Supporting Documentation

Native Vegetation Clearing Permit Application
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Wedgefield Laydown Facility

21 May 2020

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	Native Vegetation Clearing Permit Application Supporting Documentation		
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1. INTRODUCTION

IB Operations Pty Ltd (Iron Bridge), a majority-owned subsidiary of Fortescue Metals Group Limited (Fortescue), is proposing to develop a laydown and steel fabricated module staging area within the Wedgefield Industrial Estate in Port Hedland. The facility will be used for laydown of construction materials and staging of steel fabricated modules prior to their transport to the Iron Bridge mine site, which is approximately 110 kilometres (km) south of Port Hedland in the Pilbara region of Western Australia.

The Wedgefield laydown facility (WLF) (Figure 1) is located on lands managed by the Pilbara Ports Authority (PPA) for which a PPA Investigations Licence has been granted. The WLF comprises of blocks W012, W013 and W014. W012 and W014 are existing hardstands, with W013 being undeveloped, requiring approximately 65,000 m^3 of bulk fill material to be imported and compacted to form a suitable hardstand to level and match the height of blocks W012 and W014 at the site.

This Native Vegetation Clearing Permit (NVCP) application proposes to clear up to 8.1 ha of native vegetation. This report and its appendices provide all the relevant information required under Part V, Section 51E of the *Environmental Protection Act 1986* (EP Act), to assess the proposed clearing. This includes baseline environmental data, survey reports, a digital project envelope (shapefile) and assessment against the 10 Clearing Principles.

1.1 Summary of Proposal

The key details of the WLF and the proposed clearing are represented in Table 1.

Table 1: Key Details of the Proposed Clearing

Site Details			
Project Name	Wedgefield Laydown Facility		
Description of Operation	Laydown area and steel fabricated module staging area within the Wedgefield Industrial Estate. The laydown facility is to support the Iron Bridge mine site.		
Total Clearing Proposed	8.1 ha of native vegetation		
Project Commencement Date	August 2020		
Lease Agreement Details	**Lease**	**Tenement Holder**	**Status**
	PPA Investigations licence	Pilbara Port Authority	Live
Clearing Method	Clearing will be undertaken by machinery.		
Purpose of Clearing	The clearing is to allow for the undertaking of the following infrastructure requirements: • Laydown areas • Steel fabricated module staging area Temporary infrastructure comprises of the following: • 1 x temporary office • 1 x temporary ablution block • 1 x mobile waste storage tank serviced by truck • 1 x mobile small diesel generator with associated bunding		

Proponent Details		
Company Name	IB Operations Pty Ltd	
ACN	165 513 557	
Postal Address	PO Box 6915 East Perth, Western Australia	
Key Contact	[redacted]	[redacted]
	[redacted]	[redacted] – [redacted]
	[redacted]	[redacted]
	[redacted]	[redacted]

1.2 Proposed Clearing Activities

Iron Bridge is applying to disturb a 8.1 ha Indicative Disturbance Footprint (IDF) (Figure 1). The cleared area is to be used as a laydown area and a steel fabricated module staging area.

1.3 Mitigation Hierarchy

There has been considerable effort expended to ensure the WLF activities will have as minimal impact on the environment as practicable. The activities have been designed with the following principles in mind:

1. Clearing will not have a significant impact on the environment; and
2. Clearing activities can be rehabilitated.

Using these principles, all areas of environmental significance has been avoided.

1.4 Relevant Approvals and Background

Key legislation that may affect the environmental management of the WLF are included in Table 2, as well as all relevant environmental approvals that have been sought or are required before vegetation disturbance may be implemented.

Table 2: Relevant Approvals for the Wedgefield Laydown Facility

Relevant legislation	Environmental factor	Relevant approval/ Requirement
Environmental Protection Act 1986 (EP Act) – Part IV	Preliminary key environmental factors identified via the current EPA assessment include: • Flora and Vegetation • Terrestrial Fauna	Provides for the protection and regulation of impacts on the environment in Western Australia. The WLF is not considered a significant proposal as the proposed disturbance is unlikely to have a significant effect on the environment. No further approvals are required under Part IV of the Act.
Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)	Biodiversity/Flora/Fauna/Ecosystems (Matters of National Environmental Significance)	Provides for the protection and regulation of impacts on the environment (Matters of National Environmental Significance). The WLF is not a controlled action for the purposes of the EPBC Act. No further approvals are required under the Act.
EP Act – Part V	Clearing of Native Vegetation Air quality and atmospheric gases	This Native Vegetation Clearing Permit is being submitted to facilitate land clearing associated with the scope of the WLF. No prescribed premises categories, as listed in Schedule 1 of the EP Act, apply to the WLF.
Rights in Water and Irrigation Act 1914	Water resources	Provides for planning and allocation of water in Western Australia. Water required for the construction of the WLF will be sourced from existing licenced groundwater sources associated with Fortescue's Pilbara Mining Operations. No further applications for Groundwater Licences are required for the WLF.

2. STAKEHOLDER ENGAGEMENT

IBO commenced consultation for the WLF towards the end of 2019 through a combination of face to face meetings, presentations and letters to key stakeholders. The overarching objectives of the consultation program are:

- To inform stakeholders about the WLF and its impacts to the environment and to describe the outcomes of consultation on project design;
- To enable land access through areas of multiple use; and
- To establish relationships with key stakeholders that enable ongoing dialogue through implementation and regulation of the WLF.

2.1 Key Stakeholders

Key stakeholders have been identified through Fortescue's extensive experience in the Pilbara. Fortescue has also adopted previous recommendations from State government agencies on stakeholders that should be included in the program. Key stakeholders identified to date are listed in Table 3.

Table 3: Key Stakeholders for the Wedgefield Laydown Project

Government Agencies	Community and Surrounding Land Users
Department of Water and Environmental Regulation (DWER) Karratha	Town of Port Hedland (ToPH)
Department of Planning, Lands and Heritage (DPLH)	Pilbara Ports Authority (PPA)
	Main Roads Western Australia (MRWA)
	Kariyarra Aboriginal Corporation

2.2 Stakeholder Consultation

The consultation activities undertaken to date and the feedback received by Fortescue is summarised in Table 4.

