMOHG	*Triodia angusta* and/ or *Triodia pungens* and/ or *Triodia schinzii* mid open hummock grassland with isolated mid to tall shrubs dominated by *Stylobasium spathulatum* , *Acacia sclerosperma* subsp.
CI/D	Cleared and disturbed areas associated with pastoralism.
Cleared Area	Cleared roads and tracks

Legend

Study Area

Cleared

AaAfLIT

AaLIT

AaLSW

AaLW

AsTSS

AxTOS

CP

EcoMIT

EvAaLIT

EvAaLSW

EvAaLSWIT

EvLIT

TaTpTsMOHG

CI/D

Cleared Area

biologic Environmental Survey

N

1:80,000

0 1 2 4 Kilometers

Roy Hill Iron Ore Pty Ltd - Remote MAR Borefield

Reconnaissance Flora & Vegetation Survey

Fig. 4.4: Vegetation unit mapping Across the Study Area

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Size A3. Created 19/09/2018

The majority of the vegetation units (AaAfLIT, AaLIT, AaLSW, AaLW, EvAaLIT, EvAaLSW, EvAaLSWIT and EvLIT) described and delineated from the Study Area support Mulga (mostly *Acacia aptaneura*) or consisted of a dominant Mulga upper stratum. The Mulga occurred as either isolated low trees or in groves and patches. The Mulga communities were floristically and structurally different to the communities identified at the Roy Hill mine site (ecologia Environment, 2009b, 2009c) and the Stage 2 Borefield (Maia, 2018). The Mulga communities did not create the distinctive banding common in the Fortescue bioregion and discussed by Maia (2018) and ecologia Environment (2009c).

The claypans (vegetation unit CP) occurred in the west and south-east of the Study Area and were generally devoid of vegetation, excluding some claypans that supported tussock grasses (*Eragrostis australasica* and *Diplachne fusca* subsp. *fusca*). The vegetation occurring around the periphery of the claypans was consistent with the surrounding vegetation units. At the scale the vegetation units were sampled and mapped, the vegetation along the periphery of the claypans was not identified as a separate unit. There may be slight variations in species diversity and density following more systematic sampling and analysis.

The vegetated claypans (vegetation unit EvAaLSW) were floristically different to the bare claypans (vegetation unit CP) and supported a dense tussock grassland of *Eriachne* and *Eragrostis* species. In addition, the periphery of the vegetated claypans generally supported *Eucalyptus victrix* and shrubs that were not generally recorded in the surrounding landscape (for example *Eremophila longifolia, Acacia adsurgens* and *Acacia sibirica*).

The hummock grassland (*Triodia*) communities (vegetation units AaLIT and TaTpTsMOHG) occurred over a substantial portion (34%) of the Study Area from the western boundary, along the southern boundary towards the east (Figure 4.4). Within the hummock grassland communities, in particular vegetation unit TaTpTsMOHG, the dominant *Triodia* species varied in relation to changes in soil composition and micro-topographical changes (changes of less than 1 m across the landscape). *Triodia angusta* generally occurred lower in the landscape where the soil formed a hardpan crust with higher clay content. *Triodia pungens* and *Triodia schinzii* occurred slightly higher in the landscape where the soil was sandier in composition. Pockets of *Triodia basedowii* and *Triodia longiceps* were also observed within the hummock grassland communities. These pockets were isolated and small in occurrence. The occurrence of each *Triodia* species were not mapped as separate vegetation units due to the survey intensity (Reconnaissance Survey), size of the Study Area and the difficulty in identifying the boundaries of each *Triodia* community from aerial imagery. In addition, fire disturbance was patchily located throughout the hummock grassland communities ensuring it was difficult to discern separate communities from aerial imagery.

A third hummock grassland community was recorded from calcrete rises and platforms (EvAaLIT), which occurred in the north of the Study Area. The calcrete rises were interspersed with depressions that supported *Eucalyptus victrix* and other flora species consistent with wetter, moist sites (for example, the floodplain and alluvial washplain communities EvAaLSWIT and EvLIT). The calcrete rises supported *Triodia angusta* hummock grasses with isolated low

Acacia trees and shrubs. The small depressions interspersed within the calcrete rises were not mapped separately due to the survey intensity employed (Reconnaissance Survey), size of the Study Area and the scale of the mapping completed for the Study Area. The limited accessibility also ensured that a limited number of the depressions within the calcrete rises were visited, reducing the sampling accuracy.

The northeast of the Study Area consisted of a very open *Acacia synchronicia* shrubland (vegetation unit AsTSS) with a stony mantle. The vegetation unit included large, open bare areas with minimal vegetation cover (Plate 4.1). The vegetation was considered to be in good to poor condition due to cattle grazing and trampling, however the open bare patches are consistent with the Turee land system, so are not considered to be in worse condition.

Plate 4.1: Vegetation unit AsTSS showing the sparse, patchiness of vegetation consistent of the Turee land system

Acacia xiphophylla was present across a portion (7%) of the Study Area in the west (Figure 4.4). The understorey was variously dominated by *Eremophila* and *Senna* species with a ground layer of isolated halophytic shrubs (*Sclerolaena* and *Atriplex* species) and tussock grasses. Patches of *Triodia angusta* were recorded around the periphery of the community, which most likely represent an ecotone between the adjacent hummock grassland community. In general, vegetation unit AxTOS was open with large bare patches of soil.

The remaining portions of the Study Area were mapped as floodplain (EvLIT), alluvial washplain (EvAaLSWIT) and major drainage line (Fortescue River, EcoMIT). The alluvial washplain occurred away from the Fortescue River and represented areas of sheet flow and washplains which support an open upper stratum of *Eucalyptus victrix*. The floodplain and major drainage line were heavily impacted by grazing, trampling and pastoralism which has altered the mid and lower stratums of the vegetation units. Historically, Roy Hill station was overstocked in the 1930s which may have led to the alteration of the Fortescue River and floodplains (Payne & Mitchell, 1999). The perennial grasses and herbs are preferred by grazing animals and are prone to depletion under uncontrolled grazing (van Vreeswyk *et al.*, 2004).

4.9 Vegetation of Conservation Significance

4.9.1 Federal and State Listing

The desktop assessment did not identify any known TECs as potentially occurring within the Study Area. In addition, there are only two TECs known to occur in Pilbara bioregion, Themeda Grasslands and Ethel Gorge. Ethel Gorge is located approximately 60 km to the south of the

Study Area, while the nearest Themeda Grassland TEC is located over 200 km to the east-northeast. The vegetation units described from the Study Area are not considered to be analogous to the known TECs, in addition, the Ethel Gorge TEC does not represent terrestrial (above-ground) vegetation.

The desktop assessment identified four PECs as occurring within 40 km of the Study Area, with one PEC (Fortescue Marsh) occurring in association with the Study Area. The PEC is associated with the Fortescue Marsh, and the portion of the PEC that overlaps the Study Area is considered to be the buffer (5 km buffer) apportioned to the PEC. As such, the vegetation within the Study Area is not considered to be representative of the PEC.

Two of the remaining three PECs, Fortescue Valley Sand Dunes and Mosquito Land System, are located greater than 20 km from the Study Area and have defined/ unique landforms, which do not occur in the Study Area. The remaining PEC, Narbung LS, is associated with the Narbung land system, which has been mapped as occurring over 24% of the Study Area (Figure 4.1).

The PEC is described as an “alluvial washplain with prominent internal drainage foci supporting snakewood (*Acacia xiphophylla*) and mulga (*Acacia aneura* and close relatives) shrublands with halophytic (members of the Chenopodiaceae family as an example) low shrubs”. The land system is scattered with small internal draining foci, which are readily observed from aerial imagery. There are in excess of 100 claypans (vegetated or unvegetated) located within the Study Area, with a substantial portion located in the Narbung land system.

Currently there is limited information available on the Narbung LS PEC and its occurrence in the Pilbara. A review of the PEC and Land System description suggests that areas dominated by snakewood (*Acacia xiphophylla*) are more consistent with the PEC. A request for further information was submitted to the DBCA. The response provided by the DBCA indicates that the entire mapped extent of the Narbung land system is the PEC (pers. com. Val English, DBCA). As a result the PEC occurs over 24% or 5,924 ha of the Study Area. The DBCA acknowledge that their information and understanding on the PEC is limited, with not all occurrences mapped and studied extensively.

There are nine vegetation units mapped as occurring within the PEC. Vegetation unit AxTOS is the only unit that closely matches the land system description (alluvial washplain with prominent internal drainage foci supporting snakewood (*Acacia xiphophylla*) and mulga (*Acacia aneura* and close relatives) shrublands with halophytic (members of the Chenopodiaceae family as an example) low shrubs). Determining the significance of the vegetation units mapped within the PEC is difficult as the land system mapping includes areas dominated by hummock grasslands (*Triodia* spp.). As vegetation unit AxTOS is the only unit that closely matches the land system description, the local significance of AxTOS is ranked as moderate, while the remaining eight vegetation units (AaAfLIT, AaLIT, AaLW, CP, EvAaLIT, EvAaLSW, EvAaLSWIT, TaTpTsMOHG) are ranked as low local significance. The regional significance of the PEC is ranked as low, which is reflective of the Priority 3 ranking applied by the DBCA.

4.9.2 Vegetation of "Other" Significance

The EPA (2004) advises that vegetation may be of significance for reasons other than a listing as a TEC or a PEC. This may include, although is not limited to, scarcity, novel combination of species, role as a refuge, restricted distribution and vegetation extent being below a threshold level. The vegetation units mapped in the Study Area are considered to be vegetation of "other" significance, namely:

- Supporting priority listed taxa;
- Groundwater Dependent Vegetation (GDV);
- Associated with a major drainage line;
- Associated with locally restricted claypans; and
- Sheet flow dependent Mulga communities.

Eleven (11) of the 13 vegetation units are considered to be locally significant as they support, in isolation or a combination of, priority listed flora (Table 4.7), GDV/ potential GDV, occur in association with the Fortescue River, are locally restricted landforms or rely on sheet flow. The significance of the vegetation units is ranked as either High, Moderate, Low or Negligible (consistent with Table 3.5).

Table 4.7: Locally significant vegetation units mapped within the Study Area

Code and description	Area (ha / %)	Significance	Comment
AaAfLIT *Acacia ? aptaneura* and/ or *Acacia ? fuscaneura* low isolated trees over *Acacia synchronicia, Acacia sclerosperma* subsp. *sclerosperma* and *Eremophila cuneifolia* mid to tall sparse shrubland over *Triodia angusta* and *Triodia pungens* mid sparse hummock grassland with pockets of bare areas dominated by tussock grasses and herbs.	3,667 / 15	Low	Supports populations of *Eremophila youngii* subsp. *lepidota* (P4). Supports Mulga groves that may rely on sheet flow. Occurs in association with the Narbung LS PEC.
AaLIT *Acacia aptaneura* with occasional *Eucalyptus gamophylla* and *Acacia pruinocarpa* low isolated to isolated patches of trees over *Acacia sclerosperma* subsp. *sclerosperma* and other *Acacia* and *Eremophila* species mid to tall isolated shrubs over *Triodia angusta* and occasional *Triodia pungens* mid open hummock grassland.	6,375 / 26	Low	Supports populations of *Eremophila youngii* subsp. *lepidota* (P4). Occurs in association with the Narbung LS PEC.
AaLW *Acacia aptaneura* with occasional *Eucalyptus victrix* low woodland to open woodland over *Acacia sclerosperma* subsp. *sclerosperma, Psydrax latifolia* and *Acacia tetragonophylla* mid to tall isolated shrubs over *Triodia angusta* patches of mid hummock grasses over open tussock grassland and herbland.	558 / 2	Low	Supports populations of *Eremophila youngii* subsp. *lepidota* (P4) and *Goodenia nuda* (P4). Isolated occurrences of the potentially phreatophytic *Eucalyptus victrix* located within vegetation unit, which may utilise available groundwater. Occurs in association with the Narbung LS PEC.

Code and description	Area (ha / %)	Significance	Comment
AxTOS *Acacia xiphophylla* (and occasional *Acacia synchronicia*) tall open shrubland over *Eremophila youngii* subsp. *lepidota*, *Senna* sp. Meekatharra (E. Bailey 1-26) and *Eremophila cuneata* mid to low sparse shrubland over isolated tussock grasses and herbs.	1,637 / 7	Moderate	Supports populations of *Goodenia nuda* (P4) and partially mapped within the Narbung LS PEC.
CP Bare, open claypans, with occasional tussock grasses and shrubs, dominated by *Eragrostis australasica, Diplachne fusca* subsp. *fusca* and *Sesbania cannabina*.	118 / <1	Low	Supports populations of *Eremophila youngii* subsp. *lepidota* (P4), which occur on the periphery of the claypans. The claypans represent a locally restricted landform in the Fortescue subregion. Occurs in association with the Narbung LS PEC.
EcoMIT *Eucalyptus camaldulensis* subsp. *obtusa* mid isolated trees over *Eucalyptus victrix*, *Atalaya hemiglauca* and *Acacia coriacea* subsp. *pendens* low isolated trees over disturbed understorey dominated by **Vachellia farnesiana*.	226 / 1	Moderate	Supports phreatophytic and potentially phreatophytic vegetation along a major drainage line, Fortescue River.
EvAaLIT Occasional *Eucalyptus victrix* low isolated trees over *Acacia aptaneura* low isolated trees over *Acacia sclerosperma* subsp. *sclerosperma, Acacia pyrifolia* var. *pyrifolia* and *Senna glutinosa* subsp. x *luerssenii* mid to tall isolated shrubs over *Triodia angusta* mid sparse hummock grassland.	615 / 3	Low	Supports populations of *Eremophila youngii* subsp. *lepidota* (P4). Occurs in association with the Narbung LS PEC.
EvAaLSW *Eucalyptus victrix* and occasionally *Acacia aptaneura* low sparse woodland over mid to tall shrubland dominated by *Acacia (Acacia ancistrocarpa, Acacia tetragonophylla* and *Acacia sclerosperma* subsp*. sclerosperma)* and *Eremophila (Eremophila longifolia)* species over *Eulalia aurea, Chrysopogon fallax* and *Eriachne* spp. mid to low open tussock grassland.	76 / <1	Low	The vegetated claypans represent a locally restricted landform in the Fortescue subregion. Occurs in association with the Narbung LS PEC.
EvAaLSWIT *Eucalyptus victrix* and *Acacia aptaneura* low sparse woodland to isolated trees over *Acacia sclerosperma* subsp. *sclerosperma*, *Acacia tetragonophylla* and *Eremophila youngii* subsp. *lepidota* mid to tall isolated shrubs over **Malvastrum americanum* low isolated patches of herbs and occasional patches of *Triodia angusta* mid hummock grasses.	1,194 / 5	Low	Supports populations of *Eremophila youngii* subsp. *lepidota* (P4). Supports the potentially phreatophytic *Eucalyptus victrix* which may utilise available groundwater. Occurs in association with the Narbung LS PEC.

Code and description	Area (ha / %)	Significance	Comment
EvLIT *Eucalyptus victrix* and occasional patches of *Acacia aptaneura* low isolated trees over *Acacia sclerosperma* subsp. *sclerosperma*, **Vachellia farnesiana* and *Acacia tetragonophylla* mid to tall isolated shrubs over disturbed understorey dominated by **Malvastrum americanum* and **Cenchrus ciliaris*.	4,422 / 18	Low	Supports potentially phreatophytic vegetation which may utilise available groundwater.
TaTpTsMOHG *Triodia angusta* and/ or *Triodia pungens* and/ or *Triodia schinzii* mid open hummock grassland with isolated mid to tall shrubs dominated by *Stylobasium spathulatum*, *Acacia sclerosperma* subsp. *sclerosperma* and *Acacia synchronicia*.	1,907 / 8	High	Supports a population of the restricted *Eremophila pilosa* (P1), as well as populations of *Eremophila youngii* subsp. *lepidota* (P4) and *Goodenia nuda* (P4). Occurs in association with the Narbung LS PEC.

Vegetation unit TaTpTsMOHG is considered to be of regional significance and is ranked as having a high local significance. The regional and high local significance relates to the occurrence of the Priority 1 taxon *Eremophila pilosa*. *Eremophila pilosa* is restricted to the Roy Hill region and is only known from limited (less than ten) records in the east of the Fortescue subregion.

Vegetation unit EcoMIT is ranked as having a moderate local significance as it is associated with a major drainage line, the Fortescue River. The Fortescue River is one of the largest river systems in the Pilbara and supports phreatophytic vegetation and permanent pools. The extent of the Fortescue River in the Study Area supports phreatophytic and potentially phreatophytic vegetation. *Eucalyptus camaldulensis* subsp. *obtusa* occurs in the north of the Study Area, concentrated around permanent pools. Further to the south, *Eucalyptus victrix* becomes more dominant along the river channel while *Eucalyptus camaldulensis* subsp. *obtusa* occurs sporadically. The vegetation is completely degraded from cattle grazing, trampling, weed invasion and the alterations to the natural hydrological regime from a man-made dam in the north of the Study Area, near the Roy Hill homestead.

The floodplains of the Fortescue River, mapped as vegetation unit EvLIT, supports extensive stands of *Eucalyptus victrix*. *Eucalyptus victrix* is a potential phreatophyte and may access and utilise groundwater when available. As with vegetation unit EcoMIT, the floodplains have been extensively degraded by cattle grazing and trampling. Vegetation unit has been ranked as having a low local significance. The low ranking is a resultant of the presence of *Eucalyptus victrix* and the condition of the vegetation at the time of the Survey.

The Study Area supports numerous claypans that are either vegetated or unvegetated, mapped as CP or EvAaLSW. The claypans are unique features in the landscape, with a higher density of claypans located between the Fortescue Marsh and the Hamersley Ranges (based on review of aerial imagery). A proportion of these claypans are vegetated with *Eucalyptus victrix* present

around the boundary, while others support tussock grasses (*Eragrostis australasica, Diplachne fusca* subsp. *fusca*). *Eucalyptus victrix* is a potential phreatophyte. The significance of the locally restricted claypans is low. Although they are numerous, they are restricted in size and may provide important refugia for native fauna.

Seven of the 11 locally significant vegetation units (AaAfLIT, AaLIT, AaLW, AxTOS, CP, EvAaLIT and EvAaLSWIT) support populations of the Priority 4 flora species *Eremophila youngii* subsp. *lepidota* and *Goodenia nuda*. In addition, several of these vegetation units (AaAfLIT, AaLW and EvAaLSWIT) also support potentially phreatophytic species (*Eucalyptus victrix*) or support Mulga (*Acacia aptaneura*) groves that may rely on sheet flow movement across the landscape.

4.9.3 Bioregional Significance

Under the Convention of Biological Diversity, Australia has worked towards a target of 17% of the continent to be protected as part of the National Reserve System (NRS). In building the NRS, priority is given to under-represented bioregions that have less than 10% of their remaining area protected in reserves (NRSTG, 2009). The Pilbara bioregion is an underrepresented bioregion, with less than 10% of its total area protected in reserves. The Fortescue subregion is also underrepresented, with less than 10% of the subregional area protected in reserves.

Although the Pilbara bioregion, and the Fortescue subregion, are underrepresented within the NRS, greater than 99% of the bioregional and subregional area remains intact (Government of Western Australia, 2018). Irrespective of any vegetation clearing within the bounds of the Study Area, the Project will not substantially impact on the bioregional (and subregional) area remaining intact, therefore the ability of the NRS to adequately reserve vegetation within the Pilbara bioregion (and the Fortescue subregion).

4.10 Vegetation Condition

The condition of the vegetation in the Study Area ranged from Excellent to Completely Degraded, with the majority in a very good condition (Table 4.8; Figure 4.5). The extent of vegetation categorised by condition within Roy Hill tenure is detailed in Appendix K.

The most common impacts to the vegetation were from cattle grazing and trampling, which is evident across the Fortescue River floodplain (mapped as EvLIT). The vegetation structure has been substantially altered by cattle grazing and trampling that many of the native understorey species are not present. The understorey mainly consists of an introduced shrub and herb layer dominated by **Vachellia farnesiana* and **Malvastrum americanum*. Evidence of cattle, through tracks and footprints, were seen over the majority of the Study Area, with only small portions of the hummock grasslands (vegetation units AaLIT and TaTpTsMOHG) showing minor or no evidence of cattle tracks.

The presence and density of weeds varied across the Study Area. Areas that have high visitation from cattle (i.e. Fortescue River and the floodplains, Mulga and Acacia shrubland

communities) had a greater presence of weeds. Cattle are a known vector for weed dispersal (Hogan & Phillips, 2011), either via attachment to coat, by consumption or through vehicles used to transport the cattle around. Many of the weed species recorded from the Study Area have awns or hooks on the fruit that would readily attach to cattle. For example, **Bidens bipinnata* has two awns at the tip which have backwards pointing barbs that readily attach to clothing and cattle, ensuring dispersal of the weed.