Table 4: Record of Stakeholder Engagement

Date	Stakeholder	Form	Outcome
31/10/2019	MRWA	Meeting	Briefing of project and consulting with Network Manager & Regional Manager at MRWA in Port Hedland
14/11/2019	PPA and ToPH	Meeting	Site visit to Wedgefield Industrial Estate in Port Hedland
19/12/2019	DPLH	Meeting	Project introduction and access options and approvals. Project scope subsequently reduced to remove development from non-Port lands.
17/01/2020	PPA	Meeting	Project update and development planning
23/01/2020	ToPH	Meeting	Project update, including Wedgefield development

Date	Stakeholder	Form	Outcome
06/02/2020	MRWA	Meeting	Presented Wedgefield development proposal.
06/02/2020	ToPH	Meeting	Project update, including Wedgefield development
13/03/2020	PPA	Meeting	Project update and development planning
16/03/2020 & 18/03/2020	MRWA	Meeting	Project update and crossover and design layout further consulted for comment. Comments received on 18th March.

2.3 Heritage and Native Title

The WLF is located within the:

- Kariyarra Native Title Determined Land WAD232/2009, WAD47/2014, WAD6169/1998, WCD2018/015

Land access agreements (LAAs) assist in facilitating construction and development within determined land areas, and Fortescue is party to:

- Fortescue and the Kariyarra People are parties to a Land Access Agreement (LAA) dated 10 October 2005.

Fortescue regularly meets and consults with nominated representatives of the Kariyarra People over all matters relating to the identification, protection and management of their cultural heritage. Fortescue will continue to liaise with the Kariyarra traditional owners regarding the development of the WLF. There are no heritage places recorded within the IDF.

3. BASELINE ENVIRONMENTAL DATA

A reconnaissance flora and vegetation and a Level 1 fauna survey of the WLF area was undertaken by Ecoscape in February 2020. The assessment is included as Appendix 1.

Previous flora and fauna assessments have been undertaken by GHD (2009): Report for Port Hedland Industrial Land LIA 3,4,5 General Industry/Transport Part A and part B: Preliminary Environmental Impact Assessment and Biological Survey. These surveys included a Level 2 flora and vegetation assessment and a Level 1 fauna assessment. A desktop review of the previous assessments was included in the assessment undertaken by Ecoscape.

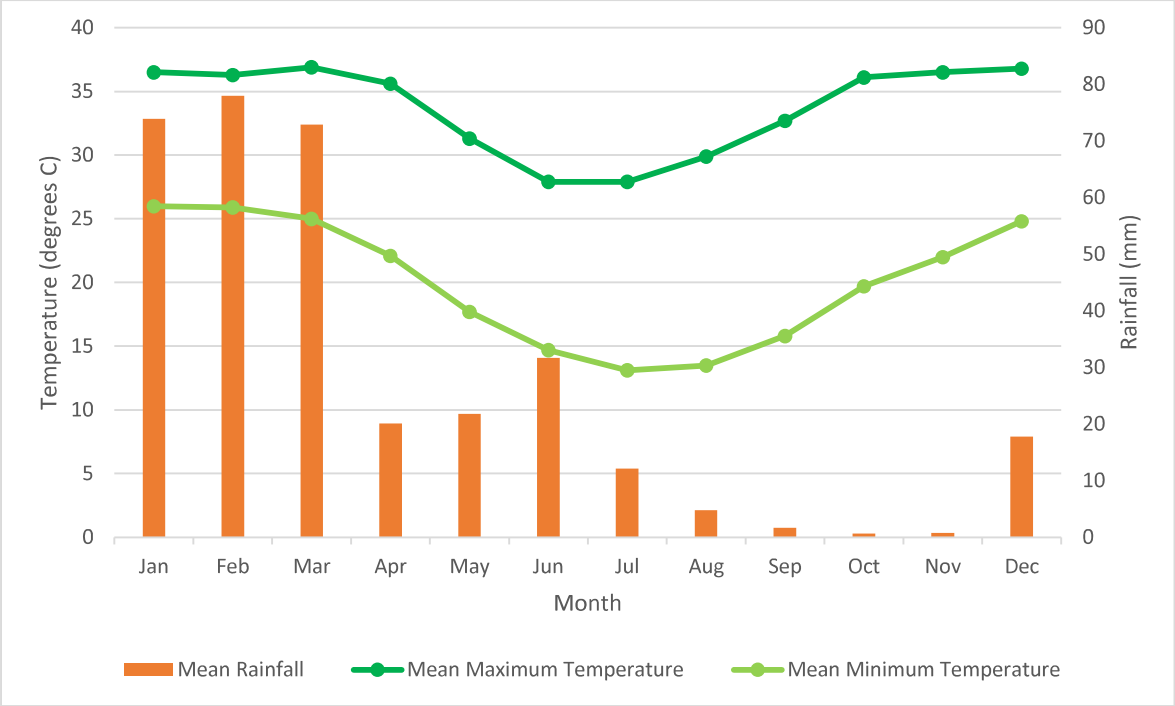
3.1 Climate

The WLF is located within the Pilbara region, which includes two broad climatic zones: hot, humid summer with a warm winter and hot, dry summer with a mild winter (van Vreeswyk, et al., 2004). The WLF is within Climate Zone 1 where there is the high humidity summer and warm winters.

The monthly rainfall and temperature averages for the Port Hedland (BoM, 2020) station, located approximately 3.4 km at the nearest point of the proposed IDF, and is shown in Graph 1. Monthly maximum temperatures range between 27.9°C and 36.9°C, and minimum temperatures range between 13.1°C and 29°C (BoM 2020).

Annual rainfall in the Pilbara has substantial yearly variation, but generally follows an inland to coastal and southern to northern increasing trend. Tropical cyclones, many of which originate in the Timor Sea, along with local thunderstorms, produce much of the summer and early autumn rainfall. The driest months are in spring (September to October), and winter rainfall is highly variable, generally decreasing from the coast through to inland areas (McKenzie et al. 2009).

Graph 1 shows the mean monthly temperatures and rainfall for the Port Hedland BoM stations.



Graph 1: Port Hedland Climate Averages

3.2 Landscape

Land use in the region is dominated by pastoral grazing as well as mining. The WLF is located entirely within the Pilbara biogeographic region of the Interim Biogeographic Regionalisation for Australia (IBRA). The Pilbara biogeographic region incorporates 17,831,892 ha and includes four subregions: Chichester, Roebourne, Hamersley, and Fortescue Plains. The WLF is located entirely within the subregion Roebourne which is described in the *2002 Biodiversity Audit of Western Australia's 53 Biogeographical Subregions* (May & McKenzie, 2003) as:

Roebourne:

Quaternary alluvial and older colluvial coastal and subcoastal plains with a grass savannah of mixed bunch and hummock grasses, and dwarf shrub steppe of *Acacia stellaticeps* or *A. pyrifolia* and *A. inaequilatera.* Uplands are dominated by *Triodia* hummock grasslands. Ephemeral drainage lines support *Eucalyptus victrix* or *Corymbia hamersleyana* woodlands. *Samphire*, *Sporobolus* and *mangal* occur on marine alluvial flats and river deltas. Resistant linear ranges of basalts occur across the coastal plains, with minor exposures of granite. Islands are either Quaternary sand accumulations, or composed of basalt or limestone, or combinations of any of these three. Climate is arid (semi-desert) tropical with highly variable rainfall, falling mainly in summer. Cyclonic activity is significant, with several systems affecting the coast and hinterland annually (May & McKenzie, 2003).

3.2.1 Land Systems

The WLF runs through one land system, as described by van Vreeswyk et al. (2004). The Uaroo land system makes up the entirety of the area (Figure 2). The Uaroo System is described as:

> **Uaroo System**
>
> Broad sandy plains, pebbly plains and drainage tracts supporting hard and soft spinifex hummock grasslands with scattered acacia shrubs.

3.3 Materials Classification

The clearing associated with the WLF will result in shallow disturbance of soils, with approximately 65,000 m^3 of bulk fill material to be imported and compacted to form a suitable hardstand to ensure the site is level.

Risks associated with acidic and metalliferous drainage, sodic and dispersive materials, and naturally occurring radioactive materials are not considered relevant to the WLF.

The IDF intersects one soil landscape land quality zone (Figure 3) according to the Department of Primary Industries and Regional Development dataset DPIRD-017, described as:

> **De Grey-Roebourne Lowlands**
> Alluvial plains and sandplains on alluvial and marine deposits over the northern Pilbara Craton with Red deep sandy duplexes, Red loamy earths, Red/brown non-cracking clays, Cracking clays, Red sandy earths and Red deep loamy duplexes.

3.4 Flora and Vegetation

The flora and vegetation of the WLF has been analysed through a desktop literature review and a reconnaissance survey, with the results being produced in this section.

3.4.1 Regional Vegetation Units

The IDF occurs entirely within one subregion of the Pilbara Interim Biogeographic Regionalisation for Australia (IBRA), being the Roebourne subregion. Vegetation units have been described on a regional scale by Beard (1975) and updated by DAFWA (2012). These vegetation units are broad scale descriptors and attempt to depict the native vegetation as it was presumed at the time of European settlement. One Beard vegetation units occur within the application area and are listed in Table 5 with their total estimated Pre-European extent.

Table 5: Beard Vegetation Unit Intersecting the Indicative Disturbance Footprint

Association	Description	Pre-European Extent (ha)	Current Extent (ha)	Extent mapped within the Indicative Disturbance Footprint (ha)
ABYDOS PLAIN 647	Hummock grassland with scattered shrubs or mallee, *Triodia spp. Acacia spp. Grevillea spp. Eucalyptus spp.*	195,861	191,711	8.1

3.4.2 Flora and Vegetation Studies

The WLF has been subject to flora and vegetation survey efforts (Table 6). The reconnaissance survey conducted by Ecoscape in 2020 included a desktop review of GHD's 2009 Level 2 flora and vegetation assessment of the area.

Table 6: Flora and Vegetation Surveys Intersecting the Study Area

Report Title	Survey Date	Survey Type
Report for Port Hedland Industrial Land LIA 3,4,5 General Industry/Transport Part A and Part B: Preliminary Environmental Impact Assessment and Biological Survey – GHD	2009	Level 2 flora and vegetation assessment
Wedgefield Flora and Fauna Report - Ecoscape	February 2020	Reconnaissance survey

3.4.3 Vegetation Communities

A total of four vegetation communities have been mapped within the IDF as depicted in Table 7 and Figure 4.

Table 7: Vegetation Communities Intersecting the Indicative Disturbance Footprint

Veg Type Code	Description	Mapped Extent within Purpose Permit Envelope (ha)
Te	*Triodia epactia* and *Acacia stellaticeps* low closed hummock grassland/shrubland	1.70
Ts	*Triodia secunda* and *Frankenia ambita* low hummock grassland/shrubland	1.84
Ta	*Tecticornia auriculate, T. indica* subsp. *leiostachya* and *T.halocnemoides* low open samphire shrubland	0.54
Ti	*Tecticornia indica* subsp. *leiostachya* and *T. halocnemoides* low samphire shrubland	0.57
Not Vegetated	Previously cleared vegetation or devoid of vegetation	3.45
	Total (ha)	8.10

3.4.4 Vegetation Condition

A total of 3.45 ha (42.59%) of the area is cleared or devoid of vegetation. The vegetation portions of the WLF ranged from Very Good to Completely Degraded condition. 45.02% of the vegetation in very good to good condition. The main factor influencing the vegetation conditions of the WLF were existing clearing, informal tracks, general edge effects and weed infestations.

3.4.5 Conservation Significant Vegetation Communities

In Western Australia, a vegetation community can be classified as a Threatened Ecological Community (TEC) by the Western Australian Minister for Environment, based on the assessment and recommendation of the Threatened Species Scientific Committee. TECs that are listed to be of State conservation significance in Western Australia are considered to be Environmentally Sensitive Areas (ESA) under Part V of the EP Act.

Potential TECs that do not meet survey criteria are added to the Priority Ecological Community (PEC) list under Priority 1, 2 or 3. Ecological communities that are adequately known, are rare but not threatened, meet criteria for “Near Threatened”, or that have been recently removed from the threatened list, are placed in Priority 4. Conservation dependent ecological communities are placed in Priority 5.