The vegetation in the south and west of the Study Area has been subjected to a wildfire within the last 36 months. The fire was patchy in distribution and was noted from sample sites E6, HS01, RH07, RH09a, RH30 and RH31. Fire is considered to be a natural and important phenomenon in the Pilbara, so the presence of fire in isolation does not justify a downgrade in vegetation condition. Consecutive, intense fires that hinder the natural recovery of vegetation and promote weed invasion and growth do warrant a downgrade in the vegetation condition. This is not the case for the Study Area, with recovery of vegetation evident and low diversity of weed invasion and proliferation.

The natural hydrological regime of Fortescue River has historically been altered through the creation of a dam across the river near the Roy Hill Homestead. This dam has resulted in a large permanent pool forming up river of the dam. The creation of the permanent pool has likely had flow on impacts up river resulting in the soil becoming permanently saturated or saturated for longer periods than normal. The soil saturation may have resulted in the death of some of the eucalypts along the main river channel (Plate 4.2). The substantial alteration of the floodplains from cattle grazing and trampling has also increased surface water flow, sedimentation and erosion along the banks of Fortescue River.

Plate 4.2: Permanent pool on the Fortescue River showing dead eucalypt trees (western bank looking north, downriver)

Table 4.8: Vegetation condition extent in the Study Area

Condition Rating	Extent (ha / %)	Comment
Excellent	3,704 / 15	Minimal evidence of anthropogenic disturbances and disturbances associated with introduced herbivores and introduced flora taxa.
Very Good	11,895 / 49	Signs and evidence of increased disturbances associated with cattle grazing and trampling, while non-invasive weeds present in low densities. Disturbances are limited and isolated in occurrence. Generally related to cattle grazing and trampling.
Good	3,368 / 14	Vegetation structure altered as a result of pastoralism. Weeds present in varying densities. Cattle grazing and trampling more evident and impacting on the vegetation structure.
Poor	87 / <1	Vegetation structure altered, generally impacting one or two of the traditional vegetation stratums (more often the mid or ground stratum). Weeds occur in large patches as well as sporadically throughout the area.
Degraded	1,517 / 6	Vegetation structure substantially altered with only resilient, hardy shrubs and trees remaining. Weeds in high densities, with invasive species present. Cattle grazing and trampling pressures evident.
Completely Degraded	3,738 / 15	Vegetation structure altered substantially as a result of pastoralism, cattle grazing and trampling. The understorey dominated by introduced weeds at high densities and diversity. Included areas that have been cleared, for example Marble Bar Road, Roy Hill homestead and the disused airstrip.
Total	**24,328 / 100**	

NB: values have been rounded to the nearest whole number

785667 790667 795667 800667 805667 810667

7494141

7489141

7484141

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

Legend

Study Area

Vegetation Condition

- Excellent
- Very Good
- Good
- Poor
- Degraded
- Completely Degraded

N

1:75,000

0 1 2 4 Kilometers

biologic Environmental Survey

Roy Hill Iron Ore Pty Ltd - Remote MAR Borefield

Reconnaissance Flora & Vegetation Survey

Fig. 4.5: Vegetation condition mapping across the Study Area

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Size A3. Created 19/09/2018

5 Discussion

The following section discusses the results of the Survey and places the significant results in a regional and local context, consistent with the requirements of EPA (2016c).

5.1 Flora of Conservation Significance

The Survey did not identify any Federal or State threatened (declared rare) flora species listed under the EPBC Act or the WC Act. Three Priority listed taxa, *Eremophila pilosa* (P1), *Eremophila youngii* subsp. *lepidota* (P4) and *Goodenia nuda* (P4), were recorded during the Survey. No other flora species recorded during the Survey are considered to significant due to range extensions, unusual/ unique taxa or recorded at the extremities of their known geographical range.

5.1.1 Regional Significance

Eremophila pilosa is listed as a Priority 1 taxon, which are considered to be poorly known and in urgent need of further surveys. *Eremophila pilosa* is known from three populations in NatureMap (DBCA, 2018a), with two of the populations located close to the Study Area and the Fortescue Marsh. The third population is located approximately 80 km east of Newman.

The identification of *Eremophila pilosa* in the Study Area is a continuation of the known populations located to the south of Study Area along Marble Bar Road (Figure 4.1). This continuation of the populations is further emphasised with the individuals and populations identified by (Ecoscape, 2012) along the Newman to Roy Hill transmission line.

None of the populations of *Eremophila pilosa* are located within the conservation estate, with all known populations located on pastoral leases and mining/ exploration tenements. The majority of the known occurrences of *Eremophila pilosa* are within the Pilbara bioregion and Fortescue subregion. One population (listed by DBCA, 2018a) is located in the Augustus subregion of the Gascoyne bioregion, although it is located close to the boundary of the Pilbara bioregion. The restricted distribution of *Eremophila pilosa*, its listing as a Priority 1 taxon and the lack of populations within the conservation estate ensure *Eremophila pilosa* is of regional significance.

The remaining two priority flora known to occur in the Study Area, *Eremophila youngii* subsp. *lepidota* and *Goodenia nuda*, are not considered to be of regional significance. Both priority taxa are listed as Priority 4 and occur extensively in the Pilbara bioregion and into adjoining bioregions. Priority 4 taxa are rare but have been adequately surveyed and are not considered currently under threat and are represented within the conservation estate.

5.1.2 Local Significance

The local significance of the three priority listed flora recorded from the Study Area has been ranked between High, Moderate, Low and Negligible. The significance ratings are based on the priority rankings, extent within the conservation estate, extent within the bioregion/ subregion

and the Study Area. As discussed in Section 5.1.1, *Eremophila pilosa* is regionally significant and consequently is rated as having a high local significance.

Eremophila youngii subsp. *lepidota was* identified as occurring within 40 km of the Study Area during the database searches (Appendix G), while also being recorded from five of the 11 reports reviewed (Table 4.1). It was recorded from 24 point locations within the Study Area, with a conservative estimate in excess of 1,000 individuals observed. It is highly likely that substantially more point locations and individuals occur within the Study Area. The limiting factor in recording additional points was accessibility across the extensive Study Area. Individuals were recorded from seven (AaAfLIT, AaLIT, AaLW, CP, EvAaLIT, EvAaLSWIT and TaTpTsMOHG) of the 13 vegetation units described and delineated from the Study Area.

Based on the known extent of *Eremophila youngii* subsp. *lepidota* in the Study Area and the surrounding landscape, as well as the extensive records within the Fortescue subregion and in association with the Fortescue Marsh, the presence of the priority taxon in the Study Area is rated as having a low local significance. *Eremophila youngii* subsp. *lepidota* is also listed a Priority 4 taxon, which are rare but have been adequately surveyed and are not considered currently under threat and are represented within the conservation estate.

Goodenia nuda was identified as occurring within 40 km of the Study Area during the database searches (Appendix G), while also being recorded from seven of the 11 reports reviewed (Table 4.1). It was recorded three times within the Study Area, with in excess of 100 individuals observed. It was recorded from three vegetation units, ranging from hummock grassland, mulga woodland and Acacia shrubland. It is plausible to suggest that additional individuals would be observed if the Study Area was more systematically searched.

Based on the known extent of *Goodenia nuda* in the Study Area and the surrounding landscape, as well as the extensive records across the Pilbara, the presence of the priority taxon in the Study Area is rated as having a low to negligible local significance. *Goodenia nuda* is also listed a Priority 4 taxon, which are rare but have been adequately surveyed and are not considered currently under threat and are represented within the conservation estate.

5.2 Vegetation of Conservation Significance

The Survey did not identify any vegetation units that are consistent with ecological communities listed as threatened under the EPBC Act or the WC Act. One potential PEC, Narbung LS, occurs across 24% of the Study Area. Eleven vegetation units recorded during the Survey are considered to be locally significant for supporting priority listed flora, phreatophytic and potential phreatophytic flora, occurring in association with a major drainage line, potential sheet flow dependent landscape and/ or unique and unusual landforms.

5.2.1 Regional Significance

The majority of the vegetation units (excluding AxTOS) recorded in the Study Area are not considered to be of regional significance. The vegetation units are not analogous to any TECs known to occur in the Pilbara. Although there is no regional vegetation dataset for the Pilbara,

the vegetation units recorded extend beyond the Study Area into the surrounding landscape. Broadly, the vegetation units described and delineated from the Study Area have been recorded from surveys completed near the Study Area (ecologia Environment, 2009a, 2009b, 2009c; Ecoscape, 2012; Maia, 2018).

Vegetation unit AxTOS may be considered to be of low local significance as it most closely resembles the Narbung LS PEC. The remaining vegetation units that were mapped as occurring in association with the Narbung land system are not regional significant, as they do not closely match the land system description. This includes vegetation units that are dominated by hummock grasses (*Triodia* spp.).

The ranking of low regional significance for vegetation unit AxTOS is reflective of the Priority 3 ranking applied to the PEC by the DBCA. Although the Narbung land system occurs in two isolated occurrences within the eastern Pilbara, to the south of the Fortescue Marsh (Figure 4.1), their extent is large (15,977 ha). In addition, the land system mapping is broad and it is likely that upon further studies and review of the PEC, the mapped extent of the PEC would be reduced to exclude areas that do not accurately represent the land system description. This could result in the removal of areas that are dominated by hummock grasses and/ or areas that do not support snakewood shrublands. Further studies would need to be completed to definitively determine the regional significance of the PEC and vegetation unit AxTOS. For the purposes of this document, only vegetation unit AxTOS is deemed to be of low regional significance.

5.2.2 Local Significance

Vegetation unit AxTOS most closely resembles the Narbung land system description, and is considered to be analogous with the Narbung LS PEC. The description for the Narbung LS is:

- Narbung LS PEC: Alluvial washplains with prominent internal drainage foci supporting snakewood (*Acacia xiphophylla*) and mulga (*Acacia aneura* and its close relatives) shrublands with halophytic low shrubs

Vegetation unit AxTOS consisted of an upper stratum of *Acacia xiphophylla* over *Eremophila* spp. and *Senna* spp. isolated shrubs over an open lower stratum of herbs from the Chenopodiaceae family and tussock grasses. In addition, the vegetation unit was scattered with internal drainage foci (claypans) that were either vegetated or unvegetated (Figure 4.4). The Narbung land system (as mapped by van Vreeswyk *et al.*, 2004) extends across 24% of the Study Area (Section 2.7 and Figure 2.3). Vegetation AxTOS was mapped across 7% of the Narbung land system. Following advice from the DBCA, the remainder of the Narbung land system is also representative of the PEC. Therefore, a further eight vegetation units (AaAfLIT. AaLIT, AaLW, CP, EvAaLIT, EvAaLSW, EvAaLSWIT and TaTpTsMOHG) mapped in association with the Narbung land system is representative of the PEC. Although, these vegetation units do not closely resemble the land system description.

Currently there is limited information available on the Narbung LS PEC and its occurrence in the Pilbara. The ecological communities database search identified one occurrence of the PEC

in association with an extent of the Narbung land system outside of the Study Area. The more extensive extent of the Narbung land system (which partially occurs in the Study Area) has not been mapped as the Narbung LS PEC. Further advice was sought the DBCA, which indicated that the entire land system extent is the PEC, although the DBCA have not mapped all occurrences in their TEC and PEC datasets.

In determining the local significance of the vegetation unit, the precautionary principle (EPA, 2016b) has been applied. Assuming that vegetation unit AxTOS is consistent with the PEC, it has been ranked as having a moderate local significance. In addition, a population of *Goodenia nuda* (P4) was recorded from the vegetation unit. If vegetation unit AxTOS is not consistent with the PEC, then the local significance of the vegetation unit is ranked as low due to the population of *Goodenia nuda* (P4).

The remaining eight vegetation units (AaAfLIT. AaLIT, AaLW, CP, EvAaLIT, EvAaLSW, EvAaLSWIT and TaTpTsMOHG) mapped in association with the Narbung land system were ranked as having a low local significance. The lower ranking relates to the vegetation units not closely resembling the land system description. In particular hummock grasses were dominant within vegetation unit TaTpTsMOHG and AaLIT, which is quite different to the land system description.

As discussed in Section 4.9.2, 11 of the 13 vegetation units described and delineated from the Study Area are considered to be locally significant. The 11 vegetation units occur in association with the Narbung LS PEC, support priority listed flora, phreatophytic and potential phreatophytic flora, occur in association with a major drainage line, potential sheet flow dependent landscape and/ or represent restricted landforms (claypans).

Vegetation unit TaTpTsMOHG was ranked as having a high local significance. The vegetation unit supports a population of *Eremophila pilosa*, which is a restricted Priority 1 listed species. Exact population extents of *Eremophila pilosa* was not achievable during the Survey due to the uncertainty of the entity. In addition, the vegetation unit was broadly described across the Study Area. *Eremophila pilosa* was recorded from sandier soil dominated by *Triodia pungens* and *Triodia schinzii* with isolated *Eucalyptus gamophylla* low mallee trees over isolated *Acacia sclerosperma* subsp. *sclerosperma*, *Acacia ancistrocarpa* and *Stylobasium spathulatum* mid shrubs. Further refinement of the vegetation unit with the aid of additional sampling would likely delineate a discrete vegetation unit in association with the *Eremophila pilosa* population. Ecoscape (2012) recorded *Eremophila pilosa* to the south (approximately 6 km) of the Study Area, although the individuals were recorded amongst a vegetation community described as a *Triodia basedowii, Triodia longiceps* and *Paraneurachne muelleri* mid low open hummock grassland/ low sparse tussock grassland.

Vegetation unit EcoMIT was ranked as having a moderate local significance. The vegetation unit occurs along the incised channels of Fortescue River and supports phreatophytic flora, namely *Eucalyptus camaldulensis* subsp. *obtusa*, as well as other potential phreatophytic flora including *Eucalyptus victrix* and *Atalaya hemiglauca*. The Fortescue River is one the major river

systems in the Pilbara and has extensive floodplains, including within the Study Area. The vegetation along Fortescue River has been heavily degraded by cattle grazing, trampling and pastoralism, this includes the adjacent floodplain within the Study Area. The condition of the vegetation was noted as being completely degraded with minimal to non-existent native understorey. As a result, the local significance was downgraded from high to moderate. The vegetation occurring upstream along the incised channel of the Fortescue River is likely to be similar in composition and structure as the Study Area.

The remainder of the eight vegetation units (AaAfLIT, AaLIT, AaLW, CP, EvAaLIT, EvAaLSW, EvAaLSWIT and EvLIT) were ranked as a having a low local significance. The remainder of the vegetation units either support:

- Priority 4 flora species *Eremophila youngii* subsp. *lepidota* and/ or *Goodenia nuda*, which are widespread in the Fortescue subregion;
- Potential phreatophytic flora species *Eucalyptus victrix*, which may utilise groundwater when available;
- Associated with unique/ unusual and restricted landforms (claypans either bare or vegetated) in the Fortescue subregion;
- Associated with groved Mulga that may or may not depend on sheet flow across the landscape; and
- Occur in association with the mapped Narbung LS PEC across the Study Area.

5.3 Groundwater Dependent Ecosystems

Groundwater Dependent Ecosystems (GDEs) and their associated vegetation is dependent on the presence of groundwater to meet some, or all, of their water requirements, either through surface expression or subsurface presence of groundwater (Hatton & Evans, 1998). GDV species that utilise groundwater are referred to as phreatophytes, and they may be classified as either obligate or facultative phreatophytes depending on their level of dependence on groundwater (Eamus *et al.*, 2006).

Obligate phreatophytes are plants that are highly dependent on groundwater. This dependence can be continual, seasonal or episodic. Obligate phreatophytes tend to be associated with surface expressions of groundwater rather than the subsurface presence of groundwater (i.e. *Melaleuca argentea*) (adapted from Astron, 2015).

Facultative phreatophytes are plants that can access groundwater but are not totally reliant on groundwater to sustain their water requirement. Rather, they utilise groundwater opportunistically, particularly during times of drought when moisture reserves in the vadose (unsaturated) zone of the soil profile become depleted. Facultative phreatophytes are generally associated with the subsurface presence of groundwater rather than surface water. Most facultative phreatophytes are large woody trees and shrubs with deep root systems capable of accessing the capillary fringe of the water table, which may occur at considerable depth within the profile (i.e. *Eucalyptus camaldulensis*) (adapted from Astron, 2015; Kath *et al.*, 2014; Thomas, 2014).

Review of the GDE Atlas (BoM, 2012) indicates that the portion of Fortescue River within the Study Area has a high potential for GDE. Review of the vegetation units and floristic assemblage indicates that the Fortescue River is considered to be a GDE due to the presence of the facultative phreatophyte *Eucalyptus camaldulensis* subsp. *obtusa* (vegetation unit EcoMIT). In addition, the vadophyte, *Eucalyptus victrix* is present along the incised channels of Fortescue River and across the floodplains (EvLIT). In addition, *Eucalyptus victrix* was recorded across the Study Area on the outer edges of vegetated and non-vegetated claypans, alluvial washplains and mulga groves (vegetation units AaLW, CP, EvAaLSW and EvAaLSWIT).

In addition to the presence of phreatophytic species *Eucalyptus camaldulensis* subsp. *obtusa* and *Eucalyptus victrix*, several other taxa are considered to be phreatophytic or potentially phreatophytic taxa (adapted from Loomes, 2010), including:

- *Atalaya hemiglauca.*
- *Acacia coriacea* subsp. *pendens*; and
- *Melaleuca glomerata*.

These phreatophytic and potential phreatophytic species were generally recorded in association with vegetation units that have already been identified as GDEs, or potential GDEs (for example EcoMIT and EvLIT).

5.4 Sheet Flow Dependent Ecosystems

Mulga is a large, variable and taxonomically complex group of plants allied to *Acacia aneura* that dominate significant areas of the vast Australian arid zone (Maslin *et al.*, 2012). The term Mulga is also used to describe vegetation communities in which these species predominate (Maslin *et al.*, 2012). A recent revision of the Mulga group (*Acacia aneura* and its close relatives) classified 12 separate entities, excluding informal variants, putative hybrids and intergrades (Maslin & Reid, 2012). The structure and patterning of mulga communities varies from strongly banded (groved) through to open shrublands and woodlands across the landscape (Page & Grierson, 2012). The bandings act as a sink for nutrients and water to infiltrate the soil and are readily available for uptake by the flora located within the banding. This banding and overland sheet flow supports a diverse biota within the Mulga bands and plays and important ecological function which is well documented (Dawson & Ahern, 1973; Saco *et al.*, 2007; Winkworth, 1973).

Four of the six land systems that occur within the Study Area, Fan, Narbung, Turee and Warri, are subjected to sheet flow (van Vreeswyk *et al.*, 2004). The Fan land system is a level washplain subject to overland sheet flow, with numerous drainage foci (groves of dense vegetation) arranged as arcuate bands transverse to the direction of the sheet flow (van Vreeswyk *et al.*, 2004). The Narbung land system is an almost level alluvial plain receiving overland sheet flow, with internal drainage zones, with prominent drainage foci, groves and small claypans (van Vreeswyk *et al.*, 2004). The Turee land system is a level plain mosaic of surfaces that are subject to sheet flow (van Vreeswyk *et al.*, 2004). The Warri land system has numerous hardpan plains that are subject to sheet flow (van Vreeswyk *et al.*, 2004).

Mulga (represented by *Acacia aptaneura, Acacia fuscaneura* and *Acacia paraneura*) dominated communities or communities with Mulga species present, were mapped within the Fan, Narbung, Turee and Warri land systems. The Mulga communities mapped within the Study Area did not display the prominent banding (Plate 5.1) seen in adjacent surrounds (for example, Maia, 2018). The Mulga communities was groved in areas of the Fan, Narbung, Turee and Warri land systems (Plate 5.1).