There are no TECs and PECs within the IDF, therefore no impact is anticipated.

One PEC (Eighty Mile Land System) is approximately 35km to the north-east of the IDF. The Eighty Mile Land System PEC (Priority 3) is described as “Beach foredunes, longitudinal coastal dunes and sandy plains with tussock grasslands and spinifex grasslands”.

3.4.6 Sheetflow Dependent Vegetation

The term ‘sheetflow dependent vegetation’ refers to vegetation communities that are dependent on an overland flow of water, which occurs on broad plains with a very gradual slope. The main communities considered to be reliant on this process in the Pilbara are typically recognised as grove-intergrove vegetation. This vegetation is often referred to as ‘Banded Mulga’, as the communities are dominated by various taxa in the *Acacia ‘aneura’* complex, however evidence-based assessments are lacking and sheetflow alone does not provide the required dynamics to maintain Mulga groves (Biota, 2017).

No sheetflow dependent vegetation units are recorded within the IDF.

3.4.7 Groundwater Dependent and Potentially Groundwater Dependent Vegetation

Groundwater Dependent Vegetation (GDV) is defined as terrestrial vegetation that is dependent on the presence of groundwater to meet some, or all, of its ecological water requirement (Astron, 2016).

GDV is often characterised by the presence of key indicator species such as Coolibah (*Melaleuca argentea*) or River Red Gum (*Eucalyptus camaldulensis*). These species obtain the majority of their water requirements from groundwater.

Other vegetation communities may potentially be dependent on groundwater. In particular, the presence of *Eucalyptus victrix* as a dominant overstory species may indicate that a vegetation community may potentially be dependent on groundwater. Considered to be a facultative phreatophyte (Batini, 2009) (Froend, 2009), *E. victrix* uses soil water derived from surface water drainage into the unsaturated zone but may obtain some of their water requirements from groundwater where it is available, particularly large mature trees. Therefore, based on available literature Fortescue considers that the presence of *E. victrix* as a dominant overstorey species may be indicative of a potential use of groundwater, depending on site-based conditions, including depth to groundwater and the surface hydrological regime.

No potential GDV has been identified within the IDF.

3.4.8 Flora Taxa

The WLF area has been subject to flora and vegetation survey effort, including a Level 2 assessment by GHD and reconnaissance survey by Ecoscape. Ecoscape included a desktop assessment of the Level 2 flora and vegetation assessment in their report.

A total of 61 vascular flora taxa from 46 genera and 23 families. The most commonly represented families were *Fabaceae* (13 taxa, including 2 introduced), *Poacea*e (12 taxa, including 2 introduced) and *Chenopodiaceae* (5 taxa). The most commonly represented genera were *Acacia* (4 taxa), *Eragrostis*, *Tecticornia* and *Trianthema* (3 taxa each).

3.4.9 Flora of Conservation Significance

No Threatened Flora listed under the *Environment Protection and Biodiversity Conservation Act 1999* or the *Biodiversity Conservation Act 2016* has been mapped within the IDF. None are anticipated to occur as they hadn't been previously recorded from within 50km of the survey area. No priority-listed flora was recorded within the IDF. A likelihood assessment was undertaken, and it was considered that it was unlikely or highly unlikely for any priority-listed flora to be recorded in the IDF. No other flora taxa of significance according to the criteria outlined in the *Flora and Vegetation Technical Guidance* (EPA, 2016) was recorded during the survey.

14 priority flora species were located outside the IDF within a buffer of 50km, including two Priority 1, one Priority 2, eight Priority 3 and three Priority 4.

3.4.10 Weeds

No Weeds of National Significance (WONS) were identified within the IDF. However, the following alien species were observed within the IDF.

- **Aerva javanica* (Kapok Bush)
- *Cenchrus ciliaris (Buffel Grass)
- **Chloris barbata* (Purpletop Chloris)
- ***Indigofera oblongifolia***
- ***Stylosanthes hamata* (Verano Stylo)

3.5 Vertebrate Fauna

A terrestrial fauna Level 1 survey was completed by Ecoscape in February 2020. The study included a desktop review of the data from the Level 1 fauna survey completed by GHD in 2009. The findings of this assessment are presented in the below sections.

3.5.1 Fauna Habitat

A total of 3 broad fauna habitat types, as assessed by Ecoscape (2020), were mapped within the IDF (Figure 5). Details regarding these habitat types are listed in Table 8, including whether they support conservation significant fauna.

Table 8: Fauna Habitats Intersecting the Indicative Disturbance Footprint

Habitat Type	Description	Significant Fauna & Suitability of Habitat Type	Mapped Extent within Indicative Disturbance Footprint (ha)
*Cleared areas	N/A	N/A	3.45
Hummock Grassland	Low grassland of *Triodia*, small shrubs, herbs and grasses on sandy soil.	Suitable for small birds (particularly granivores), mammals and reptiles.)	3.54
Halophytic Shrubland	Scattered samphire shrubs over sandy soil, ephemerally inundated.	Suitable for small bird and reptile species.	1.04
Minor Drainage Line	Seasonally wet drainage lines with bare sandy soil and scattered samphire shrubs.	Suitable as a water source for most fauna groups when inundated. Marginally suitable only for reptiles when dry.	0.07
		Total (ha)	**8.10**

**Cleared areas refer to existing cleared areas or areas devoid of vegetation.*

3.5.2 Conservation Significant Fauna

Fourteen vertebrate fauna species were recorded during the Ecoscape (2020) field survey with no conservation significant species identified.

Two vertebrate fauna species, listed as either threatened fauna (*EPBC Act*, *BC Act* Schedule) or as priority fauna (DBCA Priority list) had been identified in the 2009 GHD survey as highly likely to occur within the IDF. After the 2020 Ecoscape Level 1 fauna assessment it was considered unlikely for the fauna to exist in the area, for the following reasons:

- Brush-tailed Mulgara (*Dasycerus blythi*) (Priority 4) – considered unlikely to exist in the area due to presence of Feral cats and the 2020 survey corroborated findings from the 2009 survey where only unused and presumably abandoned burrows were recorded. No burrow or scat evidence was recorded within the IDF.
- Airlie Island Ctenotus (*Ctenotus angusticeps)* (Vulnerable & Priority 4) – considered unlikely to exist in the area as the survey area doesn't provide the appropriate habitat for the species to occur.