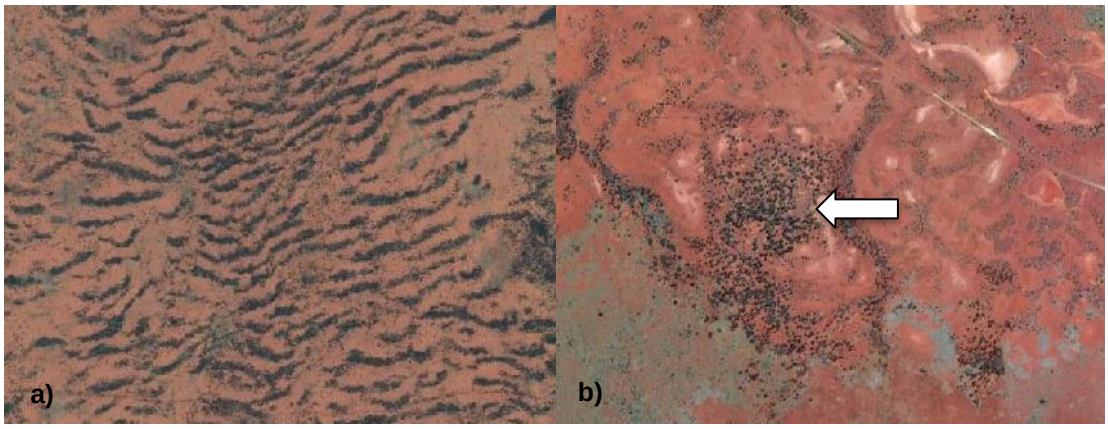

Plate 5.1: a) prominent mulga banding, observed south of the Study Area and b) mulga grove (arrow) observed within the Study Area

6 Conclusions

A reconnaissance flora and vegetation survey was completed over six days across the Study Area, with all the major vegetation units visited and sampled. A total of 53 sample sites, including 46 relevés and seven mapping points, were sampled to record the broad vegetation communities and their condition, as well as collecting an inventory of flora species present. A portion of the Study Area (4,265.73 ha) was included after the completion of the field survey component. As such, this additional area was not ground-truthed, and the mapping of vegetation units was extrapolated based on the vegetation unit mapping located to the north of the additional area.

The reconnaissance survey recorded:

- 199 vascular flora taxa from 38 families and 94 genera, including 188 native species and 11 introduced taxa;
- Three priority listed taxa:
    - *Eremophila pilosa* (P1);
    - *Eremophila youngii* subsp. *lepidota* (P4);
    - *Goodenia nuda* (P4);
- No WoNS or declared plant pests were recorded from the Study Area;
- 13 vegetation units and two mapping units (altered landscapes, including roads and cleared areas) were described and delineated from the Study Area;
- No TECs were recorded from the Study Area;
- One PEC, Narbung LS, occurs across 24% of the Study Area, and has been mapped in association with nine vegetation units. However, vegetation unit AxTOS most closely resembles the land system description;
- Two vegetation units, AxTOS and TaTpTsMOHG, are considered to be regionally significant. Vegetation unit AxTOS most closely resembles the Narbung LS PEC which is restricted in occurrence, while vegetation unit TaTpTsMOHG supports a restricted Priority 1 taxon, *Eremophila pilosa;*
- 11 vegetation units are considered to be locally significant for:
    - Occurring in association with a Priority 3 Ecological Community, Narbung LS;
    - Supporting priority listed flora;
    - Groundwater Dependent Vegetation (GDV);
    - Associated with a major drainage line;
    - Associated with locally restricted claypans;
    - Sheet flow dependent Mulga communities; and
- The vegetation condition ranged from Excellent to Completely Degraded, with the majority considered to be Very Good.

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8 Appendices

Appendix A: Conservation listings

Fauna and flora may be accorded legislative protection by being listed under the *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth) (EPBC Act) and/or the *Wildlife Conservation Act 1950* (State) (WC Act), or by being listed on the WA Department of Biodiversity, Conservation and Attractions: Parks and Wildlife Services' Priority Species List. This Appendix presents a summary of the different rankings and listings used to describe conservation status. Some categories, such as 'extinct', 'extinct in the wild' and 'conservation dependent' (EPBC Act) are not presented here, as the table includes only the information needed to fully understand the codes presented in the preceding report. Refer to the relevant legislation for a full description of all codes in use, as well as their associated criteria.

Status	Code	Description
Categories used under the EPBC Act		
Critically Endangered	Cr	Taxa that is considered to be facing an extremely high risk of extinction in the wild in the immediate future
Endangered	En	Taxa that is considered to be facing a very high risk of extinction in the wild in the near future
Vulnerable	Vu	Taxa that is considered to be facing a high risk of extinction in the wild in the medium-term future
Migratory	Mi	Fauna that migrate to, over and within Australia and its external territories.
Schedules used under the WC Act		
Critically Endangered	Schedule 1	Taxa that is rare or likely to become extinct, as critically endangered fauna
Endangered	Schedule 2	Taxa that is rare or likely to become extinct, as endangered fauna
Vulnerable	Schedule 3	Taxa that is rare or likely to become extinct, as vulnerable fauna
Presumed Extinct	Schedule 4	Taxa that is presumed to be extinct
Migratory	Schedule 5	Birds that are subject to international agreements relating to the protection of migratory birds
Parks and Wildlife Services Priority flora and fauna lists		
Priority 1	P1	Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey
Priority 2	P2	Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey

Status	Code	Description
Priority 3	P3	Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey
Priority 4	P4	(a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These species are usually represented on conservation lands. (b) Near Threatened. Species that are considered to have been adequately surveyed and that are close to qualifying for Vulnerable, but are not listed as Conservation Dependent. (c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy
Priority 5	P5	Taxa in need of monitoring. These are not considered threatened but are subject to a specific conservation programme, the cessation of which would result in the species becoming threatened within five years.

Status	Code	Description
Threatened Ecological Communities: TECs are indirectly protected under the Western Australian *Environmental Protection Act 1986* and the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*.		
Presumed Totally Destroyed	PD	An ecological community that has been adequately searched for but for which no representative occurrences have been located. The community has been found to be totally destroyed or so extensively modified throughout its range that no occurrence of it is likely to recover its species composition and/or structure in the foreseeable future. An ecological community will be listed as presumed totally destroyed if there are no recent records of the community being extant and either of the following applies (A or B): a) Records within the last 50 years have not been confirmed despite thorough searches of known or likely habitats; or b) All occurrences recorded within the last 50 years have since been destroyed.

Status	Code	Description
Critically Endangered	Cr	An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or that was originally of limited distribution and is facing severe modification or destruction throughout its range in the immediate future, or is already severely degraded throughout its range but capable of being substantially restored or rehabilitated. An ecological community will be listed as Critically Endangered when it has been adequately surveyed and is found to be facing an extremely high risk of total destruction in the immediate future. This will be determined on the basis of the best available information, by it meeting any one or more of the following criteria (a, b or c): a. The estimated geographic range, and/or total area occupied, and/or number of discrete occurrences since European settlement have been reduced by at least 90% and either or both of the following apply (i or ii): i) geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is imminent (within approximately 10 years); ii) modification throughout its range is continuing such that in the immediate future (within approximately 10 years) the community is unlikely to be capable of being substantially rehabilitated. b. Current distribution is limited, and one or more of the following apply (i, ii or iii): i. geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the immediate future (within approximately 10 years); ii. there are very few occurrences, each of which is small and/or isolated and extremely Vulnerable to known threatening processes; iii. there may be many occurrences but total area is very small and each occurrence is small and/or isolated and extremely Vulnerable to known threatening processes. c. The ecological community exists only as highly modified occurrences that may be capable of being rehabilitated if such work begins in the immediate future (within approximately 10 years).

Status	Code	Description
Endangered	En	An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or was originally of limited distribution and is in danger of significant modification throughout its range or severe modification or destruction over most of its range in the near future. An ecological community will be listed as Endangered when it has been adequately surveyed and is not Critically Endangered but is facing a very high risk of total destruction in the near future. This will be determined on the basis of the best available information by it meeting any one or more of the following criteria (a, b, or c): a. The geographic range, and/or total area occupied, and/or number of discrete occurrences have been reduced by at least 70% since European settlement and either or both of the following apply (i or ii): i. the estimated geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is likely in the short term future (within approximately 20 years); ii. modification throughout its range is continuing such that in the short term future (within approximately 20 years) the community is unlikely to be capable of being substantially restored or rehabilitated. b. Current distribution is limited, and one or more of the following apply (i, ii or iii): i. geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the short term future (within approximately 20 years); ii. there are few occurrences, each of which is small and/or isolated and all or most occurrences are very Vulnerable to known threatening processes; iii. there may be many occurrences but total area is small and all or most occurrences are small and/or isolated and very Vulnerable to known threatening processes. c. The ecological community exists only as very modified occurrences that may be capable of being substantially restored or rehabilitated if such work begins in the short-term future (within approximately 20 years).

Status	Code	Description
Vulnerable	Vu	An ecological community that has been adequately surveyed and is found to be declining and/or has declined in distribution and/or condition and whose ultimate security has not yet been assured and/or a community that is still widespread but is believed likely to move into a category of higher threat in the near future if threatening processes continue or begin operating throughout its range. An ecological community will be listed as Vulnerable when it has been adequately surveyed and is not Critically Endangered or Endangered but is facing a high risk of total destruction or significant modification in the medium to long-term future. This will be determined on the basis of the best available information by it meeting any one or more of the following criteria (a, b or c): a. The ecological community exists largely as modified occurrences that are likely to be capable of being substantially restored or rehabilitated. b. The ecological community may already be modified and would be Vulnerable to threatening processes, is restricted in area and/or range and/or is only found at a few locations. c. The ecological community may be still widespread but is believed likely to move into a category of higher threat in the medium to long term future because of existing or impending threatening processes.
Priority One	P1	Poorly-known ecological communities. Ecological communities that are known from very few occurrences with a very restricted distribution (generally =5 occurrences or a total area of = 100ha). Occurrences are believed to be under threat either due to limited extent, or being on lands under immediate threat (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) or for which current threats exist. May include communities with occurrences on protected lands. Communities may be included if they are comparatively well-known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range.
Priority Two	P2	Poorly-known ecological communities. Communities that are known from few occurrences with a restricted distribution (generally =10 occurrences or a total area of =200ha). At least some occurrences are not believed to be under immediate threat of destruction or degradation. Communities may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under threat from known threatening processes.
Priority Three	P3	Communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation or communities known from a few widespread occurrences, which are either large or with significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat, or communities made up of large, and/or widespread occurrences, that may or may not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, and inappropriate fire regimes. Communities may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and/or are not well defined, and known threatening processes exist that could affect them.

Status	Code	Description
Priority Four	P4	Rare or Near Threatened Ecological Communities or Ecological communities that have been removed from the list of threatened communities during the past five years. These communities require regular monitoring. **Rare:** Ecological communities known from few occurrences that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These communities are usually represented on conservation lands. **Near Threatened:** Ecological communities that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable.
Priority Five	P5	Conservation dependant ecological communities. Ecological communities that are not threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming threatened within five years.

Appendix B: Flora relevé data

Site	Date	Site Type	Soil	Rock Type	Vegetation	Vegetation Condition	Fire Age (yrs)	Landform	Water presence	Rock (%)	Bare soil (%)	Litter (%)	Perennial ground cover (%)	Photo
E1R	13/07/2018	Relevé	Clay loam	None discernible	*Eucalyptus victrix* low isolated trees to sparse woodland over **Vachellia farnesiana* mid to tall isolated shrubs over isolated herbs, tussock grasses and sedges	Completely Degraded	>10	Drainage Line	Intermittently inundated	0	90	5	5	
E3	12/07/2018	Relevé	Clay loam	None discernible	*Eucalyptus camaldulensis* subsp. *obtusa* low to mid isolated to sparse woodland over *Eucalyptus victrix* (further from water's edge) low sparse woodland over **Vachellia farnesiana* mid to tall isolated to sparse shrubland over weed dominated understorey	Completely Degraded	>10	Drainage Line	Permanently inundated	0	85	5	10	
E4	12/07/2018	Relevé	Light clay	Calcrete	*Eucalyptus victrix* and *Acacia aptaneura* low open woodland over *Acacia sclerosperma* subsp. *sclerosperma* isolated tall to mid trees over **Malvastrum americanum* isolated low herbs	Degraded	>10	floodplain	Seasonally waterlogged	2	73	15	10	
E5	11/07/2018	Relevé	Clay loam	None discernible	*Eucalyptus victrix* and *Acacia aptaneura* low sparse woodland over *Acacia pyrifolia* var. *pyrifolia, Senna glutinosa* subsp. x *luerssenii* and *Acacia* ? *sibirica* tall to mid sparse shrubland over *Triodia angusta* mid hummock grassland	Very Good	>10	Flat	Intermittently waterlogged	0	40	5	55	
E6	14/07/2018	Relevé	Clay loam	Calcrete	*Eucalyptus victrix* low isolated trees over *Petalostylis labicheoides* mid to tall isolated shrubs over *Triodia angusta* mid open hummock grassland	Very Good	<1, 1 to 3	Rise	Dry	45	35	10	10	
HS01	10/07/2018	Relevé	Sandy loam	None discernible	*Hakea lorea* subsp. *lorea* isolated mid shrubs over *Triodia pungens* low open hummock grassland with fire ephemerals and opportunists dominated by Malvaceae family.	Excellent	1 to 3	Flat	Dry	0	40	5	55	

Site	Date	Site Type	Soil	Rock Type	Vegetation	Vegetation Condition	Fire Age (yrs)	Landform	Water presence	Rock (%)	Bare soil (%)	Litter (%)	Perennial ground cover (%)	Photo
HS02	10/07/2018	Relevé	Clay loam	None discernible	*Eucalyptus victrix* mid to low isolated trees over *Acacia aptaneura* low open woodland over *Hakea lorea* subsp. *lorea*, *Acacia sclerosperma* subsp. *sclerosperma* and *Acacia sericophylla* tall sparse shrubland over herbs and grasses	Poor	>10	floodplain	Intermittently waterlogged	0	60	20	20	
HS03	12/07/2018	Relevé	Clay loam	Calcrete	*Eucalyptus victrix* and *Acacia aptaneura* low sparse woodland over *Acacia sclerosperma* subsp. *sclerosperma* mid to tall isolated shrubs over **Cenchrus ciliaris* and **Malvastrum americanum* dominated groundcover.	Degraded	>10	floodplain	Intermittently waterlogged	1	75	6	15	
HS04	12/07/2018	Relevé	Sandy loam	Ironstone	**Vachellia farnesiana* isolated patches of mid to tall shrubs over isolated patches of tussock grasses consisting of *Dactyloctenium radulans, Eriachne xerophila* and **Cenchrus ciliaris*.	Poor	>10	Flat	Intermittently waterlogged	75	5	15	5	
HS05	11/07/2018	Relevé	Sand	Quartzite	*Acacia* ? *fuscaneura* low isolated trees over *Acacia synchronicia, Acacia sclerosperma* subsp. *sclerosperma* and *Eremophila cuneifolia* tall to mid sparse shrubland over *Triodia angusta* mid to low open hummock grassland	Excellent	>10	Flat	Dry	1	65	4	30	
HS07	13/07/2018	Relevé	Sand	None discernible	*Eucalyptus gamophylla* low isolated shrubs over *Acacia sclerosperma* subsp. *sclerosperma, Acacia ancistrocarpa* and *Stylobasium spathulatum* mid sparse shrubland to isolated shrubs over *Triodia pungens* and *Triodia schinzii* low to mid open hummock grassland	Excellent	>10	Flat	Dry	0	65	5	30	
HS08	12/07/2018	Relevé	Clay loam	None discernible	*Acacia sclerosperma* subsp. *sclerosperma* and *Acacia synchronicia* mid to tall sparse shrubland over *Triodia pungens* mid hummock grassland	Excellent	>10	Flat	Dry	0	45	5	50	

Site	Date	Site Type	Soil	Rock Type	Vegetation	Vegetation Condition	Fire Age (yrs)	Landform	Water presence	Rock (%)	Bare soil (%)	Litter (%)	Perennial ground cover (%)	Photo
HS10	12/07/2018	Relevé	Sandy loam	Ironstone, Quartzite	*Acacia* ? *aptaneura* isolated low trees over *Acacia synchronicia* and *Acacia sclerosperma* subsp. *sclerosperma* mid to tall sparse shrubland over isolated chenopod shrubs dominated by *Sclerolaena* species	Good	>10	Flat	Dry	70	5	5	20	
HS11	10/07/2018	Relevé	Sandy loam	None discernible	*Acacia xiphophylla* low sparse woodland over *Acacia synchronicia, Senna* sp. Meekatharra (E. Bailey 1-26) and *Eremophila cuneifolia* mid to low isolated shrubs over isolated tussock grasses and herbs.	Very Good	>10	Flat	Dry	0	75	5	20	
HS13	10/07/2018	Relevé	Sandy loam	None discernible	*Acacia aptaneura* low sparse to isolated woodland over *Eremophila youngii* subsp. *lepidota* and *Acacia tetragonophylla* mid to tall isolated shrubs over *Triodia angusta* mid hummock grassland	Very Good	>10	Flat	Intermittently waterlogged	0	50	5	45	
HS14	11/07/2018	Relevé	Clay loam	None discernible	*Acacia ? fuscaneura* low isolated woodland over *Acacia synchronicia, Eremophila cuneifolia* and *Senna* sp. Meekatharra (E. Bailey 1-26) tall to mid sparse shrubland over *Triodia pungens* and *Triodia angusta* mid isolated patches of hummock grasses	Good	>10	Flat	Intermittently waterlogged	0	50	20	30	
HS15	12/07/2018	Relevé	Sandy loam	Calcrete, Ironstone	*Acacia aptaneura* low sparse woodland to isolated patches of trees over *Acacia tetragonophylla, Acacia sclerosperma* subsp. *sclerosperma* and *Acacia synchronicia* mid to tall isolated shrubs over **Cenchrus ciliaris* and **Cenchrus setiger* low open to sparse tussock grassland	Degraded	>10	Flat	Dry	75	5	5	15	
HS16	12/07/2018	Relevé	Clay loam	Calcrete, Ironstone	*Eucalyptus victrix* low isolated trees over *Acacia synchronicia* and **Vachellia farnesiana* mid to tall sparse shrubland over **Cenchrus ciliaris* low sparse tussock grassland.	Poor	>10	floodplain	Intermittently waterlogged	2	50	33	15	

Site	Date	Site Type	Soil	Rock Type	Vegetation	Vegetation Condition	Fire Age (yrs)	Landform	Water presence	Rock (%)	Bare soil (%)	Litter (%)	Perennial ground cover (%)	Photo
RH01	10/07/2018	Relevé	Sand	None discernible	*Acacia aptaneura* isolated patches of low trees over *Triodia angusta* and *Triodia pungens* mid hummock grassland	Excellent	>10	small dune	Dry	0	50	10	40	
RH02	10/07/2018	Relevé	Sandy loam	Ironstone, Quartz, Quartzite	*Acacia xiphophylla* low open woodland over *Senna* sp. Meekatharra (E. Bailey 1-26) low sparse shrubland over isolated tussock grasses and herbs	Very Good	>10	Flat	Dry	15	65	5	15	
RH03	10/07/2018	Relevé	Clay loam	None discernible	*Eucalyptus victrix* and *Acacia aptaneura* low sparse woodland over *Eremophila longifolia, Acacia tetragonophylla* and over *Eriachne* spp. low tussock grassland	Very Good	>10	Depression	Intermittently waterlogged	0	15	35	50	
RH04	10/07/2018	Relevé	Clay loam	None discernible	*Acacia aptaneura* isolated patches of low trees over *Eremophila youngii* subsp. *lepidota* mid isolated shrubs over *Triodia angusta* mid open hummock grassland	Excellent	>10	Flat	Dry	1	65	5	30	
RH05	11/07/2018	Relevé	Clay loam	Calcrete	*Eucalyptus victrix* and *Acacia aptaneura* low sparse woodland over *Acacia sclerosperma* subsp. *sclerosperma*, *Eremophila youngii* subsp. *lepidota* and *Acacia synchronicia* tall to mid sparse shrubland over *Triodia angusta* mid sparse hummock grassland.	Very Good	>10	Flat	Intermittently inundated	5	65	5	25	
RH06	11/07/2018	Relevé	Clay loam	Quartz	*Acacia ? aptaneura* low isolated trees over *Eremophila youngii* subsp. *lepidota* and *Eremophila cuneifolia* mid to tall sparse shrubland over *Triodia pungens* low to mid sparse hummock grassland	Very Good	>10	Flat	Dry	1	80	4	15	

Site	Date	Site Type	Soil	Rock Type	Vegetation	Vegetation Condition	Fire Age (yrs)	Landform	Water presence	Rock (%)	Bare soil (%)	Litter (%)	Perennial ground cover (%)	Photo
RH07	11/07/2018	Mapping Note	Clay loam	None discernible	*Acacia aptaneura* low woodland with isolated *Eucalyptus victrix* over *Senna notabilis* low open shrubland over sparse tussock grassland	Good	1 to 3	Flat	Intermittently waterlogged	0	40	10	50	
RH08	11/07/2018	Relevé	Clay loam	None discernible	*Eucalyptus gamophylla, Acacia pruinocarpa* and *Acacia aptaneura* low sparse woodland over *Acacia sclerosperma* subsp. *sclerosperma* mid to tall isolated shrubs over *Triodia pungens* low open hummock grassland	Very Good	>10	floodplain	Intermittently waterlogged	0	70	5	25	
RH09	11/07/2018	Relevé	Sandy loam	Ironstone, Quartzite	*Triodia angusta* mid hummock grassland with isolated shrubs	Excellent	>10	Flat	Dry	2	60	8	30	
RH09a	11/07/2018	Relevé	Sandy loam	None discernible	*Eucalyptus victrix* low sparse woodland over *Chrysopogon fallax* and *Eulalia aurea* mid sparse tussock grassland	Very Good	1 to 3	Depression	Intermittently waterlogged	0	85	0	15	
RH10	11/07/2018	Relevé	Sandy loam	Ironstone, Quartz	*Acacia xiphophylla* tall open shrubland over isolated chenopod shrubs	Excellent	>10	Flat	Dry	1	90	1	8	
RH11	12/07/2018	Relevé	Clay loam	Calcrete	*Acacia* ? *aptaneura* and *Acacia tetragonophylla* tall isolated to sparse shrubland over *Eremophila forrestii* subsp. *forrestii* and *Solanum lasiophyllum* low to mid isolated to sparse shrubland over *Eragrostis* ? *eriopoda* and *Enneapogon caerulescens* low isolated tussock grasses	Good	>10	rise	Dry	75	0	5	20	

Site	Date	Site Type	Soil	Rock Type	Vegetation	Vegetation Condition	Fire Age (yrs)	Landform	Water presence	Rock (%)	Bare soil (%)	Litter (%)	Perennial ground cover (%)	Photo
RH12	12/07/2018	Relevé	Light clay	None discernible	*Eucalyptus camaldulensis* subsp. *obtusa* mid sparse woodland over surface water and degraded banks of the Fortescue River	Completely Degraded	>10	Drainage Line	Permanently inundated	0	95	0	5	
RH13	12/07/2018	Relevé	Sandy loam	Ironstone	*Acacia synchronicia* and **Vachellia farnesiana* mid to tall isolated shrubs over *Eriachne xerophila* and **Cenchrus ciliaris* isolated patches of low tussock grasses	Poor	>10	Flat	Dry	50	5	15	30	
RH14	12/07/2018	Mapping Note	Sandy loam	Ironstone	Bare open stony area with isolated patches of *Acacia synchronicia* and **Vachellia farnesiana* over isolated patches of chenopod shrubs, herbs and tussock grasses	Good	>10	Flat	Dry	100	0	0	0	
RH15	12/07/2018	Relevé	Light clay	None discernible	*Eucalyptus victrix* and *Atalaya hemiglauca* low sparse woodland with occasional *Eucalyptus camaldulensis* subsp. *obtusa* mid trees over **Vachellia farnesiana* mid to tall isolated shrubs over herbs and tussock grasses	Completely Degraded	>10	Drainage Line	Permanently inundated	0	85	5	10	
RH16	12/07/2018	Relevé	Sandy loam	Ironstone, Quartz	*Acacia synchronicia* tall to mid sparse shrubland over *Eriachne xerophila* isolated patches of low tussock grasses	Good	>10	Flat	Dry	80	5	5	10	
RH17	12/07/2018	Relevé	Light clay	None discernible	*Sesbania cannabina* isolated mid shrubs over *Diplachne fusca* subsp. *fusca* mid sparse tussock grassland	Very Good	>10	Wetland	Intermittently inundated	0	95	0	5	

Site	Date	Site Type	Soil	Rock Type	Vegetation	Vegetation Condition	Fire Age (yrs)	Landform	Water presence	Rock (%)	Bare soil (%)	Litter (%)	Perennial ground cover (%)	Photo
RH18	13/07/2018	Relevé	Clay loam	None discernible	*Acacia* ? *aptaneura* low woodland over *Psydrax latifolia* mid to tall isolated shrubs over isolated tussock grasses dominated by *Aristida contorta*	Very Good	>10	Flat	Intermittently waterlogged	0	50	30	20	
RH19	13/07/2018	Mapping Note	Sandy loam	Ironstone	*Triodia angusta* mid hummock grassland with isolated patches of *Acacia synchronicia* and *Acacia sclerosperma* subsp. *sclerosperma* mid to tall shrubs	Excellent	>10	Flat	Dry	20	40	10	30	
RH20	13/07/2018	Relevé	Sand	None discernible	*Acacia sclerosperma* subsp. *sclerosperma* and *Acacia synchronicia* mid to tall sparse shrubland over *Triodia pungens* mid hummock grassland	Very Good	>10	Flat	Dry	0	60	10	30	
RH21	13/07/2018	Relevé	Clay loam	None discernible	*Eucalyptus victrix* and *Acacia* ? *aptaneura* low sparse woodland over *Eremophila youngii* subsp. *lepidota* tall sparse shrubland over isolated patches of **Malvastrum americanum*.	Very Good	>10	floodplain	Intermittently waterlogged	0	70	5	25	
RH22	13/07/2018	Relevé	Clay loam	Calcrete	Low isolated trees over *Acacia sclerosperma* subsp. *sclerosperma* and *Senna glutinosa* subsp. *glutinosa* mid to tall isolated shrubs over *Triodia angusta* mid hummock grassland	Excellent	>10	calcrete rise	Dry	60	0	10	30	
RH23	13/07/2018	Relevé	Clay loam	Calcrete	*Eucalyptus victrix* low isolated trees to sparse woodland over **Malvastrum americanum* low isolated herbs	Completely Degraded	>10	floodplain	Intermittently waterlogged	1	90	4	5	

Site	Date	Site Type	Soil	Rock Type	Vegetation	Vegetation Condition	Fire Age (yrs)	Landform	Water presence	Rock (%)	Bare soil (%)	Litter (%)	Perennial ground cover (%)	Photo
RH24	13/07/2018	Relevé	Light clay	None discernible	*Eucalyptus camaldulensis* subsp. *obtusa* mid isolated trees over *Eucalyptus victrix* and *Acacia coriacea* subsp. *pendens* low isolated trees over **Vachellia farnesiana* mid to tall isolated shrubs	Completely Degraded	>10	Drainage Line	Permanently inundated	0	90	4	6	
RH25	13/07/2018	Relevé	Clay loam	Calcrete	*Eucalyptus victrix, Acacia coriacea* subsp. *pendens* and *Acacia aptaneura* low sparse woodland over *Acacia tetragonophylla, Acacia sclerosperma* subsp. *sclerosperma* and *Eremophila forrestii* subsp. *forrestii* mid to tall isolated shrubs over **Malvastrum americanum* low isolated herbs.	Good	>10	floodplain	Intermittently waterlogged	0	40	40	20	
RH26	14/07/2018	Mapping Note	Light clay	None discernible	*Eucalyptus victrix* and *Acacia aptaneura* low isolated shrubs over *Eremophila youngii* subsp. *lepidota*, *Acacia tetragonophylla* and *Acacia sclerosperma* subsp. *sclerosperma* mid to tall isolated shrubs over *Triodia angusta* mid isolated hummock grasses on bank of bare clay pan.	Good	>10	Wetland	Intermittently inundated	0	80	5	15	
RH27	14/07/2018	Relevé	Clay loam	None discernible	*Acacia aptaneura* low isolated trees over *Acacia sclerosperma* subsp. *sclerosperma*, *Acacia tetragonophylla* and *Acacia aptaneura* mid to tall sparse shrubland over *Triodia angusta* mid sparse hummock grassland	Very Good	5 to 10	Flat	Intermittently waterlogged	0	40	15	45	
RH28	14/07/2018	Relevé	Sandy loam	None discernible	*Acacia xiphophylla* tall sparse shrubland over *Senna* sp. Meekatharra (E. Bailey 1-26) and *Sclerolaena cuneata* low to mid isolated shrubs over *Triodia angusta* isolated patches of mid to low hummock grasses	Very Good	>10	Flat	Dry	0	70	10	20	
RH29	14/07/2018	Relevé	Sandy loam	None discernible	*Triodia angusta* mid open hummock grassland with isolated patches of *Acacia synchronicia* mid shrubs	Very Good	>10	Flat	Dry	0	70	5	25	

Site	Date	Site Type	Soil	Rock Type	Vegetation	Vegetation Condition	Fire Age (yrs)	Landform	Water presence	Rock (%)	Bare soil (%)	Litter (%)	Perennial ground cover (%)	Photo
RH30	14/07/2018	Mapping Note	Sand	None discernible	*Triodia schinzii* low to mid open hummock grassland with isolated patches of *Acacia ancistrocarpa, Acacia pyrifolia* var. *pyrifolia* and *Stylobasium spathulatum*.	Very Good	1 to 3	Flat	Dry	0	60	20	20	
RH31	14/07/2018	Mapping Note	Sand	None discernible	*Triodia pungens* (with occasional *Triodia angusta*) low to mid open hummock grassland with isolated patches of *Acacia sclerosperma* subsp. *sclerosperma*, *Acacia pyrifolia* var. *pyrifolia* and *Stylobasium spathulatum* mid shrubs	Very Good	1 to 3	Flat	Dry	0	60	15	25	
RH32	14/07/2018	Relevé	Clay loam	None discernible	*Acacia xiphophylla* (and occasional *Acacia synchronicia*) tall sparse shrubland over *Senna* sp. Meekatharra (E. Bailey 1-26) low to mid isolated shrubs over *Triodia longiceps* mid isolated hummock grasses	Very Good	>10	Flat	Dry	0	65	10	25	
RH33	14/07/2018	Mapping Note	Light clay	None discernible	*Eriachne* sp. (? *benthamii*/ *flaccida*) low sparse tussock grassland with isolated low *Eucalyptus victrix* trees and isolated mid *Senna* sp. Meekatharra (E. Bailey 1-26) and *Acacia synchronicia* shrubs.	Very Good	>10	Depression	Intermittently waterlogged	0	75	5	20	
RH34	14/07/2018	Relevé	Clay loam	None discernible	*Eucalyptus victrix* and *Acacia aptaneura* low isolated trees to sparse woodland over *Acacia adsurgens, Acacia ancistrocarpa* and *Acacia sclerosperma* subsp. *sclerosperma* tall sparse shrubland over *Eulalia aurea* mid open tussock grassland	Very Good	>10	Wetland	Intermittently waterlogged	0	35	15	50	

Appendix C: Vegetation structure definition

NVIS Vegetation Structural Classifications

Cover Characteristics							
Foliage cover *	70-100	30-70	10-30	<10	≈0	0-5	unknown
Crown cover **	>80	50-80	20-50	0.25-20	<0.25	0-5	unknown
% Crown cover ***	>80	50-80	20-50	0.25-20	<0.25	0-5	unknown
Cover code	d	c	i	r	bi	bc	unknown

Growth Form	Height ranges (m)	Structural Formation Classes						
tree, palm	>30 Tall 10-30 Mid <10 Low	closed forest	open forest	woodland	open woodland	isolated trees	isolated clumps of trees	trees
tree mallee	10-30 Tall <10 Mid <3 Low	closed mallee forest	open mallee forest	mallee woodland	open mallee woodland	isolated mallee trees	isolated clumps of mallee trees	mallee trees
shrub, cycad, grass-tree, fern	>2 Tall 1-2 Mid <1 Low	closed shrubland	shrubland	open shrubland	sparse shrubland	isolated shrubs	isolated clumps of shrubs	shrubs
mallee shrub	10-30 Tall <10 Mid <3 Low	closed mallee shrubland	mallee shrubland	open mallee shrubland	sparse mallee shrubland	isolated mallee shrubs	isolated clumps of mallee shrubs	mallee shrubs
heath shrub	>2 Tall 1-2 Mid <1 Low	closed heathland	heathland	open heathland	sparse heathland	isolated heath shrubs	isolated clumps of heath shrubs	heath shrubs

Growth Form	Height ranges (m)	Structural Formation Classes						
chenopod shrub	>2 Tall 1-2 Mid <1 Low	closed chenopod shrubland	chenopod shrubland	open chenopod shrubland	sparse chenopod shrubland	isolated chenopod shrubs	isolated clumps of chenopod shrubs	chenopod shrubs
samphire shrub	>0.5 Low <0.5 Low	closed samphire shrubland	samphire shrubland	open samphire shrubland	sparse samphire shrubland	isolated samphire shrubs	isolated clumps of samphire shrubs	samphire shrubs
hummock grass	>2 Tall <2 Tall	closed hummock grassland	hummock grassland	open hummock grassland	sparse hummock grassland	isolated hummock grasses	isolated clumps of hummock grasses	hummock grasses
tussock grass	>0.5 Mid <0.5 Low	closed tussock grassland	tussock grassland	open tussock grassland	sparse tussock grassland	isolated tussock grasses	isolated clumps of tussock grasses	tussock grasses
other grass	>0.5 Mid <0.5 Low	closed grassland	grassland	open grassland	sparse grassland	isolated grasses	isolated clumps of grasses	other grasses
sedge	>0.5 Mid <0.5 Low	closed sedgeland	sedgeland	open sedgeland	sparse sedgeland	isolated sedges	isolated clumps of sedges	sedges
rush	>0.5 Mid <0.5 Low	closed rushland	rushland	open rushland	sparse rushland	isolated rushes	isolated clumps of rushes	rushes
forb	>0.5 Mid <0.5 Low	closed forbland	forbland	open forbland	sparse forbland	isolated forbs	isolated clumps of forbs	forbs

Growth Form	Height ranges (m)	Structural Formation Classes						
fern	>2 Tall	closed fernland	fernland	open fernland	sparse fernland	isolated ferns	isolated clumpsof ferns	ferns
	1-2 Tall							
	<1 Low							
bryophyte	<0.5	closed bryophyte land	bryophyte land	open bryophyte land	sparse bryophyte land	isolated bryophytes	isolated clumps of bryophytes	bryophytes
lichen	<0.5	closed lichenland	lichenland	open lichenland	sparse lichenland	isolated lichens	isolated clumps of lichens	lichens
vine	>30 Tall	closed vineland	vineland	open vineland	sparse vineland	isolated vines	isolated clumps of vines	vines
	10-30 Med							
	<10 Low							
aquatic	<1 Tall	closed aquatic bed	aquatic bed	open aquatic bed	sparse aquatics	isolated aquatics	isolated clumps of aquatics	aquatics
	0-0.5 Low							
seagrass	<1 Tall	closed seagrass bed	Seagrass bed	open seagrass bed	sparse seagrass bed	isolated seagrasses	isolated clumps of seagrasses	seagrasses
	0-0.5 Low							

From: NVIS Structural Formation Terminology (Australian Vegetation Attribute Manual Version 6.0 August 2003 http://www.environment.gov.au/erin/nvis/publications/avam/pubs/vegetation-attribute-manual-6.pdf)

* Foliage Cover is defined for each stratum as ‘the proportion of the ground, which would be shaded if sunshine came from directly overhead’. It includes branches and leaves and is similar to the Crown type of Walker and Hopkins (1990) but is applied to a stratum or plot rather than an individual crown. It is generally not directly measured in the field for the upper stratum, although it can be measured by various line interception methods for ground layer vegetation. For the attribute COVER CODE in the Stratum table, the ground cover category refers to ground foliage cover not percentage cover.

** Crown Cover (canopy cover) as per Walker and Hopkins (1990). Although relationships between the two are dependent on season, species, species age etc. (Walker & Hopkins, 1990), the crown cover category classes have been adopted as the defining measure.

*** The percentage cover is defined as the percentage of a strictly defined plot area, covered by vegetation. This can be an estimate and is a less precise measure than using, for example, a point intercept transect methods on ground layer, or overstorey vegetative cover. That is for precisely measured values (e.g. crown densitometer or point intercept transects) the value measured would be 'foliage' cover. Where less precise or qualitative measures are used these will most probably be recorded as 'percentage' cover.

Appendix D: Vegetation condition rating

Sourced from EPA (2016c)

Code	Description
E = Excellent	=Pristine of Bush Forever Pristine or nearly so; no obvious signs of damage caused by the activities of European man.
VG = Very Good	=Excellent of Bush Forever Some relatively slight 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 **Bidens bipinnata* or **Malvastrum americanum*, or occasional vehicle tracks.
G = Good	=Very Good of Bush Forever 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 **Cenchrus* spp.
P = Poor	= Good of Bush Forever 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 **Cenchrus* spp.
D = Degraded	= Degraded of Bush Forever Severely impacted by grazing, very frequent fires, clearing or a combination of these activities. Scope for some regeneration but not without intensive management. Usually with a number of weed species including very aggressive species.
D = Completely Degraded	Areas that are completely or almost completely without native species in the structure of their vegetation; i.e. areas that are cleared or 'parkland cleared' with their flora comprising weed or crop species with isolated native trees or shrubs.

Appendix E: Letter Report for Additional Area

Biologic Environmental Survey Pty Ltd
PO Box 179
Floreat, WA, 6014

21st September 2018

Attn: Ben Kraft & Vlad Rios-Vera

Roy Hill Iron Ore
5 Whitham Road
Perth Airport, WA, 6105

Dear Ben and Vlad,

Biologic Environmental Survey Pty Ltd (Biologic) was contacted by Roy Hill Iron Ore Pty Ltd (Roy Hill) on the 6th of September 2018 to include an additional Desktop Flora and Fauna Assessment of part of miscellaneous tenement L47/642 (hereafter referred to as the Study Area, Figure 1). Biologic have previously completed flora and fauna assessment reports for separate areas of Roy Hill tenure. These existing reports are to be updated to include the results of the additional desktop flora and fauna assessment of the Study Area.

Objective and Scope of Works

The overarching objective of the additional desktop flora and fauna assessment of miscellaneous tenement L47/642 was to map the vegetation units and fauna habitat types within the Study Area. The results of the mapping exercise will then be included with the existing flora and fauna assessment reports prepared by Biologic. The following scope of works was completed to meet the overarching objective:

- Review existing desktop assessment;
- Review existing vegetation unit mapping and fauna habitat type mapping within and/or adjacent to the Study Area;
- Complete extrapolation mapping of the Study Area to map the vegetation units and fauna habitat types; and
- Incorporate results of the extrapolation mapping into the existing flora and fauna assessments completed by Biologic.

Methodology

Desktop assessments have already been undertaken for the existing work completed by Biologic. These existing desktop assessments are deemed adequate and sufficient to cover the Study Area. As such, no additional database searches or literature reviews were completed. The existing desktop assessments were reviewed to assist in the extrapolation of vegetation units and fauna habitat types.

The key component of the additional work was the description and delineation of vegetation units and fauna habitat types within the Study Area. The mapping of vegetation units and fauna habitat types was extrapolated based on existing survey work completed within and adjacent to the Study Area.

Biologic and Maia Environmental Consultancy (Maia, 2018) have completed vegetation unit mapping immediately to the north and south, respectively, of the Study Area. The extrapolation and delineation of vegetation units within the Study Area utilised this existing work. The vegetation units will be delineated with the aid of aerial imagery and vegetation unit descriptions from Biologic and Maia (2018).

Biologic have completed fauna habitat mapping to the north and south of the Study Area, as well as a portion in the east of the Study Area. The extrapolation and delineation of fauna habitat types within the Study Area utilised this existing work. In addition, Biologic have completed five habitat assessments within the Study Area. The data collected from these habitat assessments assisted in the delineation of the fauna habitat types across the remainder of the Study Area.

Limitations

Tenement L47/642 was not ground-truthed during the most recent field surveys completed in July 2018. As a result, the describing and delineation of vegetation units within the Study Area has been extrapolated. The extrapolation utilised the vegetation unit description and delineation completed by Biologic within tenements E47/1326 and E46/586 and the flora and vegetation assessment completed by Maia (2018) for the Southern Borefield assessment (part tenements L47/642 and L47/735).

The extrapolation of vegetation units provides a broad understanding of vegetation and depending on the contextual information available (i.e. recent detailed surveys in close proximity, historical surveys and regional context like Land System mapping) is considered to vary in confidence from low to high. The extrapolation and description of the vegetation units utilised the existing mapping by Biologic located to the north. The more detailed survey work completed by Maia (2018) was not used as this survey is considered to be at a higher mapping intensity/ detail. In addition, Biologic did not complete this work, so we were reluctant to utilise this vegetation unit mapping. The confidence in the extrapolation may have been lower using the more detailed mapping completed by Maia (2018).

The extrapolation of the additional vegetation units within the Study Area is considered to be of moderate confidence. The vegetation unit delineation to the north, completed by Biologic, is broad so it suited the extrapolation exercise. It is likely that the broad extrapolation would be further refined with additional vegetation units delineated if a more detailed survey was completed.