It is considered unlikely for there to be any significant impact on any conservation significant species within the IDF.

3.5.3 Short Range Endemic Invertebrates

Short-range endemic (SRE) fauna are defined as animals that display restricted geographic distributions, normally less than 10,000 km^2, that may also be disjunct and highly localised (Harvey, 2002).

There were no potential SRE species recorded within the IDF and therefore it is unlikely to be any significant impact to SRE invertebrates or their habitat.

3.5.4 Feral Animals

Three introduced mammal species have been recorded in the IDF, including:

- *Felis catus* (Cat)
- *Canis lupus* subsp. *familiaris* (Dingo/dog)
- *Oryctolagus cuniculus* (Rabbit)

3.6 Hydrology

Pilbara creeks are typically ephemeral and are dry for the majority of the year, with the exception of pools and groundwater fed springs. Pilbara soils typically have high initial infiltration rates for dry catchment conditions, i.e. when the antecedent moisture content of the

soils is low. Significant streamflow usually occurs when antecedent moisture content of the soils is high, which is caused by significant rainfall in the days or weeks preceding a storm event.

There are typically two different types of climatic events which cause flood response in the Pilbara, namely: Cyclonic activity/Tropical Low-Pressure Systems, and localised diurnal thunderstorms.

Cyclonic activity can result in severe and widespread flooding, generally on a river catchment scale. The occurrence of this flooding activity can be forecast in advance (albeit with significant uncertainty), so catchment wide flood warnings are typically issued. This type of flooding typically produces large peak flows and may result in damage to infrastructure due to the magnitude of flow. However, not all cyclones will result in severe flooding.

Isolated thunderstorms have the potential to create fast and localised flooding, referred to as flash flooding. These events are much harder to predict as they can occur in the upper reaches of catchments. These events generally have a lower potential for widespread damage as the extent and magnitude of flooding is much smaller than cyclonic events.

There is 0.07 ha of minor drainage lines and no permanent surface water features within the IDF. Significant disturbance to the natural drainage of water from the landscape is not anticipated with the proposed clearing.

4. ENVIRONMENTAL IMPACTS AND MANAGEMENT

The environmental impacts of the proposed vegetation clearing have been considered in the following section.

4.1 Potential Impacts to Flora and Vegetation

Potential impacts to flora and vegetation resulting from implementation of WLF vegetation disturbance include:

- Direct loss of vegetation at a local level
- Degradation of vegetation due to indirect impacts such as:
  - Fragmentation, leading to edge effects
  - Dust deposition
  - Chemical and hydrocarbon spills and leaks

4.1.1 Direct Loss of Vegetation

Vegetation disturbance for the WLF will result in disturbance of approximately 8.1 ha of native vegetation, comprising of a total of four vegetation communities, these are detailed in Table 7 and Figure 4.

IBO minimised the impact to vegetation by consulting with Main Roads Western Australia to access the facility via the highway which resulted in a reduction in vegetation clearing.

4.1.2 Direct Loss of Conservation Significant Vegetation

During the design of infrastructure placement, specific attention was given to avoiding flora and vegetation communities of environmental significance. There are no TECs or PECs within the IDF.

4.1.3 Direct Loss of Sheetflow Dependent Vegetation

No sheetflow dependent vegetation unit are recorded within the IDF, therefore no impact is expected.

4.1.4 Direct Loss of Potentially Groundwater Dependent Vegetation

No potential GDV has been identified within the IDF.

4.1.5 Direct Loss of Flora of Conservation Significance

There is no priority flora species located within the IDF and during the Ecoscape (2020) survey it was considered that it was unlikely for priority species to be located within the IDF. It is considered that the clearing of vegetation will not pose a significant threat to any priority species.

4.1.6 Degradation of Vegetation

Degradation of vegetation may occur as a result of:

- Uncontrolled vehicle access leading to physical damage of vegetation and/or the introduction or spread of weeds
- Dust deposition on vegetation resulting from land clearing and construction activities
- Introduction or spread of weed species
- Leaks of containment structures, pipes, vehicles or equipment leading to contamination of soils, surface water or groundwater
- Spills of chemicals or hydrocarbons leading to contamination of soils, surface water or groundwater
- Inappropriate disposal of domestic waste, waste hydrocarbons and chemicals, construction waste or treated sewage leading to contamination of soils, surface water or groundwater

Dust Deposition

Dust deposition can occur through movement of vehicles and earth moving. Dust deposition on foliage can impact on a plants ability to photosynthesise, or control water loss through transpiration. One published study indicates that vegetation health is not impacted by dust deposition until relatively high levels of dust are experienced, that is, greater than 7g/m^2/month (Doley, 2006). The impact from dust deposition from this proposal is low due to short construction timeframe due to rolling nature of construction activities and Fortescue's dust management measures (refer to Table 9).

Chemical Spills, Leaks and Leachate

Contamination of soil by chemical and hydrocarbon spills can impede plant growth or kill vegetation. Drainage from infrastructure can contain higher levels of sediments which may cause a decline in vegetation health. Fortescue consider the risk of impacts to vegetation from contamination and pollution to be low with the implementation of the measures detailed in Table 9.

4.1.7 Management Measures for Flora and Vegetation

There has been considerable effort expended to ensure the IDF and associated activities will have as minimal an impact on flora and vegetation as practicable. The activities have been designed to ensure that the clearing avoids any significant impact on the environment.

The design and placement of the WLF is does not have any Threatened or Priority Flora listed under the *Environment Protection and Biodiversity Conservation Act 1999* or the *Biodiversity Conservation Act 2016* within the IDF*,* and no TECs or PECs will be impacted.

Mitigation measures to manage the residual risk are captured in Table 9.

Fortescue manages clearing of native vegetation through a Land Use Certification (LUC). A LUC identifies the area to be disturbed and considers multiple factors, such as environmental (significant values and approvals), heritage, tenure, pastoral leases and water, prior to disturbance being permitted. Each LUC application is reviewed for each factor by technical leads with Fortescue before approval is granted. Conditions are placed on each LUC with regards to the identified factors to ensure clearing is undertaken in accordance with legal obligations and with regards to environmental or heritage values. The LUC process allows applicants to modify their application to avoid significant or sensitive values in consultation with the technical leads prior to approval of the LUC.