Fauna habitat mapping completed by Biologic occurs within the central to eastern portion of the Study Area. The extrapolation of fauna habitats across the remainder of the Study Area utilised this existing mapping. The confidence in the accuracy of the extrapolation of the fauna habitat mapping is high due to the existing mapping and the previous sampling of habitats in 2017.

Results

Vegetation Unit Mapping

The extrapolation exercise mapped the occurrence of seven vegetation units and one mapping unit (Cleared and disturbed) (Table 1) within the Study Area. The dominant vegetation unit within the Study Area was mapped as AaLIT, followed by AaAfLIT (Table 1).

Table 1: Vegetation units extrapolated within the Study Area

Unit Code	Vegetation Unit Description	Extent in Study Area (ha)	Extent in Study Area (%)
AaAfLIT	*Acacia ? aptaneura* and/ or *Acacia ? fuscaneura* low isolated trees over *Acacia synchronicia*, *Acacia sclerosperma* subsp. *sclerosperma* and *Eremophila cuneifolia* mid to tall sparse shrubland over *Triodia angusta* and *Triodia pungens* mid sparse hummock grassland with pockets of bare areas dominated by tussock grasses and herbs.	1,136.2	27
AaLIT	*Acacia aptaneura* with occasional *Eucalyptus gamophylla* and *Acacia pruinocarpa* low isolated to isolated patches of trees over *Acacia sclerosperma* subsp. *sclerosperma* and other *Acacia* and *Eremophila* species mid to tall isolated shrubs over *Triodia angusta* and occasional *Triodia pungens* mid open hummock grassland.	2,462.5	58
AaLW	*Acacia aptaneura* with occasional *Eucalyptus victrix* low woodland to open woodland over *Acacia sclerosperma* subsp. *sclerosperma*, *Psydrax latifolia* and *Acacia tetragonophylla* mid to tall isolated shrubs over *Triodia angusta* patches of mid hummock grasses over open tussock grassland and herbland.	186.7	4

Unit Code	Vegetation Unit Description	Extent in Study Area (ha)	Extent in Study Area (%)
AxTOS	*Acacia xiphophylla* (and occasional *Acacia synchronicia*) tall open shrubland over *Eremophila youngii* subsp. *lepidota*, *Senna* sp. Meekatharra (E. Bailey 1-26) and *Eremophila cuneata* mid to low sparse shrubland over isolated tussock grasses and herbs.	327.0	8
CP	Bare, open claypans, with occasional tussock grasses and shrubs, dominated by *Eragrostis australasica*, *Diplachne fusca* subsp. *fusca* and *Sesbania cannabina*.	4.6	<1
EvAaLSW	*Eucalyptus victrix* and occasionally *Acacia aptaneura* low sparse woodland over mid to tall shrubland dominated by *Acacia* (*Acacia ancistrocarpa*, *Acacia tetragonophylla* and *Acacia sclerosperma* subsp. *sclerosperma*) and *Eremophila* (*Eremophila longifolia*) species over *Eulalia aurea, Chrysopogon fallax* and *Eriachne* spp. mid to low open tussock grassland.	2.6	<1
TaTpTsMOHG	*Triodia angusta* and/ or *Triodia pungens* and/ or *Triodia schinzii* mid open hummock grassland with isolated mid to tall shrubs dominated by *Stylobasium spathulatum, Acacia sclerosperma* subsp. *sclerosperma* and *Acacia synchronicia*.	136.3	3
Cleared Area	Cleared and disturbed areas associated with pastoralism.	9.9	<1
Total		4,265.7	100

The condition of the vegetation units within the Study Area have not been actively traversed or ground-truthed, as such, it is difficult to determine the vegetation condition. It is anticipated that the vegetation condition would range between Poor and Very Good, with potential for isolated occurrences of Excellent vegetation or Degraded and Completely Degraded vegetation. The Study Area is located within an active pastoral lease (Roy Hill), so the presence of cattle may be impacting on the condition of the vegetation. Vegetation condition mapping located immediately to the north (completed by Biologic) and the south (completed by Maia, 2018) suggests the vegetation is most likely in a Very Good condition. As such, the vegetation within the Study Area has been conservatively mapped as Very Good.

Fauna Habitat Type Mapping

The extrapolation exercise mapped the occurrence of four fauna habitat types (Table 2) within the Study Area. Three fauna habitat types had previously been mapped within the Study Area, with the addition of the Snakewood Shrubland fauna habitat type. The dominant fauna habitat type mapped within the Study Area is Spinifex Sandplain, closely followed by Mulga Woodland (Table 2).

Table 2: Fauna habitat types extrapolated within the Study Area

Unit Code	Fauna Habitat Description	Extent in Study Area (ha)	Extent in Study Area (%)
Spinifex Sandplain	Spinifex Sandplains are characterised by sandy soils supporting dense spinifex grasslands often with sparse shrubs. The shrub layer varied from dense thickets to scattered shrubs often dominated by *Acacia*. Mallee were also common within instances of this habitat type. Sandy soils for burrowing were a key feature of the habitat type.	1,660.8	39
Mulga Woodland	This habitat includes woodlands in which Mulga is the dominant strata, either as the principal *Acacia* species or mixed with others. It consists of disintegrating groves on stony and alluvial soils. Small hollows, leaf litter and woody debris are components of this habitat.	1,718.0	40
Mulga Spinifex	The Mulga Spinifex habitat comprised areas where Mulga Woodlands occur over hummock grasslands. They differ from Mulga Woodland habitat due to a sandier substrate and often support a unique composition of fauna due to this association.	739.2	17
Snakewood Shrubland	Snakewood Tall Open Shrubland consists of a dominant overstorey of *Acacia xiphophylla* (Snakewood). Mid storey and understorey species include scattered species of *Eremophila*, *Senna* over isolated tussock grasses and herbs.	147.7	3
Total		**4,265.7**	**100**

Conclusions

The results of the extrapolation mapping exercise have been incorporated into the Version 2 Reconnaissance Flora and Vegetation Assessment report and the Version 5 Level 1 Targeted Vertebrate Fauna Assessment report currently being prepared by Biologic.

For further information or clarification, please contact the undersigned on +61 8 6142 7119.

Yours sincerely,

Clinton van den Bergh
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Talitha Moyle
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(08) 6142 7119 | 0411 238 685

References

Maia, Environmental Consultancy,. (2018). *Roy Hill: Southern borefield study area (L47/642 and L47/735) detailed (Level 2) flora and vegetation assessment (2017/2018) - Draft*. Unpublished report prepared for Roy Hill Iron Ore Pty Ltd. Subiaco, WA:

791617 796617 801617 806617 811617

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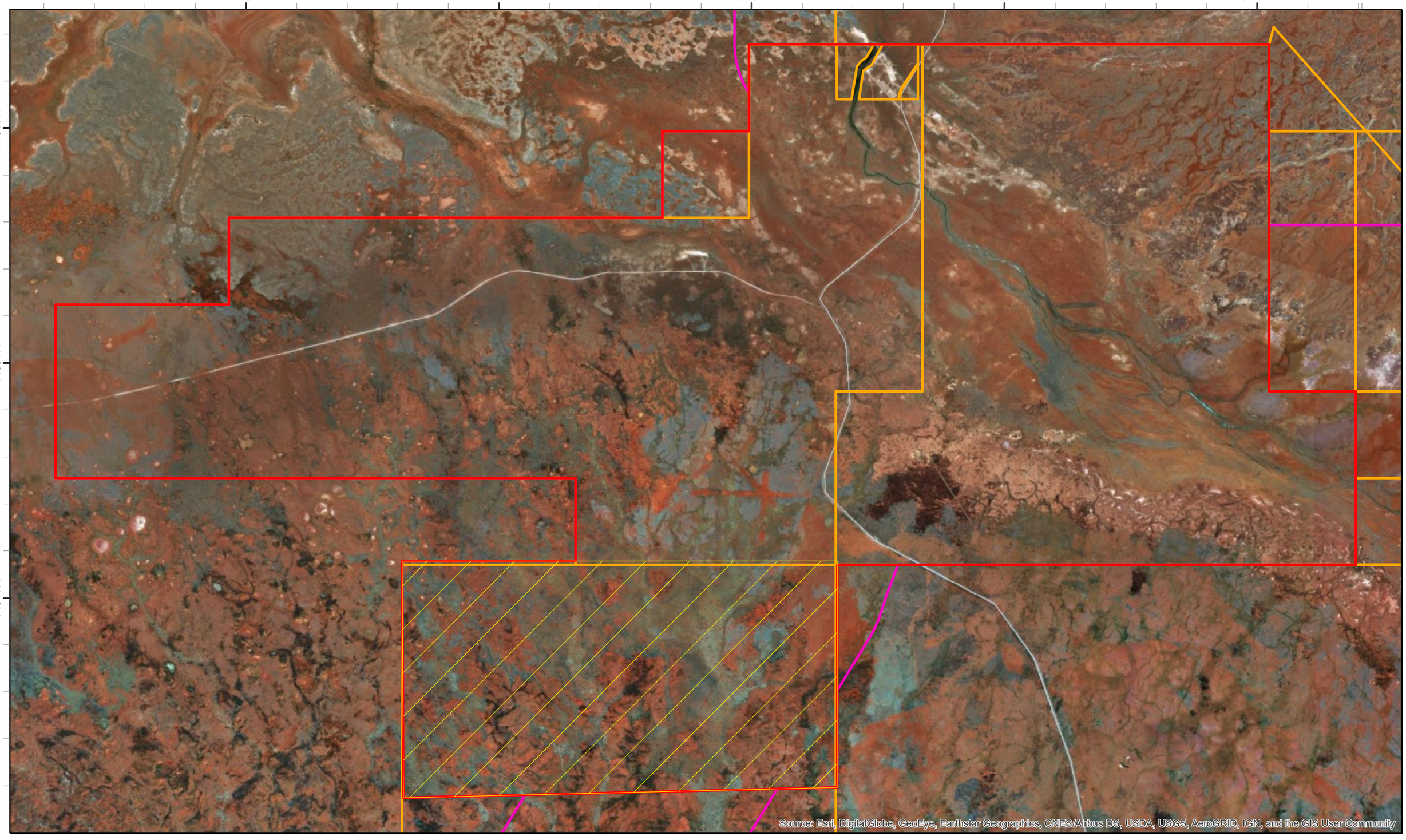

Legend

- Additional Area L47/642
- Flora and Vegetation Study Area
- Vertebrate Fauna StudyArea
- Roy Hill Tenements
- Major Roads

biologic Environmental Survey

N

1:75,000

0 1 2 4 Kilometers

Roy Hill Iron Ore Pty Ltd - Remote MAR Borefield

Reconnaissance Flora & Vegetation Survey

L47/642 Additional Area

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Size A3. Created 20/09/2018

Appendix F: Database Search Results

Parks and Wildlife Service (DBCA, 2018c)

EPBC Act Protected Matters Search (DoEE, 2018)

NatureMap (DBCA, 2018a)

Atlas of Living Australia (ALA, 2018)

Western Australian Organism List (DPIRD, 2018)

Family	Taxon	DBCA	EPBC Act	NatureMap	ALA	WAOL	Conservation Rating			Introduced
							EPBC Act	WC Act	DBCA	
Acanthaceae	*Dicladanthera forrestii*	•		•						
	Dipteracanthus chichesterensis	•							1	
	Rostellularia adscendens				•					
	Rostellularia adscendens var. *clementii*			•						
	Rostellularia adscendens var. *latifolia*	•		•					3	
Aizoaceae	*Trianthema triquetrum*			•	•					
	Zaleya galericulata				•					
	Zaleya galericulata subsp. *galericulata*			•						
Alismataceae	*Sagittaria platyphylla*					•				Y
Amaranthaceae	*Aerva javanica*			•	•					Y
	Alternanthera angustifolia			•						
	Alternanthera denticulata			•						
	Alternanthera nana			•						
	Alternanthera nodiflora			•						
	Amaranthus centralis	•							3	
	Amaranthus cuspidifolius			•	•					
	Amaranthus mitchellii				•					
	Amaranthus undulatus			•						
	Gomphrena affinis				•					
	Gomphrena flaccida			•						
	Gomphrena kanisii			•	•					
	Ptilotus aervoides			•						
	Ptilotus astrolasius			•	•					
	Ptilotus auriculifolius			•						
	Ptilotus axillaris			•	•					
	Ptilotus calostachyus			•						
	Ptilotus carinatus			•	•					
	Ptilotus chamaecladus			•						
	Ptilotus clementii			•						

Family	Taxon	DBCA	EPBC Act	NatureMap	ALA	WAOL	Conservation Rating			Introduced
							EPBC Act	WC Act	DBCA	
	Ptilotus gomphrenoides			•	•					
	Ptilotus helipteroides			•						
	Ptilotus macrocephalus			•						
	Ptilotus nobilis			•						
	Ptilotus nobilis subsp. *nobilis*			•						
	Ptilotus obovatus			•						
	Ptilotus polystachyus			•						
	Ptilotus rotundifolius			•						
	Ptilotus schwartzii			•						
	Ptilotus schwartzii var. *georgei*			•						
	Ptilotus schwartzii var. *schwartzii*			•						
	Ptilotus wilsonii	•							1	
Apocynaceae	*Calotropis procera*					•				Y
	Cryptostegia madagascariensis					•				Y
	Marsdenia australis			•	•					
Araceae	*Pistia stratiotes*					•				Y
	Zantedeschia aethiopica					•				Y
Araliaceae	*Hydrocotyle ranunculoides*					•				Y
	Trachymene bialata			•						
	Trachymene oleracea			•	•					
Asparagaceae	*Asparagus asparagoides*					•				Y
Asteraceae	*Angianthus cyathifer*			•						
	Calocephalus beardii			•						
	Calocephalus francisii			•						
	Calocephalus knappii			•						
	Calotis multicaulis			•	•					
	Calotis plumulifera			•	•					
	Calotis porphyroglossa			•						
	Calotis squamigera	•							1	

Family	Taxon	DBCA	EPBC Act	NatureMap	ALA	WAOL	Conservation Rating			Introduced
							EPBC Act	WC Act	DBCA	
	Centipeda crateriformis subsp. *crateriformis*			•						
	Centipeda minima			•						
	Centipeda minima subsp. *macrocephala*			•						
	Centipeda minima subsp. *minima*			•						
	Centipeda thespidioides			•	•					
	Chondrilla juncea					•				Y
	Chrysocephalum eremaeum			•						
	Conyza bonariensis			•						Y
	Gnaphalium polycaulon			•						Y
	Gnephosis brevifolia			•						
	Helichrysum oligochaetum	•		•					1	
	Iotasperma sessilifolium	•		•					3	
	Ixiochlamys cuneifolia			•						
	Minuria integerrima			•	•					
	Myriocephalus oldfieldii			•	•					
	Myriocephalus rudallii			•						
	Myriocephalus scalpellus	•		•					1	
	Onopordum acaulon					•				Y
	Pentalepis trichodesmoides subsp. *trichodesmoides*			•						
	Pluchea dunlopii			•	•					
	Pluchea rubelliflora			•						
	Podolepis capillaris			•	•					
	Podolepis eremaea			•						
	Pterocaulon serrulatum				•					
	Pterocaulon serrulatum var. *velutinum*			•						
	Pterocaulon sphacelatum			•	•					
	Pterocaulon sphaeranthoides			•						
	Rhodanthe charsleyae			•						
	Rhodanthe floribunda			•	•					

Family	Taxon	DBCA	EPBC Act	NatureMap	ALA	WAOL	Conservation Rating			Introduced
							EPBC Act	WC Act	DBCA	
	Rhodanthe margarethae			•						
	Rhodanthe sterilescens			•	•					
	Rhodanthe stricta			•						
	Silybum marianum					•				Y
	Streptoglossa adscendens			•	•					
	Streptoglossa bubakii			•						
	Streptoglossa cylindriceps			•	•					
	Streptoglossa liatroides			•	•					
	Streptoglossa odora			•						
	Streptoglossa tenuiflora			•						
	Xanthium spinosum					•				Y
	Xanthium strumarium					•				Y
	Xerochrysum boreale	•							3	
Bixaceae	*Cochlospermum macnamarae*	•							1	
Boraginaceae	*Echium plantagineum*					•				Y
	Halgania solanacea var. Mt Doreen (G.M. Chippendale 4206)			•						
	Heliotropium chrysocarpum			•						
	Heliotropium curassavicum			•						
	Heliotropium glanduliferum			•						
	Heliotropium heteranthum			•	•					
	Heliotropium inexplicitum				•					
	Trichodesma zeylanicum var. *zeylanicum*			•						
Brassicaceae	*Cardamine paucijuga*	•		•					2	
	Lepidium catapycnon	•							4	
	Lepidium echinatum			•	•					
	Lepidium pedicellosum			•						
	Lepidium phlebopetalum			•	•					
	Lepidium pholidogynum			•						
	Lepidium platypetalum			•						

Family	Taxon	DBCA	EPBC Act	NatureMap	ALA	WAOL	Conservation Rating			Introduced
							EPBC Act	WC Act	DBCA	
	Stenopetalum nutans			•						
Byblidaceae	*Byblis* sp.			•						
Cactaceae	*Austrocylindropuntia cylindrica*					•				Y
	Austrocylindropuntia subulata					•				Y
	Cylindropuntia fulgida					•				Y
	Cylindropuntia imbricata					•				Y
	Cylindropuntia kleiniae					•				Y
	Cylindropuntia pallida					•				Y
	Cylindropuntia tunicata					•				Y
	Opuntia elata					•				Y
	Opuntia elatior					•				Y
	Opuntia engelmannii					•				Y
	Opuntia ficus-indica					•				Y
	Opuntia microdasys					•				Y
	Opuntia monacantha					•				Y
	Opuntia polyacantha					•				Y
	Opuntia puberula					•				Y
	Opuntia stricta					•				Y
	Opuntia tomentosa					•				Y
Campanulaceae	*Lobelia heterophylla*			•						
	Wahlenbergia tumidifructa			•						
Capparaceae	*Capparis lasiantha*			•	•					
	Capparis spinosa				•					
	Capparis umbonata			•	•					
Caryophyllaceae	*Polycarpaea longiflora*			•	•					
Celastraceae	*Macgregoria racemigera*			•	•					
	Stackhousia muricata subsp. annual (W.R. Barker 2172)			•						
Chenopodiaceae	*Atriplex amnicola*			•	•					
	Atriplex bunburyana			•						

Family	Taxon	DBCA	EPBC Act	NatureMap	ALA	WAOL	Conservation Rating			Introduced
							EPBC Act	WC Act	DBCA	
	Atriplex codonocarpa			•	•					
	Atriplex flabelliformis	•			•				3	
	Atriplex semilunaris			•	•					
	Atriplex spinulosa	•							1	
	Chenopodium auricomum			•						
	Chenopodium gaudichaudianum			•						
	Dysphania melanocarpa			•						
	Dysphania platycarpa			•						
	Dysphania rhadinostachya subsp. *inflata*			•						
	Dysphania rhadinostachya subsp. *rhadinostachya*			•						
	Enchylaena tomentosa				•					
	Enchylaena tomentosa var. *tomentosa*			•						
	Maireana amoena			•						
	Maireana carnosa			•						
	Maireana eriosphaera			•						
	Maireana platycarpa			•						
	Maireana pyramidata			•						
	Maireana tomentosa			•						
	Maireana triptera			•						
	Rhagodia eremaea			•	•					
	Rhagodia sp. Hamersley (M. Trudgen 17794)	•		•					3	
	Sclerolaena bicornis				•					
	Sclerolaena bicornis var. *bicornis*			•						
	Sclerolaena cornishiana			•	•					
	Sclerolaena costata			•						
	Sclerolaena cuneata			•	•					
	Sclerolaena densiflora			•						
	Sclerolaena diacantha			•						
	Sclerolaena eriacantha			•						