Conditions of the LUC may include ground inspections for conservation significant flora or fauna depending on the receiving environment and the conditions of any environmental approval applicable to the area. No LUC would be approved without the area having been subject to heritage survey.

Table 9: Management Measures for Flora and Vegetation

Impact	Management Actions
Direct Loss of Vegetation and Flora	• Review the proposed project design against the vegetation survey data to avoid/minimise clearing of significant flora and vegetation. • All Threatened and Priority Flora are to be identified on the ground by appropriate signage, fencing and/or flagging prior to clearing. • Minimise clearing and vegetation disturbance to ensure significant flora and vegetation are protected. Conduct vegetation clearing in accordance with a permit issued under the *Land Use Certificate (LUC) Procedure (100-PR-TA-0001).* • Ensure staff and contractors are aware of the location of significant flora and vegetation on site and their responsibility to ensure they are protected.
Fragmentation	• Weed hygiene requirements are implemented for plant and equipment in identified weed risk areas and/or in areas where weed populations have been identified and high-risk activities are proposed to be undertaken in accordance with the *Weed Management Plan (100-PL-EN-1017).*

Impact	Management Actions
Altered fire regimes	• Site induction will inform about fire risk and potential sources. • A Hot Works Permit system will be implemented. • Appropriate fire breaks will be installed from workspaces and around camps and other infrastructure in accordance with regulations.
Dust	• Vehicle speeds restricted according to *Traffic Management Plan (100-PR-SA-0049).* • Dust suppression will be carried out during construction. • Appropriate cover placed on open areas to minimise dust lift off post-closure.
Chemical and Hydrocarbon Spills	• Ensure relevant personnel and contractors involved in chemical and hydrocarbon handling and storage activities are provided with the appropriate training and equipment as outlined in the *Chemical and Hydrocarbon Spills Procedures 100-PR-EN-0014* and *the Hazardous Materials Management Procedure 100-PR-SA-1059.* • Chemicals and hydrocarbons should be stored in accordance with AS 1940, AS 3833 or AS 3780 to minimise the potential for environmental harm. Storage should only be in designated areas and within the limits specified in applicable Licence conditions under the EP Act. • Where a chemical or hydrocarbon spill has occurred, manage the spill including any contaminated material, in accordance with the *Chemical and Hydrocarbon Spills Procedure 100-PR-EN-0014* and investigate and report the incident in accordance with the *Incident Event Management Procedure 100-PR-SA-0011.* • Contain and appropriately manage potentially contaminated stormwater prior to release to the environment. • Remediate any area declared contaminated as defined under the *Contaminated Sites Act 2003* in accordance with the DER's Contaminated Sites Management Series – Assessment Levels for Soil, Sediment and Water (2011).
Altered surface hydrology	• Conduct a risk assessment to determine the likelihood of a change to the surface water regime that may lead to unacceptable environmental impacts. • Protect natural drainage lines from construction impacts where possible to minimise impacts to water quality.

4.1.8 Conclusion – Impacts to Flora

Considering the existing environment, proposed activities and management strategies, IBO believes the impacts to flora and vegetation of the proposed clearing are not significant.

4.2 Potential Impacts to Fauna

Potential impacts to terrestrial fauna, including the conservation significant fauna and SRE invertebrates resulting from implementation of WLF include:

- Habitat loss from direct clearing of fauna habitat

- Habitat fragmentation, resulting in:
    - Restriction or removal of access to breeding habitat, foraging habitat or water sources through placement of infrastructure
    - Increased feral animal species
    - Increased weed species
- Increased vehicle strike

4.2.1 Habitat Loss

The WLF has been designed to avoid or minimise impacts to fauna habitat of conservation significance. No conservation significant fauna species have been recorded within the IDF and the likelihood of conservation significant fauna species within the IDF was rated low by Ecoscape.

4.2.2 Fragmentation of Habitat

Fragmentation occurs when a large expanse of habitat is transformed into a number of smaller patches due to clearing, isolating these smaller fragments from each other by cleared areas (Wilcove, McLellan, & Dobson, 1986). Where the landscape surrounding the fragments is inhospitable to species of the original habitat, and when dispersal is low, remnant patches can be considered true habitat islands and local communities will be isolates. Small habitat fragments are likely to be low in heterogeneity, that is, the habitat may not present the range of habitat variety required by some species (e.g. both foraging and breeding habitat) (Wilcove, McLellan, & Dobson, 1986).

It is possible that the vegetation disturbance for the IDF may cause a barrier to some species movement within their home ranges, particularly small reptiles and mammals. Significant impacts to fauna resulting from habitat fragmentation is not anticipated.

4.2.3 Increased Vehicle Strike

The undertaking of vegetation disturbance will result in an increase in the number of vehicles in the local area. Vehicles may strike fauna species on roads, particularly slow-moving animals or species that are easily startled. Vehicles travelling at night are more likely to strike native fauna when visibility is reduced and animals are more active. Species such as birds of prey are also likely to feed off dead carcases on roads and may also become victim to vehicle strike.

Fortescue keeps a record of all vehicle related fauna incidents. The species with the highest number of vehicle strikes at Fortescue's operating sites is the kangaroo, usually at dawn and dusk. There have been relatively few vehicle strikes involving significant fauna at Fortescue

sites. It is not expected that the clearing activities will result in a significant increase in vehicle strikes.

4.2.4 Increased Weed Species

Clearing for development and increased movement of vehicles, including earth moving machinery may result in the spread of existing or the establishment of new, populations of weed species. Increased numbers of weeds can significantly increase the risk of fire, which can impact on fauna habitat value. Areas of dense weed infestation can also reduce the ability of fauna to move through their habitat and impact on their ability to forage. Weed species palatable to feral herbivores may attract these animals to the area causing an increase in predation of native species, potential land degradation and further spreading of weed species either by movement of soil or in the animal's dung. Through the implementation of weed hygiene management measures and creating hardstands within the IDF, it is not expected that the WLF will result in significant spread of or the introduction of new weed populations.

4.2.5 Mitigation

Fortescue has applied the mitigation hierarchy of the WLF in relation to terrestrial fauna. Mitigation measures to address potential impacts are detailed in Table 10.

Table 10: Management Measures for Fauna

Impact	Management Actions
Loss of habitat	• Record conservation significant fauna and habitat identified during a targeted fauna survey in the Corporate GIS and PIMS in accordance with the *Environmental Datasets – Data Governance Guidelines (100-GU-EN-0020)*. • Land use certification (LUC) procedure. Must be adhered to before any ground disturbance, rehabilitation or land access. This ensures all proposed disturbance is checked for: purpose; cultural heritage; and environmental significance. No ground disturbance can take place without a valid land use certificate. • Ensure infrastructure location, design, construction and operation reflects risk assessment outcomes in minimising impacts on conservation significant fauna and associated habitat. • Prior to conducting ground disturbance activities, ensure known locations of environmentally sensitive areas to be retained and protected from disturbance are identified on the ground by appropriate signage, fencing or flagging.
Fragmentation of habitat	• Land use certification (LUC) procedure must be adhered to before any ground disturbance, rehabilitation or land access. This ensures all proposed disturbance is checked for: purpose; cultural heritage; and environmental significance. No ground disturbance can take place without a valid land use certificate.
Increased Feral Animals	• Domestic waste stored in appropriate bins inaccessible to animals. • All domestic waste will be transported off site. • No domestic animals permitted on site.
Vehicle Strike	• To minimise the potential for fauna injuries or deaths on access roads, implement appropriate mitigation measures such as speed limit restrictions, right of way for fauna and the prohibition of off tenure driving.
Weeds	• Weed hygiene requirements are implemented for plant and equipment in identified weed risk areas and/or in areas where weed populations have been identified and

Impact	Management Actions
	high-risk activities are proposed to be undertaken in accordance with the *Weed Management Plan (100-PL-EN-1017).*

4.2.6 Conclusion – Impacts to Fauna

Considering the existing environment, proposed activities and management strategies, Fortescue believes the impacts to fauna and fauna habitat from the proposed clearing are not significant.

4.3 Assessment Against the Ten Clearing Principles

The *Environmental Protection Act 1986* includes ten principles that provide decision makers with a guide on whether native vegetation should be cleared. The principles, outlined in *'Schedule 5 – Principles for Clearing Native Vegetation'*, are used as a comparative tool by DWER and DMIRS in determining whether clearing activities are environmentally acceptable and capable of being appropriately managed. Table 11 assesses the proposed clearing against these Principles.

Table 11: Proponent Assessment of the Clearing Principles

Proponent Assessment of the Clearing Principles
(a) Native vegetation should not be cleared if it comprises a high level of biological diversity.
Proposed clearing is not likely to be at variance to this Principle The WLF has been subject to flora and vegetation survey efforts. The reconnaissance survey conducted by Ecoscape in 2020 included a desktop review of GHD's 2009 Level 2 flora and vegetation assessment of the area. The Ecoscape assessment recorded a total of 61 vascular flora taxa from 46 genera and 23 families. The vegetation condition of the IDF has been classified as very good to good condition (45.02%) whilst the remaining area is cleared or devoid of vegetation (42.59%). No Weeds of National Significance (WONS) were identified within the IDF as detailed under section 3.4.10. Weed species within the IDF include **Aerva javanica* (Kapok Bush), **Cenchrus ciliaris* (Buffel Grass), **Chloris barbata* (Purpletop Chloris), **Indigofera oblongifolia* and **Stylosanthes hamata* (Verano Stylo). As noted in Principle (b), the fauna habitat and recorded fauna species of the IDF indicated that it is not more biodiverse when compared to other locations within the Pilbara bioregion. The IDF is composed of vegetation and fauna habitat that are typical in the landscape thereby not reducing the potential biodiversity by reducing habitat diversity. Based on the above, the proposed clearing is not likely to be at variance to this Principle.
(b) Native vegetation should not be cleared if it comprises the whole or part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to Western Australia.
Proposed clearing is not at variance to this Principle

Proponent Assessment of the Clearing Principles

The IDF was subject to a reconnaissance survey by Ecoscape (2020), which included a desktop survey of GHD's 2009 Level 2 flora and vegetation assessment of the area. No conservation significant species were recorded within the IDF. It is considered unlikely for any Conservation Significant Fauna to exist within the IDF.

There are minor drainage lines within the IDF, however it is considered that clearing within the IDF will not have an impact on any major drainage or creek lines.

Based on the above, the proposed clearing is not likely to be at variance to this Principle.

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

Proposed clearing is not at variance to this Principle

There is no threatened flora mapped within the IDF and none have been previously recorded from within 50km of the survey area. No priority-listed flora was recorded within the IDF and it was considered unlikely or highly unlikely to occur within the IDF.

The habitat types that are proposed to be cleared are common in the landscape and are not considered habitat that would support threatened flora.

Based on the above, the proposed clearing is not at variance to this Principle.

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

Proposed clearing is not at variance to this Principle

There are no TECs or PECs within the IDF. One PEC (Eighty Mile Land System) is approximately 35km to the north-east of the IDF. The Eighty Mile Land System PEC (Priority 3) is described as "Beach foredunes, longitudinal coastal dunes and sandy plains with tussock grasslands and spinifex grasslands".

Based on the above, the proposed clearing is not at variance to this Principle

(e) Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared.

Proposed clearing is not at variance to this Principle

The IDF occurs within one subregion of the Pilbara Interim Biogeographic Regionalisation for Australia (IBRA), being the Roebourne subregion. The Roebourne subregion have not been extensively cleared nor are there vegetation communities within the IDF that would be considered a remnant.

There is one Beard (1975) vegetation community within the IDF. This vegetation community is considered widespread across the Pilbara, with over 98 percent of their pre-European extent remaining:

- ABYDOS PLAIN 647; Hummock grassland with scattered shrubs or mallee, *Triodia spp. Acacia spp. Grevillea spp. Eucalyptus spp.*

Based on the above, the proposed clearing is not at variance to this Principle.

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

Proposed clearing is not likely to be at variance to this Principle

Proponent Assessment of the Clearing Principles

There is 0.07 ha of minor drainage lines falling within the IDF as outlines in Section 3.5.1. There are no permanent surface water features within the IDF. Significant disturbance to the natural drainage of water from the landscape is not anticipated with the proposed clearing.