Family	Taxon	DBCA	EPBC Act	NatureMap	ALA	WAOL	Conservation Rating			Introduced
							EPBC Act	WC Act	DBCA	
	Sclerolaena glabra			•	•					
	Sclerolaena lanicuspis			•	•					
	Sclerolaena recurvicuspis			•						
	Tecticornia auriculata			•						
	Tecticornia globulifera	•		•					1	
	Tecticornia halocnemoides			•						
	Tecticornia indica subsp. *bidens*			•						
	Tecticornia indica subsp. *leiostachya*			•						
	Tecticornia medusa	•		•	•				3	
	Tecticornia pergranulata subsp. *pergranulata*			•						
	Tecticornia sp. Christmas Creek (K.A. Shepherd & T. Colmer et al. KS 1063)	•		•					1	
	Tecticornia sp. Dennys Crossing (K.A. Shepherd & J. English KS 552)			•						
	Tecticornia undulata			•						
	Eremophea spinosa			•						
Cleomaceae	*Cleome oxalidea*			•						
	Cleome viscosa			•						
Commelinaceae	*Commelina ensifolia*			•						
Convolvulaceae	*Bonamia erecta*			•	•					
	Bonamia media			•						
	Convolvulus clementii			•						
	Cressa australis			•						
	Cuscuta victoriana			•						
	Duperreya commixta			•	•					
	Evolvulus alsinoides var. *villosicalyx*			•						
	Ipomoea coptica			•						
	Ipomoea diamantinensis			•						
	Ipomoea muelleri			•						
	Ipomoea racemigera	•							2	

Family	Taxon	DBCA	EPBC Act	NatureMap	ALA	WAOL	Conservation Rating			Introduced
							EPBC Act	WC Act	DBCA	
Cucurbitaceae	*Citrullus colocynthis*			•						Y
	Cucumis melo			•	•					
	Cucumis variabilis			•						
Cyperaceae	*Cyperus bifax*			•	•					
	Cyperus bulbosus			•						
	Cyperus concinnus			•						
	Cyperus difformis			•						
	Cyperus hesperius			•						
	Cyperus iria			•						
	Cyperus pygmaeus			•						
	Cyperus squarrosus			•						
	Cyperus vaginatus			•						
	Eleocharis papillosa	•		•					3	
	Fimbristylis microcarya			•						
	Lipocarpha microcephala			•						
	Schoenoplectiella dissachantha			•						
Elatinaceae	*Bergia perennis*			•	•					
	Bergia perennis subsp. *exigua*			•						
	Bergia perennis subsp. *obtusifolia*			•						
	Bergia perennis subsp. *perennis*			•						
Euphorbiaceae	*Adriana tomentosa* var. *tomentosa*			•						
	Euphorbia australis			•	•					
	Euphorbia australis var. *australis*			•						
	Euphorbia biconvexa			•						
	Euphorbia boophthona			•	•					
	Euphorbia tannensis				•					
	Euphorbia tannensis subsp. *eremophila*			•						
	Jatropha gossypiifolia					•				Y
Fabaceae	*Acacia acradenia*			•						

Family	Taxon	DBCA	EPBC Act	NatureMap	ALA	WAOL	Conservation Rating			Introduced
							EPBC Act	WC Act	DBCA	
	Acacia adsurgens			•	•					
	Acacia ampliceps			•						
	Acacia ancistrocarpa			•	•					
	Acacia aneura			•	•					
	Acacia aphanoclada	•							1	
	Acacia aptaneura			•						
	Acacia balsamea			•						
	Acacia bivenosa			•						
	Acacia bromilowiana	•							4	
	Acacia catenulata subsp. *occidentalis*			•						
	Acacia coriacea subsp. *pendens*			•						
	Acacia cyperophylla var. *omearana*	•							1	
	Acacia dictyophleba			•						
	Acacia distans			•						
	Acacia effusa	•							3	
	Acacia fecunda	•							1	
	Acacia grasbyi				•					
	Acacia hilliana			•	•					
	Acacia inaequilatera			•						
	Acacia kempeana			•						
	Acacia maitlandii			•	•					
	Acacia marramamba			•						
	Acacia melleodora			•						
	Acacia microneura				•					
	Acacia monticola			•						
	Acacia pachyacra			•						
	Acacia pruinocarpa			•						
	Acacia pyrifolia var. *pyrifolia*			•						
	Acacia rhodophloia			•						

Family	Taxon	DBCA	EPBC Act	NatureMap	ALA	WAOL	Conservation Rating			Introduced
							EPBC Act	WC Act	DBCA	
	Acacia sclerosperma			•	•					
	Acacia sclerosperma subsp. *sclerosperma*			•						
	Acacia sericophylla			•						
	Acacia sibilans			•	•					
	Acacia sibirica			•						
	Acacia sp. Nullagine (B.R. Maslin 4955)	•							1	
	Acacia stellaticeps			•						
	Acacia subtiliformis	•							3	
	Acacia synchronicia			•						
	Acacia tenuissima			•	•					
	Acacia tetragonophylla			•	•					
	Acacia trachycarpa			•						
	Acacia trudgeniana			•						
	Acacia tumida var. *pilbarensis*			•						
	Acacia tumida var. *tumida*			•						
	Acacia victoriae			•	•					
	Acacia xiphophylla			•	•					
	Aeschynomene indica			•						
	Alhagi maurorum					•				Y
	Alysicarpus muelleri			•						
	Crotalaria cunninghamii			•						
	Crotalaria smithiana	•							3	
	Cullen cinereum			•	•					
	Cullen graveolens			•						
	Cullen leucanthum			•	•					
	Cullen leucochaites			•						
	Cullen martinii			•						
	Glycine falcata	•							3	
	Gompholobium polyzygum			•						

Family	Taxon	DBCA	EPBC Act	NatureMap	ALA	WAOL	Conservation Rating			Introduced
							EPBC Act	WC Act	DBCA	
	Indigofera ammobia	•							3	
	Indigofera ixocarpa	•							2	
	Indigofera linnaei			•						
	Indigofera monophylla			•	•					
	Lotus australis				•					
	Lotus cruentus			•	•					
	Neptunia dimorphantha			•						
	Parkinsonia aculeata		•			•				Y
	Petalostylis labicheoides			•	•					
	Prosopis glandulosa x velutina					•				Y
	Rhynchosia minima				•					
	Senna alata					•				Y
	Senna artemisioides				•					
	Senna artemisioides subsp. *helmsii*			•						
	Senna artemisioides subsp. *oligophylla*			•						
	Senna glutinosa subsp. *chatelainiana*			•						
	Senna glutinosa subsp. *glutinosa*			•						
	Senna glutinosa subsp. *pruinosa*			•						
	Senna notabilis			•	•					
	Senna obtusifolia					•				Y
	Senna occidentalis			•	•					Y
	Senna sericea			•	•					
	Senna sp. Meekatharra (E. Bailey 1-26)			•						
	Senna stricta			•						
	Sesbania cannabina			•						
	Swainsona kingii			•	•					
	Swainsona maccullochiana			•						
	Swainsona paucifoliolata			•						
	Swainsona stenodonta			•	•					

Family	Taxon	DBCA	EPBC Act	NatureMap	ALA	WAOL	Conservation Rating			Introduced
							EPBC Act	WC Act	DBCA	
	Swainsona tanamiensis			•						
	Swainsona thompsoniana	•							3	
	Templetonia egena			•						
	Tephrosia rosea var. *clementii*			•						
	Tephrosia rosea var. Fortescue creeks (M.I.H. Brooker 2186)			•						
	Tephrosia sp. Newman (A.A. Mitchell PRP 29)			•						
	Trigonella suavissima			•						
	Ulex europaeus					•				Y
	Vachellia farnesiana			•	•					
Frankeniaceae	*Frankenia cinerea*			•						
	Frankenia irregularis			•						
	Frankenia pauciflora			•						
	Frankenia setosa			•						
Gentianaceae	*Schenkia australis*			•	•					
	Schenkia spicata				•					
Goodeniaceae	*Goodenia cusackiana*			•	•					
	Goodenia hartiana	•							2	
	Goodenia lamprosperma			•						
	Goodenia lyrata	•							3	
	Goodenia microptera			•						
	Goodenia muelleriana			•	•					
	Goodenia nuda	•		•					4	
	Goodenia pedicellata	•							1	
	Goodenia prostrata			•	•					
	Goodenia scaevolina			•						
	Goodenia sp. East Pilbara (A.A. Mitchell PRP 727)	•		•					3	
	Goodenia tenuiloba			•						
	Goodenia vilmoriniae			•	•					

Family	Taxon	DBCA	EPBC Act	NatureMap	ALA	WAOL	Conservation Rating			Introduced
							EPBC Act	WC Act	DBCA	
	Goodenia wilunensis			•						
	Scaevola parvifolia			•						
	Scaevola parvifolia subsp. *pilbarae*			•						
	Scaevola spinescens			•						
Haloragaceae	*Haloragis gossei* var. *gossei*			•						
Hemerocallidaceae	*Corynotheca pungens*			•						
Iridaceae	*Moraea flaccida*					•				Y
	Moraea miniata					•				Y
Lamiaceae	*Basilicum polystachyon*			•						
	Dicrastylis cordifolia			•	•					
	Newcastelia cephalantha			•	•					
	Newcastelia hexarrhena			•	•					
	Teucrium pilbaranum	•							2	
	Teucrium racemosum			•						
Linderniaceae	*Lindernia tectanthera*			•						
Loganiaceae	*Mitrasacme connata*			•						
Loranthaceae	*Amyema fitzgeraldii*				•					
	Amyema hilliana				•					
	Amyema preissii			•						
	Lysiana subfalcata			•						
Lythraceae	*Ammannia multiflora*			•						
	Rotala diandra			•						
Malvaceae	*Abutilon fraseri*			•						
	Abutilon lepidum			•						
	Abutilon otocarpum			•	•					
	Abutilon oxycarpum				•					
	Abutilon oxycarpum subsp. Prostrate (A.A. Mitchell PRP 1266)			•						
	Corchorus elachocarpus			•						
	Corchorus laniflorus			•						

Family	Taxon	DBCA	EPBC Act	NatureMap	ALA	WAOL	Conservation Rating			Introduced
							EPBC Act	WC Act	DBCA	
	Corchorus lasiocarpus			•						
	Corchorus lasiocarpus subsp. *parvus*			•						
	Corchorus parviflorus			•						
	Corchorus sidoides subsp. *sidoides*			•						
	Gossypium australe			•	•					
	Hibiscus sp. Gurinbiddy Range (M.E. Trudgen MET 15708)	•							2	
	Hibiscus sturtii var. grandiflorus			•						
	Hibiscus sturtii var. platychlamys			•						
	Malvastrum americanum			•	•					
	Melhania oblongifolia			•						
	Seringia elliptica			•	•					
	Seringia nephrosperma			•						
	Sida arenicola			•						
	Sida arsiniata			•						
	Sida echinocarpa			•						
	Sida fibulifera				•					
	Sida sp. Barlee Range (S. van Leeuwen 1642)	•							3	
	Sida sp. spiciform panicles (E. Leyland s.n. 14/8/90)			•						
	Sida sp. Supplejack Station (T.S. Henshall 2345)			•						
	Sida trichopoda			•						
	Triumfetta maconochieana			•						
Marsileaceae	*Marsilea hirsuta*			•	•					
Molluginaceae	*Glinus lotoides*			•						
Montiaceae	*Calandrinia pumila*			•						
	Calandrinia quadrivalvis				•					
	Calandrinia schistorhiza			•						
	Calandrinia stagnensis			•	•					

Family	Taxon	DBCA	EPBC Act	NatureMap	ALA	WAOL	Conservation Rating			Introduced
							EPBC Act	WC Act	DBCA	
	Calandrinia tepperiana			•						
Myrtaceae	*Calytrix carinata*			•						
	Corymbia candida			•						
	Corymbia deserticola subsp. *deserticola*			•						
	Corymbia hamersleyana			•	•					
	Eucalyptus camaldulensis				•					
	Eucalyptus camaldulensis subsp. *arida*			•						
	Eucalyptus gamophylla			•	•					
	Eucalyptus leucophloia				•					
	Eucalyptus leucophloia subsp. *leucophloia*			•						
	Eucalyptus lucasii			•	•					
	Eucalyptus pilbarensis			•	•					
	Eucalyptus rowleyi	•		•	•				3	
	Eucalyptus socialis			•						
	Eucalyptus socialis subsp. *eucentrica*			•						
	Eucalyptus trivalva			•	•					
	Eucalyptus victrix			•	•					
	Eucalyptus xerothermica			•						
	Melaleuca eleuterostachya				•					
	Melaleuca glomerata			•						
	Melaleuca xerophila			•	•					
Nyctaginaceae	*Boerhavia coccinea*			•	•					
Onagraceae	*Ludwigia perennis*			•						
Phrymaceae	*Elacholoma hornii*			•						
	Glossostigma diandrum			•						
	Mimulus gracilis			•						
	Peplidium aithocheilum			•	•					
	Peplidium muelleri				•					
	Peplidium sp. C Evol. Fl. Fauna Arid Aust. (N.T. Burbidge & A. Kanis 8158)			•						

Family	Taxon	DBCA	EPBC Act	NatureMap	ALA	WAOL	Conservation Rating			Introduced
							EPBC Act	WC Act	DBCA	
	Peplidium sp. E Evol. Fl. Fauna Arid Aust. (A.S. Weston 12768)			•						
Phyllanthaceae	*Synostemon hamersleyensis*	•							1	
	Synostemon rhytidospermus			•	•					
Plantaginaceae	*Stemodia* sp. Battle Hill (A.L. Payne 1006)	•		•					1	
	Stemodia viscosa			•						
Plumbaginaceae	*Muellerolimon salicorniaceum*			•	•					
Poaceae	*Aristida anthoxanthoides*			•						
	Aristida contorta			•						
	Aristida holathera			•						
	Aristida jerichoensis var. *subspinulifera*	•							3	
	Aristida latifolia			•						
	Astrebla pectinata			•	•					
	Cenchrus ciliaris		•	•	•					Y
	Chloris pectinata			•						
	Chloris pumilio			•						
	Chrysopogon fallax			•						
	Cynodon prostratus			•						
	Dactyloctenium radulans			•						
	Elytrophorus spicatus			•						
	Enneapogon avenaceus				•					
	Enneapogon caerulescens			•						
	Enneapogon cylindricus			•	•					
	Enneapogon lindleyanus			•						
	Enneapogon robustissimus			•						
	Enteropogon ramosus			•						
	Eragrostis australasica			•						
	Eragrostis cilianensis			•	•					Y
	Eragrostis cumingii			•						
	Eragrostis dielsii			•						

Family	Taxon	DBCA	EPBC Act	NatureMap	ALA	WAOL	Conservation Rating			Introduced
							EPBC Act	WC Act	DBCA	
	Eragrostis eriopoda			•						
	Eragrostis falcata			•						
	Eragrostis leptocarpa			•	•					
	Eragrostis pergracilis			•	•					
	Eragrostis setifolia			•						
	Eragrostis sp. Erect spikelets (P.K. Latz 2122)			•						
	Eragrostis tenellula			•						
	Eragrostis xerophila			•	•					
	Eriachne aristidea			•						
	Eriachne festucacea			•						
	Eriachne flaccida			•						
	Eriachne helmsii			•						
	Eriachne mucronata			•						
	Eriachne tenuiculmis			•						
	Eriochloa procera			•						
	Eriochloa pseudoacrotricha			•						
	Eulalia aurea			•						
	Iseilema eremaeum			•						
	Iseilema macratherum			•						
	Iseilema vaginiflorum			•						
	Lachnagrostis filiformis			•						
	Panicum decompositum			•	•					
	Panicum laevinode			•						
	Paractaenum refractum			•						
	Paspalidium constrictum			•						
	Perotis rara			•						
	Setaria verticillata				•					
	Sporobolus australasicus			•						
	Sporobolus mitchellii			•	•					

Family	Taxon	DBCA	EPBC Act	NatureMap	ALA	WAOL	Conservation Rating			Introduced
							EPBC Act	WC Act	DBCA	
	Themeda sp. Hamersley Station (M.E. Trudgen 11431)	•		•					3	
	Themeda triandra			•	•					
	Triodia angusta				•					
	Triodia basedowii			•						
	Triodia brizoides			•						
	Triodia epactia			•						
	Triodia longiceps			•						
	Triodia pungens			•						
	Triodia schinzii			•						
	Triodia scintillans			•						
	Triodia triticoides	•							1	
	Triodia vanleeuwenii			•						
	Triodia wiseana			•						
	Triraphis mollis			•						
	Urochloa subquadripara			•						
	Xerochloa barbata			•	•					
	Xerochloa laniflora			•	•					
Polygonaceae	*Duma florulenta*			•	•					
Portulacaceae	*Portulaca cyclophylla*			•						
	Portulaca oleracea			•	•					
	Portulaca pilosa			•						Y
Primulaceae	*Samolus repens*				•					
	Samolus sp. Fortescue Marsh (A. Markey & R. Coppen FM 9702)	•		•					1	
Proteaceae	*Grevillea juncifolia* subsp. *juncifolia*			•						
	Grevillea saxicola	•							3	
	Grevillea striata				•					
	Grevillea wickhamii subsp. *aprica*			•						
	Grevillea wickhamii subsp. *hispidula*			•						

Family	Taxon	DBCA	EPBC Act	NatureMap	ALA	WAOL	Conservation Rating			Introduced
							EPBC Act	WC Act	DBCA	
	Hakea lorea				•					
Pteridaceae	*Cheilanthes sieberi* subsp. *sieberi*			•						
Rhamnaceae	*Ziziphus mauritiana*					•				Y
Rosaceae	*Rubus ulmifolius*					•				Y
Rubiaceae	*Psydrax latifolia*			•						
	Spermacoce brachystema			•						
	Synaptantha tillaeacea var. *tillaeacea*			•						
Santalaceae	*Anthobolus leptomerioides*			•	•					
Sapindaceae	*Atalaya hemiglauca*			•	•					
	Dodonaea coriacea			•						
	Dodonaea petiolaris			•						
Scrophulariaceae	*Eremophila compacta*			•						
	Eremophila cuneifolia			•						
	Eremophila forrestii			•						
	Eremophila forrestii subsp. *forrestii*			•						
	Eremophila latrobei subsp. *filiformis*			•						
	Eremophila latrobei subsp. *glabra*			•						
	Eremophila longifolia			•	•					
	Eremophila maculata				•					
	Eremophila maculata subsp. *brevifolia*			•						
	Eremophila magnifica subsp. *velutina*	•							3	
	Eremophila margarethae			•						
	Eremophila pilosa	•		•					1	
	Eremophila rigida	•							3	
	Eremophila sp. Hamersley Range (K. Walker KW 136)	•							1	
	Eremophila sp. Nooloo grey				•					
	Eremophila spongiocarpa	•		•	•				1	
	Eremophila youngii				•					
	Eremophila youngii subsp. lepidota	•		•					4	

Family	Taxon	DBCA	EPBC Act	NatureMap	ALA	WAOL	Conservation Rating			Introduced
							EPBC Act	WC Act	DBCA	
Solanaceae	*Nicotiana benthamiana*			•						
	Nicotiana heterantha	•		•	•				3	
	Nicotiana occidentalis			•						
	Nicotiana rosulata subsp. *rosulata*			•						
	Nicotiana umbratica	•							3	
	Solanum diversiflorum			•						
	Solanum elaeagnifolium					•				Y
	Solanum elatius			•	•					
	Solanum esuriale			•						
	Solanum horridum			•						
	Solanum lasiophyllum			•	•					
	Solanum linnaeanum					•				Y
	Solanum morrisonii			•						
	Solanum phlomoides			•						
	Solanum sp. Mosquito Creek (A.A. Mitchell et al. AAM 10795) PN	•							1	
	Solanum sturtianum			•	•					
Stylidiaceae	*Stylidium desertorum*			•						
	Stylidium weeliwolli	•							3	
Surianaceae	*Stylobasium spathulatum*			•	•					
Tamaricaceae	*Tamarix aphylla*		•			•				Y
Typhaceae	*Typha domingensis*			•						
Verbenaceae	*Lantana camara*					•				Y
Violaceae	*Hybanthus aurantiacus*			•						
Zygophyllaceae	*Tribulus astrocarpus*			•						
	Tribulus cistoides			•						
	Tribulus hirsutus			•						
	Tribulus macrocarpus			•						
	Tribulus minutus	•							1	
	Tribulus suberosus			•						

Family	Taxon	DBCA	EPBC Act	NatureMap	ALA	WAOL	Conservation Rating			Introduced
							EPBC Act	WC Act	DBCA	
	Zygophyllum eichleri			•						
	Zygophyllum simile			•						

Appendix G: Assessment of Conservation Significant Flora Likelihood of Occurrence Based on the Desktop Assessment

Taxon	Conservation Status			Source[1]	Habit and Habitat[2]	Habitat within Study Area	Within Current Known Distribution	Distance to Nearest Record	Recorded within Study Area	Likelihood of Occurrence
	EPBC Act	WC Act	DBCA							
Acacia aphanoclada			1	A	Slender, wispy shrub, 1.7-5 m high. Fl. yellow, Aug to Oct. Skeletal stony soils. Rocky hills, ridges & rises	No	No	>65 km N	No	Highly Unlikely
Acacia bromilowiana			4	A	Tree or shrub, to 12 m high, bark dark grey, fibrous; phyllodes more or less glaucous & slightly pruinose; inflorescence in spikes. Fl. yellow/pink, Jul to Aug. Red skeletal stony loam, orange-brown pebbly, gravel loam, laterite, banded ironstone, basalt. Rocky hills, breakaways, scree slopes, gorges, creek beds	Potential	Yes	>60 km E	No	Unlikely
Acacia cyperophylla var. *omearana*			1	A	Tree, 4-10 m high, 'minni-ritchi' bark. Fl. yellow, Mar to Apr. Stony & gritty alluvium. Along drainage lines	Yes	No	>75 km N	No	Unlikely
Acacia effusa			3	A	Low, dense, spreading, somewhat viscid shrub, 0.3-1 m high, bark 'minni-ritchi'. Fl. yellow, May to Aug. Stony red loam. Scree slopes of low ranges	No	No	>100 km W	No	Highly Unlikely
Acacia fecunda			1	A	Erect, obconic shrub, to 3 m high, bark grey, smooth becoming yellow-brown on upper branches; phyllodes more or less sub-glaucous with a slight sheen; inflorescence of spikes. Fl. yellow, May or Aug. Quartzite gibbers over grey-red skeletal soil. Along shallow creeks and drainage lines, hills, road verges	No	No	>80 km NNE	No	Highly Unlikely
Acacia microneura			1	D	Slender shrub (with resinous, angled young branches), to 1.5 m high, phyllodes flat, long, needle-like, 4-11 cm long; inflorescence globular to broadly ellipsoid. Fl. yellow, Aug to Oct. Sand to loam over granite. Heathlands, disturbed road verges	No	No	>1,000 km S	No	Highly Unlikely
Acacia sp. Nullagine (B.R. Maslin 4955)			1	A	Erect, spindly shrub, to 3 m high, bark minni-ritchi, grey above, red underneath. Rocky clay. Low-lying areas between rocky hills	No	No	>100 km N	No	Highly Unlikely
Acacia subtiliformis			3	A	Spindly, slender, erect shrub, to 3.5 m high, phyllodes green, new growth slightly viscid, resinous, aromatic; inflorescence in heads to 6 mm diameter; peduncles red. Fl. yellow, Jun. On rocky calcrete plateau	No	No	>50 km SW	No	Highly Unlikely
Amaranthus centralis			3	A, B	Annual herb, decumbent or erect to 0.6 m high. Grows in red sand in ephemeral watercourses, sandy to clayey loam on river banks and edges of permanent pools in eucalypt lined channels, or acacia shrubland.	Yes	Yes	>30 km SSE	No	Possible
Aristida jerichoensis subsp. subspinulifera			3	A	Compactly tufted perennial, grass-like or herb, 0.3-0.8 m high, lemma groove muricate. Hardpan plains	Potential	Yes	>60 Km SW	No	Possible
Atriplex flabelliformis			3	A, B, D	Monoecious, erect, rounded perennial, herb, to 0.35 m high. Clay loam, loam. Saline flats or marshes	Potential	Yes	>30 km W	No	Possible
Atriplex spinulosa			1	A	Monoecious, erect, rounded annual, herb, ca 0.2 m high	Potential	No	>80 km N	No	Unlikely
Calotis squamigera			1	B	Procumbent annual, herb, to 0.21 m high. Fl. yellow, Jul. Pebbly loam	No	Yes	>37 km	No	Possible
Cardamine paucijuga			2	B, C	Slender erect annual, herb, to 0.4 m high. Fl. white, Sep to Oct. In moist to dry habitats	Potential	Yes	15 km W	No	Possible
Cochlospermum macnamarae			1	A	Spreading, multi-stemmed shrub to c. 2 m high and 3 m wide. Fl. Yellow. Occurs on the upper slopes of a low hill in shallow, stony soil closely underlain by granitic bedrock.	No	No	>100 km N	No	Highly Unlikely

Taxon	Conservation Status			Source[1]	Habit and Habitat[2]	Habitat within Study Area	Within Current Known Distribution	Distance to Nearest Record	Recorded within Study Area	Likelihood of Occurrence
	EPBC Act	WC Act	DBCA							
Crotalaria smithiana			3	A, B	Annual, herb, to 0.4 m high. Fl. yellow, Jun. Regeneration site on floodplain	Potential	Yes	>36 km S	No	Possible
Dipteracanthus chichesterensis			1	A	Spreading, glabrescent, perennial subshrub to 0.3 m high. Red-brown cracking clay soils associated with basalts on Chichester Plateau	No	No	>100 km WNW	No	Highly Unlikely
Eleocharis papillosa			3	B, C	Annual, herb. Fl. brown, Nov. Red clay over granite, open clay flats. Claypans	Yes	Yes	>18 km NW	No	Likely
Eremophila magnifica subsp. velutina			3	A	Shrub, 0.5-1.5 m high. Fl. blue-purple, Aug to Sep. Skeletal soils over ironstone. Summits	No	No	>120 km WSW	No	Highly Unlikely
Eremophila pilosa			1	A, B, C	Shrub, ca 0.8 m high. Fl. purple, Sep	Yes	Yes	6 km S	No	Confirmed
Eremophila rigida			3	A	Bushy shrub, 0.3-4 m high. Fl. cream, Sep. Red sand alluvium. Hardpan plains, stony clay depressions	Potential	No	>90 km S	No	Highly Unlikely
Eremophila sp. Hamersley Range (K. Walker KW 136)			1	A	Erect shrub 1-3.5 m tall. Grows in open rocky slopes, gullies and rock faces associated with large hills and cliffs.	No	No	>90 km S	No	Highly Unlikely
Eremophila spongiocarpa			1	A, B, C, D	Compact, succulent-leaved shrub, to 1 m high. Fl. white, May or Sep. Weakly saline alluvial plain on margins of marsh	Yes	Yes	0.5 km W	No	Highly Unlikely
Eremophila youngii subsp. lepidota			4	A, B, C	Dense, spreading shrub, (0.2-)1-3 m high. Fl. purple-red-pink, Jan or Mar or Jun or Aug to Sep. Stony red sandy loam. Flats plains, floodplains, sometimes semi-saline, clay flats	Yes	Yes	Within	Yes	Confirmed
Eucalyptus rowleyi			3	A, B, C	Lignotuberous mallee 3-5 m tall. Fl. white, Nov-Jun. Restricted to the plains of the upper De Grey River system	Potential	Yes	0.1 km S	No	Highly Likely
Glycine falcata			3	A	Mat-forming perennial, herb, to 0.2 m high. Fl. blue-purple, May or Jul. Black clayey sand. Along drainage depressions in crabhole plains on river floodplains	Potential	Yes	>9.5 km W	No	Likely
Goodenia hartiana			2	A	Erect to spreading, multi-stemmed perennial, herb or shrub (sub-shrub). Sand. Sand dune swales, sandhills	No	No	>70 km S	No	Unlikely
Goodenia lyrata			3	A	Prostrate herb, with lyrate leaves. Fl. yellow, Aug. Red sandy loam. Near claypan	Yes	No	>100 km W	No	Unlikely
Goodenia nuda			4	A, B, C	Erect to ascending herb, to 0.5 m high. Fl. yellow, Apr to Aug	Yes	Yes	8 km W	No	Confirmed
Goodenia pedicellata			1	A	Single-stemmed perennial, herb (with dense, cottony and strigose hairs), to 0.25 m high. Rocky clayey soils. Rocky slopes and crests of small hills	No	No	>150 km NE	No	Highly Unlikely
Goodenia sp. East Pilbara (A.A. Mitchell PRP 727)			3	A, B, C	Open, erect annual or biennial, herb, to 0.2 m high. Fl. yellow. Red-brown clay soil, calcrete pebbles. Low undulating plain, swampy plains	Potential	Yes	>55 km SW	No	Unlikely
Grevillea saxicola			3	A	Shrub or small tree (1.0-)2.5-7.0 m tall. Fl. Cream to pale yellow, late spring to early autumn. Orange-brown to red-brown loam soils on the upper scree/breakaway slopes and crests, associated with banded iron formation outcrops.	No	No	>50 km SW	No	Highly Unlikely
Helichrysum oligochaetum			1	A, B, C	Erect annual, herb, to ca 0.25 m high. Fl. yellow, Aug to Nov. Red clay. Alluvial plains	Yes	Yes	>6.5 km W	No	Highly Likely
Hibiscus sp. Gurinbiddy Range (M.E. Trudgen MET 15708)			2	B	Large diffuse perennial shrub 1.5-2.5 m tall. Fl. Mauve. Grows in sheltered or rocky drainage lines below associated cliff-lines or rocky ridges.	No	No	>37 km S	No	Highly Unlikely

Taxon	Conservation Status			Source[1]	Habit and Habitat[2]	Habitat within Study Area	Within Current Known Distribution	Distance to Nearest Record	Recorded within Study Area	Likelihood of Occurrence
	EPBC Act	WC Act	DBCA							
Indigofera ammobia			3	A	Many-stemmed shrub, to 0.5 m high. Fl. green & purple, Sep. Red sand. Sand dunes	No	No	>190 km NE	No	Highly Unlikely
Indigofera ixocarpa			2	A	Shrub, to 1 m high. Fl. pink, May. Skeletal red soils over massive ironstone	No	No	>150 km W	No	Highly Unlikely
Iotasperma sessilifolium			3	A, B, C	Erect herb. Fl. pink. Cracking clay, black loam. Edges of waterholes, plains	Potential	Yes	>17 km SE	No	Likely
Ipomoea racemigera			2	A	Creeping annual, herb or climber. Fl. white	Potential	Yes	>55 km SE	No	Possible
Lepidium catapycnon			4	A	Open, woody perennial, herb or shrub, 0.2-0.3 m high, stems zigzag. Fl. white, Oct. Skeletal soils. Hillsides	No	Yes	>35 km W	No	Highly Unlikely
Myriocephalus scalpellus			1	A, B, C	Semi-erect herb, 0.03-0.08 m high. Clay. Depression on flood plain	Yes	Yes	>50 km WSW	No	Likely
Nicotiana heterantha			3	A, B, C, D	Decumbent, short-lived annual or perennial, herb, to 0.5 m high, forming low, spreading colonies. Fl. white-cream, Mar to Jun or Sep. Black clay. Seasonally wet flats	Yes	Yes	>7 km NW	No	Likely
Nicotiana umbratica			3	A	Erect, short-lived annual or perennial, herb, 0.3-0.7 m high. Fl. white, Apr to Jun. Shallow soils. Rocky outcrops	No	No	>100 km N	No	Highly Unlikely
Ptilotus wilsonii			1	A	Shrub, ca 0.5 m high. Fl. green-white, Oct. Stony gravelly soils. Rocky hills	No	No	>80 km N	No	Highly Unlikely
Rhagodia sp. Hamersley (M. Trudgen 17794)			3	B, C	Shrub, sometimes scrambling to 4 m high. Recorded from mulga on cracking clays.	Yes	Yes	5.5 km S	No	Highly Likely
Rostellularia adscendens var. latifolia			3	B, C	Herb or shrub, 0.1-0.3 m high. Fl. blue-purple-violet, Apr to May. Ironstone soils. Near creeks, rocky hills	No	Yes	>23 km N	No	Highly Unlikely
Samolus sp. Fortescue Marsh (A. Markey & R. Coppen FM 9702)			1	B, C	Erect perennial herb 0.3-1.0 m high. Flat flood-out area alongside freshwater pool and channel of upper Fortescue River. Channel and water hole landform of Marsh Land system	Potential	Yes	0.6 km W	No	Likely
Sida sp. Barlee Range (S. van Leeuwen 1642)			3	B	Spreading shrub, to 0.5 m high. Fl. yellow, Aug. Skeletal red soils pockets. Steep slope	No	No	>37 km SW	No	Highly Unlikely
Solanum sp. Mosquito Creek (A.A. Mitchell et. Al. AAM 10795) PN			1	A	Upright grey shrub, growing up to 1 m tall. Semi saline clay plain or depressions with light brown clay.	Potential	No	>80 km N	No	Unlikely
Stemodia sp. Battle Hill (A.L. Payne 1006)			1	A, B, C	Low shrub. Cracking clay. Floodplain	Yes	Yes	>5.5 km E	No	Likely
Stylidium weeliwolli			3	A	Annual, herb, 0.1-0.25 m high, throat appendages 4, rod-shaped. Fl. pink & red, Aug to Sep. Gritty sand soil, sandy clay. Edge of watercourses	No	Yes	>45 km WSW	No	Highly Unlikely
Swainsona thompsoniana			3	B	Prostrate, annual herb to 10 cm high. Fl. Mauve, Jan-Dec. Gibber plains, crabhole plains and gilgai.	Potential	Yes	>40 km N	No	Possible
Synostemon hamersleyensis			1	A	Glabrous subshrub with stems much-branched to 50 cm long. Fl. Spring. Geological correlation to Joffre member of the Brockman Iron Formation.	No	No	>50 km W	No	Highly Unlikely
Tecticornia globulifera			1	B, C	Perennial shrub to 0.5 m high. Moderately saline flats on red-brown gritty clay associated with other samphire species. Fl. Aug.	Potential	Yes	15 km NW	No	Unlikely

Taxon	Conservation Status			Source[1]	Habit and Habitat[2]	Habitat within Study Area	Within Current Known Distribution	Distance to Nearest Record	Recorded within Study Area	Likelihood of Occurrence
	EPBC Act	WC Act	DBCA							
Tecticornia medusa			3	A, B, C, D	Perennial shrubs to 0.7 m high. Fl. Jul-Nov. Red-brown, gritty clay on a saline alluvial plain some distance from the shoreline.	Potential	Yes	1.8 km N	No	Unlikely
Tecticornia sp. Christmas Creek (K.A. Shepherd & T. Colmer et. Al. KS 1063)			1	A, B, C	Perennial shrub to 0.8 m high. Widespread across the saline flats of the Fortescue Marsh on red-brown clay.	Potential	Yes	10.5 km N	No	Unlikely
Teucrium pilbaranum			2	A	Upright shrub, 0.2 m high. Fl. white, May or Sep. Clay. Crab hole plain in a river floodplain, margin of calcrete table	Potential	No	>90 km WNW	No	Unlikely
Themeda sp. Hamersley Station (M.E. Trudgen 11431)			3	B, C	Tussocky perennial, grass-like or herb, 0.9-1.8 m high. Fl. Aug. Red clay. Clay pan, grass plain	Potential	Yes	>26 km NW	No	Possible
Tribulus minutus			1	A	Prostrate herb, plants villous; leaflet pairs 5-7; petals 2.5-7 mm long; spines on fruit not well-developed	No	No	>200 km E	No	Highly Unlikely
Triodia triticoides			1	A	Tussock-forming perennial, grass-like or herb, 0.45-2 m high, panicle spiciform continuous racemose, lemma deeply and unequally lobed. Fl. Jan to Mar or Jun to Jul. Rocky sandstone & limestone hillslopes	No	No	>1,000 km NE	No	Highly Unlikely
Xerochrysum boreale			3	A	Erect perennial, branched herb to 50 cm high. Loamy, sandy or gravelly soils on grassland or woodland, sometimes seasonally inundated areas.	Potential	No	>60 km SW	No	Unlikely

1 – A: Threatened and Priority Flora Database (DBCA, 2018c); B: WA Herbarium Specimen Database (DBCA, 2018c); C: NatureMap (DBCA, 2018a), D: Atlas of Living Australia (ALA, 2018).

2 – WAH (1998-), Rio Tinto and WAH (2015), Wilson (2017), Trudgen *et al.* (2015).

Appendix H: Introduced taxa identified from the desktop assessment

Family	Taxon	Common Name	WoNS	DPP	Ecological	Invasiveness	Source
Amaranthaceae	*Aerva javanica*	Kapok bush	No	No	High	Rapid	C, D
Fabaceae	*Alhagi maurorum*	Camelthorn	No	Yes	Not assessed	Not assessed	A
Asparagaceae	*Asparagus asparagoides*	Bridal creeper	Yes	Yes	Not assessed	Not assessed	A
Cactaceae	*Austrocylindropuntia cylindrica*		Yes	Yes	Not assessed	Not assessed	A
Cactaceae	*Austrocylindropuntia subulata*	Eve's needle	Yes	Yes	Not assessed	Not assessed	A
Apocynaceae	*Calotropis procera*	Rubber bush	No	Yes	Not assessed	Not assessed	A
Poaceae	*Cenchrus ciliaris*	Buffel grass	No	No	High	Rapid	B, C, D
Asteraceae	*Chondrilla juncea*	Skeleton weed	No	Yes	Not assessed	Not assessed	A
Cucurbitaceae	*Citrullus colocynthis*	Colocynth	No	No	Unknown	Moderate	C
Asteraceae	*Conyza bonariensis*	Fleabane	No	No	Not assessed	Not assessed	C
Apocynaceae	*Cryptostegia madagascariensis*	Madagascar rubber vine	No	Yes	Not assessed	Not assessed	A
Cactaceae	*Cylindropuntia fulgida*	Coral Cactus	Yes	Yes	High	Slow	A
Cactaceae	*Cylindropuntia imbricata*	Rope pear	Yes	Yes	Not assessed	Not assessed	A
Cactaceae	*Cylindropuntia kleiniae*	Klein's pencil cactus	Yes	Yes	Not assessed	Not assessed	A
Cactaceae	*Cylindropuntia pallida*	White-spined hudson pear	Yes	Yes	Not assessed	Not assessed	A
Cactaceae	*Cylindropuntia tunicata*	Thistle cholla	Yes	Yes	Not assessed	Not assessed	A
Boraginaceae	*Echium plantagineum*	Paterson's curse	No	Yes	Not assessed	Not assessed	A
Poaceae	*Eragrostis cilianensis*	Stinkgrass	No	No	Not assessed	Not assessed	C, D
Asteraceae	*Gnaphalium polycaulon*	Indian cudweed	No	No	Not assessed	Not assessed	C
Araliaceae	*Hydrocotyle ranunculoides*	Water pennywort	No	Yes	Not assessed	Not assessed	A
Euphorbiaceae	*Jatropha gossypiifolia*	Bellyache bush	Yes	Yes	Not assessed	Not assessed	A

Family	Taxon	Common Name	WoNS	DPP	Ecological	Invasiveness	Source
Verbenaceae	*Lantana camara*	Lantana	Yes	Yes	Not assessed	Not assessed	A
Malvaceae	*Malvastrum americanum*	Spiked malvastrum	No	No	High	Rapid	C, D
Iridaceae	*Moraea flaccida*	One-leaf cape tulip	No	Yes	Not assessed	Not assessed	A
Iridaceae	*Moraea miniata*	Two-leaf cape tulip	No	Yes	Not assessed	Not assessed	A
Asteraceae	*Onopordum acaulon*	Stemless thistle	No	Yes	Not assessed	Not assessed	A
Cactaceae	*Opuntia elata*	Riverina pear	Yes	Yes	Not assessed	Not assessed	A
Cactaceae	*Opuntia elatior*	Red-flower prickly pear	Yes	Yes	Not assessed	Not assessed	A
Cactaceae	*Opuntia engelmannii*	Engelman pear	Yes	Yes	Not assessed	Not assessed	A
Cactaceae	*Opuntia ficus-indica*	Indian fig	Yes	Yes	Not assessed	Not assessed	A
Cactaceae	*Opuntia microdasys*	Teddy bear cactus	Yes	Yes	Not assessed	Not assessed	A
Cactaceae	*Opuntia monacantha*	Drooping tree pear	Yes	Yes	Not assessed	Not assessed	A
Cactaceae	*Opuntia polyacantha*	Plain's prickly pear	Yes	Yes	Not assessed	Not assessed	A
Cactaceae	*Opuntia puberula*	Nopal de Tortuga	Yes	Yes	Not assessed	Not assessed	A
Cactaceae	*Opuntia stricta*	Common prickly pear	Yes	Yes	High	Rapid	A
Cactaceae	*Opuntia tomentosa*	Velvet prickly pear	Yes	Yes	Not assessed	Not assessed	A
Fabaceae	*Parkinsonia aculeata*	Parkinsonia	Yes	Yes	High	Rapid	A, B
Araceae	*Pistia stratiotes*	Water lettuce	No	Yes	Not assessed	Not assessed	A
Portulacaceae	*Portulaca pilosa*	Pink purslane	No	No	Not assessed	Not assessed	C
Fabaceae	*Prosopis glandulosa x velutina*	Mesquite	Yes	Yes	High	Rapid	A
Rosaceae	*Rubus ulmifolius*	Elmleaf blackberry	Yes	Yes	Not assessed	Not assessed	A
Alismataceae	*Sagittaria platyphylla*	Delta arrowhead	Yes	Yes	Not assessed	Not assessed	A

Family	Taxon	Common Name	WoNS	DPP	Ecological	Invasiveness	Source
Fabaceae	*Senna alata*	Seven-golden-candlesticks	No	Yes	Not assessed	Not assessed	A
Fabaceae	*Senna obtusifolia*	Sicklepod senna	No	Yes	Not assessed	Not assessed	A
Fabaceae	*Senna occidentalis*	Wild coffee	No	No	Not assessed	Not assessed	C, D
Poaceae	*Setaria verticillata*	Whorled pigeon grass	No	No	High	Rapid	D
Asteraceae	*Silybum marianum*	Variegated thistle	No	Yes	Not assessed	Not assessed	A
Solanaceae	*Solanum elaeagnifolium*	Silver nightshade	Yes	Yes	Not assessed	Not assessed	A
Solanaceae	*Solanum linnaeanum*	Apple of Sodom	No	Yes	Not assessed	Not assessed	A
Tamaricaceae	*Tamarix aphylla*	Athel Pine	Yes	Yes	High	Rapid	A, B
Fabaceae	*Ulex europaeus*	Gorse	Yes	Yes	Not assessed	Not assessed	A
Fabaceae	*Vachellia farnesiana*	Mimosa bush	No	No	High	Rapid	C, D
Asteraceae	*Xanthium spinosum*	Thorny burweed	No	Yes	Not assessed	Not assessed	A
Asteraceae	*Xanthium strumarium*	Noogoora bush	No	Yes	Not assessed	Not assessed	A
Araceae	*Zantedeschia aethiopica*	Arum lily	No	Yes	Not assessed	Not assessed	A
Rhamnaceae	*Ziziphus mauritiana*	Chinese apple	No	Yes	Not assessed	Not assessed	A

A: WAOL (DPIRD, 2018); B: PMST (DoEE, 2018); C: NatureMap (DBCA, 2018a); D: ALA (2018)

Appendix I: Flora taxa list

Family	Species	Conservation Code	Introduced
Aizoaceae	*Trianthema triquetrum*		
Amaranthaceae	**Aerva javanica*		Yes
	Alternanthera nana		
	Alternanthera nodiflora		
	Ptilotus aervoides		
	Ptilotus auriculifolius		
	Ptilotus axillaris		
	Ptilotus calostachyus		
	Ptilotus gomphrenoides		
	Ptilotus helipteroides		
	Ptilotus exaltatus		
	Ptilotus obovatus		
	Ptilotus roei		
Apocynaceae	*Cynanchum viminale*		
	Rhyncharrhena linearis		
Asteraceae	**Bidens bipinnata*		Yes
	Centipeda minima		
	Minuria integerrima		
	Pluchea ferdinandi-muelleri		
	Pluchea sp.		
	Pluchea tetranthera		
	Pterocaulon sphacelatum		
Boraginaceae	*Heliotropium chrysocarpum*		
	Heliotropium glanduliferum		
	Trichodesma zeylanicum var. *zeylanicum*		
Capparaceae	*Capparis spinosa* subsp. *nummularia*		
	Capparis umbonata		
Celastraceae	*Macgregoria racemigera*		
Chenopodiaceae	*Atriplex codonocarpa*		
	Atriplex sp.		
	Chenopodium gaudichaudianum		
	Dissocarpus paradoxus		
	Enchylaena tomentosa var. *tomentosa*		
	Maireana ? georgei		
	Maireana carnosa		
	Maireana georgei		
	Maireana melanocoma		
	Maireana pyramidata		
	Maireana triptera		
	Rhagodia eremaea		
	Salsola australis		
	Sclerolaena bicornis		

Family	Species	Conservation Code	Introduced
	Sclerolaena costata		
	Sclerolaena cuneata		
	Sclerolaena diacantha		
Cleomaceae	*Cleome viscosa*		
Convolvulaceae	*Bonamia erecta*		
	Evolvulus alsinoides var. *decumbens*		
	Operculina aequisepala		
Cucurbitaceae	*Cucumis variabilis*		
Cyperaceae	*Cyperus bifax*		
	Cyperus hesperius		
	Fimbristylis dichotoma		
Elatinaceae	*Bergia trimera*		
Euphorbiaceae	*Euphorbia boophthona*		
	Euphorbia tannensis subsp. *eremophila*		
Fabaceae	*Acacia ? aptaneura*		
	Acacia ? fuscaneura		
	Acacia ? sibirica		
	Acacia adsurgens		
	Acacia ancistrocarpa		
	Acacia aptaneura		
	Acacia coriacea subsp. *pendens*		
	Acacia dictyophleba		
	Acacia pachyacra		
	Acacia paraneura		
	Acacia pruinocarpa		
	Acacia pyrifolia var. *pyrifolia*		
	Acacia sclerosperma subsp. *sclerosperma*		
	Acacia sericophylla		
	Acacia sibirica		
	Acacia synchronicia		
	Acacia tetragonophylla		
	Acacia xiphophylla		
	Indigofera boviperda subsp. *boviperda*		
	Indigofera georgei		
	Indigofera monophylla		
	Petalostylis labicheoides		
	Rhynchosia minima		
	Senna artemisioides subsp. *artemisioides*		
	Senna artemisioides subsp. *filifolia*		
	Senna artemisioides subsp. *helmsii*		
	Senna artemisioides subsp. *oligophylla*		
	Senna glutinosa subsp. *glutinosa*		

Family	Species	Conservation Code	Introduced
	Senna glutinosa subsp. x *luerssenii*		
	Senna notabilis		
	**Senna occidentalis*		Yes
	Senna sp. Meekatharra (E. Bailey 1-26)		
	Sesbania cannabina		
	Tephrosia ? rosea var. Fortescue creeks (M.I.H. Brooker 2186)		
	**Vachellia farnesiana*		Yes
Goodeniaceae	*Goodenia forrestii*		
	Goodenia lamprosperma		
	Goodenia microptera		
	Goodenia muelleriana		
	Goodenia nuda	Priority 4	
	Goodenia prostrata		
	Goodenia triodiophila		
	Goodenia vilmoriniae		
	Scaevola amblyanthera var. *centralis*		
	Scaevola parvifolia subsp. *pilbarae*		
	Scaevola spinescens		
Haloragaceae	*Haloragis gossei* var. *gossei*		
Lamiaceae	*Dicrastylis cordifolia*		
Loranthaceae	*Amyema fitzgeraldii*		
	Amyema preissii		
Malvaceae	*Abutilon macrum*		
	Abutilon otocarpum		
	Abutilon oxycarpum		
	Corchorus sidoides subsp. *sidoides*		
	Corchorus sp.		
	Gossypium australe		
	Hibiscus brachychlaenus		
	Hibiscus burtonii		
	Hibiscus sturtii var. *platychlamys*		
	**Malvastrum americanum*		Yes
	Sida fibulifera		
	Sida platycalyx		
	Sida sp.		
	Waltheria indica		
Marsileaceae	*Marsilea* sp.		
Molluginaceae	*Trigastrotheca molluginea*		
Montiaceae	*Calandrinia* sp.		
Myrtaceae	*Corymbia hamersleyana*		
	Eucalyptus camaldulensis subsp. *obtusa*		

Family	Species	Conservation Code	Introduced
	Eucalyptus gamophylla		
	Eucalyptus socialis subsp. *eucentrica*		
	Eucalyptus victrix		
	Melaleuca glomerata		
Nyctaginaceae	*Boerhavia* sp.		
Phrymaceae	*Peplidium aithocheilum*		
Poaceae	*Aristida contorta*		
	Aristida holathera var. *holathera*		
	Aristida latifolia		
	**Cenchrus ciliaris*		Yes
	**Cenchrus setiger*		Yes
	**Chloris virgata*		Yes
	Chrysopogon fallax		
	Dactyloctenium radulans		
	Dichanthium sericeum subsp. *humilius*		
	Diplachne fusca subsp. *fusca*		
	**Echinochloa colona*		Yes
	Enneapogon caerulescens		
	Enneapogon polyphyllus		
	Enteropogon ramosus		
	Eragrostis ? eriopoda		
	Eragrostis australasica		
	Eragrostis cumingii		
	Eragrostis dielsii		
	Eragrostis falcata		
	Eragrostis xerophila		
	Eriachne ? benthamii		
	Eriachne aristidea		
	Eriachne mucronata		
	Eriachne sp.		
	Eriachne sp. (*? benthamii/ flaccida*)		
	Eulalia aurea		
	Panicum decompositum		
	Panicum laevinode		
	Paraneurachne muelleri		
	**Setaria verticillata*		Yes
	Sporobolus australasicus		
	Themeda triandra		
	Tragus australianus		
	Triodia angusta		
	Triodia basedowii		
	Triodia longiceps		

Family	Species	Conservation Code	Introduced
	Triodia pungens		
	Triodia schinzii		
	Triodia sp. *(pungens)*		
Polygonaceae	*Duma florulenta*		
Portulacaceae	*Portulaca cyclophylla*		
	Portulaca oleracea		
Proteaceae	*Hakea lorea* subsp. *lorea*		
Pteridaceae	*Cheilanthes sieberi* subsp. *sieberi*		
Rubiaceae	*Psydrax latifolia*		
	Synaptantha tillaeacea		
Santalaceae	*Santalum lanceolatum*		
	Santalum spicatum		
Sapindaceae	*Atalaya hemiglauca*		
	Dodonaea coriacea		
	Dodonaea petiolaris		
Scrophulariaceae	*Eremophila cuneifolia*		
	Eremophila forrestii subsp. *forrestii*		
	Eremophila lanceolata		
	Eremophila latrobei subsp. *latrobei*		
	Eremophila longifolia		
	Eremophila maculata subsp. *brevifolia*		
	Eremophila pilosa	Priority 1	
	Eremophila youngii subsp. *lepidota*	Priority 4	
Solanaceae	*Solanum cleistogamum*		
	Solanum esuriale		
	Solanum lasiophyllum		
	Solanum phlomoides		
Surianaceae	*Stylobasium spathulatum*		
Zygophyllaceae	*Tribulus hirsutus*		
	Tribulus macrocarpus		
	**Tribulus terrestris*		Yes
	Zygophyllum simile		

Appendix J: Conservation Significant Flora Locations

Taxon	Priority Status	Datum	Zone	Easting	Northing	Count	Condition	Reproductive status
Eremophila pilosa	Priority 1	GDA94	50K	806270	7485136	Common	Healthy	Flowering
Eremophila youngii subsp. *lepidota*	Priority 4	GDA94	51K	195974	7485161	20-50	Healthy	Flowering
Eremophila youngii subsp. *lepidota*	Priority 4	GDA94	51K	196282	7485168	20-50	Healthy	Flowering
Eremophila youngii subsp. *lepidota*	Priority 4	GDA94	51K	196303	7485678	20-50	Healthy	Flowering
Eremophila youngii subsp. *lepidota*	Priority 4	GDA94	50k	788467	7488346	10-20	Healthy	Flowering
Eremophila youngii subsp. *lepidota*	Priority 4	GDA94	50k	788951	7488863	20-50	Healthy	Flowering
Eremophila youngii subsp. *lepidota*	Priority 4	GDA94	50k	789278	7488297	10-20	Healthy	Flowering
Eremophila youngii subsp. *lepidota*	Priority 4	GDA94	50k	789689	7488810	10-20	Healthy	Flowering
Eremophila youngii subsp. *lepidota*	Priority 4	GDA94	50k	791099	7488283	20-50	Healthy	Flowering
Eremophila youngii subsp. *lepidota*	Priority 4	GDA94	50k	791373	7491870	20-50	Healthy	Flowering
Eremophila youngii subsp. *lepidota*	Priority 4	GDA94	50k	791523	7490571	50-100	Healthy	Flowering
Eremophila youngii subsp. *lepidota*	Priority 4	GDA94	50k	791758	7490487	20-50	Healthy	Flowering
Eremophila youngii subsp. *lepidota*	Priority 4	GDA94	50k	791980	7490263	20-50	Healthy	Flowering
Eremophila youngii subsp. *lepidota*	Priority 4	GDA94	50k	794416	7490180	<10	Healthy	Flowering
Eremophila youngii subsp. *lepidota*	Priority 4	GDA94	50k	795628	7492136	20-50	Healthy	Flowering
Eremophila youngii subsp. *lepidota*	Priority 4	GDA94	50k	796879	7488787	10-20	Healthy	Flowering
Eremophila youngii subsp. *lepidota*	Priority 4	GDA94	50K	796997	7491772	10-20	Healthy	Flowering
Eremophila youngii subsp. *lepidota*	Priority 4	GDA94	50k	798390	7490372	10-20	Healthy	Flowering
Eremophila youngii subsp. *lepidota*	Priority 4	GDA94	50K	798418	7490271	10-20	Healthy	Flowering
Eremophila youngii subsp. *lepidota*	Priority 4	GDA94	50k	800176	7491889	>100	Healthy	Flowering
Eremophila youngii subsp. *lepidota*	Priority 4	GDA94	50k	800178	7491866	>100	Healthy	Flowering

Taxon	Priority Status	Datum	Zone	Easting	Northing	Count	Condition	Reproductive status
Eremophila youngii subsp. *lepidota*	Priority 4	GDA94	50k	803755	7494788	10-20	Healthy	Flowering
Eremophila youngii subsp. *lepidota*	Priority 4	GDA94	50k	804463	7488013	50-100	Healthy	Flowering
Eremophila youngii subsp. *lepidota*	Priority 4	GDA94	50k	804757	7488805	50-100	Healthy	Flowering
Eremophila youngii subsp. *lepidota*	Priority 4	GDA94	50k	806436	7487397	50-100	Healthy	Flowering
Goodenia nuda	Priority 4	GDA94	50k	789722	7488898	20-50	Healthy	Flowering
Goodenia nuda	Priority 4	GDA94	50k	791241	7487672	<10	Healthy	Flowering
Goodenia nuda	Priority 4	GDA94	50k	796908	7487298	20-50	Healthy	Flowering

Appendix K: Extent of vegetation units and condition within Roy Hill tenure

Vegetation unit extent within Roy Hill tenure

Code	Description	Study Area		E47/1326		E46/586		L47/642	
		ha	%	ha	%	ha	%	ha	%
AaAfLIT	*Acacia ? aptaneura* and/ or *Acacia ? fuscaneura* low isolated trees over *Acacia synchronicia, Acacia sclerosperma* subsp. *sclerosperma* and *Eremophila cuneifolia* mid to tall sparse shrubland over *Triodia angusta* and *Triodia pungens* mid sparse hummock grassland with pockets of bare areas dominated by tussock grasses and herbs.	3,667	15	1,114	10	1,417	15	3,664	15
AaLIT	*Acacia aptaneura* with occasional *Eucalyptus gamophylla* and *Acacia pruinocarpa* low isolated to isolated patches of trees over *Acacia sclerosperma* subsp. *sclerosperma* and other *Acacia* and *Eremophila* species mid to tall isolated shrubs over *Triodia angusta* and occasional *Triodia pungens* mid open hummock grassland.	6,375	26	3,750	34	194	2	6,344	27
AaLSW	*Acacia aptaneura* low sparse woodland to isolated patches of trees over *Acacia tetragonophylla, Acacia sclerosperma* subsp. *sclerosperma* and *Acacia synchronicia* mid to tall isolated shrubs over **Cenchrus ciliaris* and **Cenchrus setiger* low open to sparse tussock grassland.	454	2	223	2	231	3	384	2

Code	Description	Study Area		E47/1326		E46/586		L47/642	
		ha	%	ha	%	ha	%	ha	%
AaLW	*Acacia aptaneura* with occasional *Eucalyptus victrix* low woodland to open woodland over *Acacia sclerosperma* subsp. *sclerosperma, Psydrax latifolia* and *Acacia tetragonophylla* mid to tall isolated shrubs over *Triodia angusta* patches of mid hummock grasses over open tussock grassland and herbland.	558	2	200	2	171	2	556	2
AsTSS	*Acacia synchronicia* tall to mid sparse shrubland, with occasional **Vachellia farnesiana* over *Eragrostis xerophila*, **Cenchrus ciliaris* and *Dactyloctenium radulans* isolated patches of low tussock grasses and isolated patches of *Sclerolaena cuneata, Sclerolaena costata* and *Sclerolaena diacantha* low chenopod shrubs.	2,903	12	0	0	2,903	32	2,903	12
AxTOS	*Acacia xiphophylla* (and occasional *Acacia synchronicia*) tall open shrubland over *Eremophila youngii* subsp. *lepidota*, *Senna* sp. Meekatharra (E. Bailey 1-26) and *Eremophila cuneata* mid to low sparse shrubland over isolated tussock grasses and herbs.	1,637	7	1,310	12	0	0	1,631	7
CP	Bare, open claypans, with occasional tussock grasses and shrubs, dominated by *Eragrostis australasica, Diplachne fusca* subsp. *fusca* and *Sesbania cannabina*.	118	<1	90	1	23	<1	118	<1

Code	Description	Study Area		E47/1326		E46/586		L47/642	
		ha	%	ha	%	ha	%	ha	%
EcoMIT	*Eucalyptus camaldulensis* subsp. *obtusa* mid isolated trees over *Eucalyptus victrix, Atalaya hemiglauca* and *Acacia coriacea* subsp. *pendens* low isolated trees over disturbed understorey dominated by **Vachellia farnesiana*.	226	1	33	<1	193	2	226	1
EvAaLIT	Occasional *Eucalyptus victrix* low isolated trees over *Acacia aptaneura* low isolated trees over *Acacia sclerosperma* subsp. *sclerosperma, Acacia pyrifolia* var. *pyrifolia* and *Senna glutinosa* subsp. x *luerssenii* mid to tall isolated shrubs over *Triodia angusta* mid sparse hummock grassland.	615	3	614	5	0	0	538	2
EvAaLSW	*Eucalyptus victrix* and occasionally *Acacia aptaneura* low sparse woodland over mid to tall shrubland dominated by *Acacia* (*Acacia ancistrocarpa, Acacia tetragonophylla* and *Acacia sclerosperma* subsp. *sclerosperma*) and *Eremophila* (*Eremophila longifolia*) species over *Eulalia aurea, Chrysopogon fallax* and *Eriachne* spp. mid to low open tussock grassland.	76	<1	71	1	2	<1	76	<1

Code	Description	Study Area		E47/1326		E46/586		L47/642	
		ha	%	ha	%	ha	%	ha	%
EvAaLSWIT	*Eucalyptus victrix* and *Acacia aptaneura* low sparse woodland to isolated trees over *Acacia sclerosperma* subsp. *sclerosperma*, *Acacia tetragonophylla* and *Eremophila youngii* subsp. *lepidota* mid to tall isolated shrubs over **Malvastrum americanum* low isolated patches of herbs and occasional patches of *Triodia angusta* mid hummock grasses.	1,194	5	906	8	286	3	1,137	5
EvLIT	*Eucalyptus victrix* and occasional patches of *Acacia aptaneura* low isolated trees over *Acacia sclerosperma* subsp. *sclerosperma, *Vachellia farnesiana* and *Acacia tetragonophylla* mid to tall isolated shrubs over disturbed understorey dominated by **Malvastrum americanum* and **Cenchrus ciliaris*.	4,422	18	1,582	14	2,840	32	4,174	18
TaTpTsMOHG	*Triodia angusta* and/ or *Triodia pungens* and/ or *Triodia schinzii* mid open hummock grassland with isolated mid to tall shrubs dominated by *Stylobasium spathulatum*, *Acacia sclerosperma* subsp. *sclerosperma* and *Acacia synchronicia*.	1,907	8	1,138	10	641	7	1,903	8
Cl/D	Cleared and disturbed areas associated with pastoralism.	80	<1	68	1	15	<1	47	<1
Cleared Area	Gazetted public roads.	96	<1	69	1	18	<1	96	<1
Total		**24,328**	**100**	**11,169**	**100**	**8.936**	**100**	**23,798**	**100**

Vegetation condition extent within Roy Hill tenure

Condition	Study Area		E47/1326		E46/586		L47/642	
	ha	%	ha	%	ha	%	ha	%
Excellent	3,704	15	2,958	26	746	8	3,627	15
Very Good	11,895	49	5,977	54	1,702	19	11,811	50
Good	3,386	14	209	2	3,177	36	3,371	14
Poor	87	<1	87	1	0	0	86	<1
Degraded	1,517	6	237	2	1,280	14	1,445	6
Completely Degraded	3,738	15	1,702	15	2,029	23	3,458	15
Total	**24,328**	**100**	**11,169**	**100**	**8,936**	**100**	**23,798**	**100**

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