Based on the above, the proposed clearing is not likely to be at variance to this Principle.

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

Proposed clearing is not likely to be at variance to this Principle

The management measures detailed in previous sections will assist in reducing the likelihood of land degradation as a result of clearing of the WLF. These management measures include surface water and weed management. In addition, all of the proposed clearing is for the instatement of hardstands which will be maintained so it will be unlikely erosion to take place.

Based on the above, the proposed clearing is not likely to be at variance to this Principle.

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

Proposed clearing is not at variance to this Principle

The IDF does not intersect or adjoin any conservation areas. There is no vegetation that is associated with watercourses within the IDF. It is not predicted that there will be any impact on surface water flows through the proposed disturbance of the WLF.

Based on the above, the proposed clearing is not at variance to this Principle.

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

Proposed clearing is not likely to be at variance to this Principle

The only surface water features within the IDF are minor drainage lines (0.07 ha). Surface water along the drainage lines is only present following significant rainfall events. The proposed clearing is unlikely to have a significant impact on surface water quality during these sporadic events. Appropriate stormwater, vegetation clearing, and materials handling management measures will be put in place to minimise the potential impact on water quality. It is unlikely that the proposed clearing will impact groundwater quality.

Based on the above, the proposed clearing is not likely to be at variance to this Principle.

(j) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause, or exacerbate, the incidence or intensity of flooding.

Proposed clearing is not at variance to this Principle

The WLF does not significantly impact on any natural watercourse and drainage lines. The natural drainage features of the landscape will largely be unaffected by the IDF and hence impacts to the landscape associated with this aspect are not anticipated to occur.

Based on the above, the proposed clearing is not at variance to this Principle.

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Figure 1: Wedgefield Laydown Facility Overview

N

0 50 100 150

Meters

Data Source(s):
Imagery, FMG, 2020

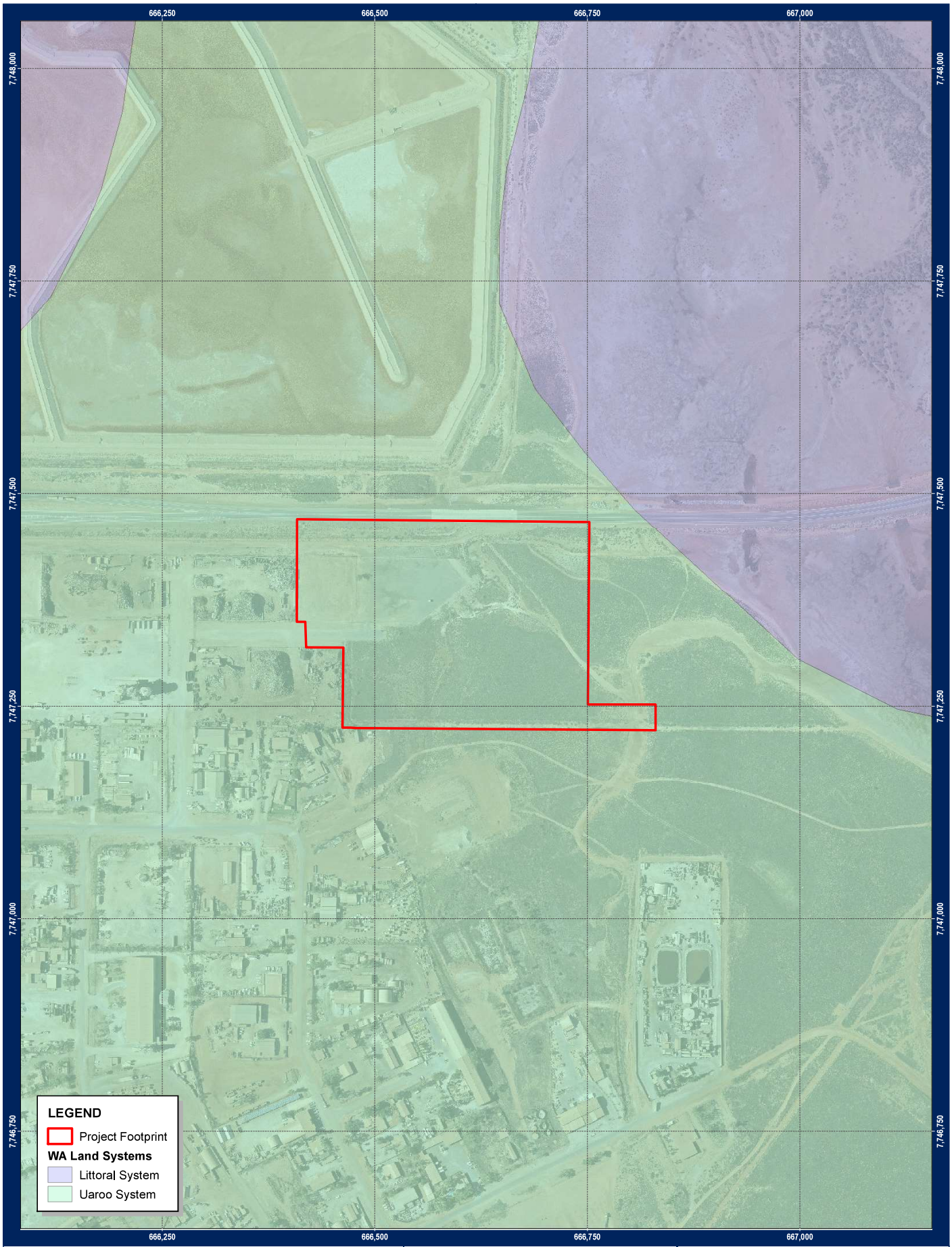
Requested By: Jane Humphrey
Drawn By: Sang Li
Revised By: sanli
Approved By:
Scale: 1:4,000
Coordinate System: GDA 1994 MGA Zone 50
Document Name: P_MP_EN_0178_01_r0

Date: 01/04/2020
Size: A3P
Revision: 0
Confidentiality: 1

Map 1: Project Footprint
Wedgefield

Fortescue

Figure 2: Land Systems



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Data Source(s):
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Imagery, FMG, 2020

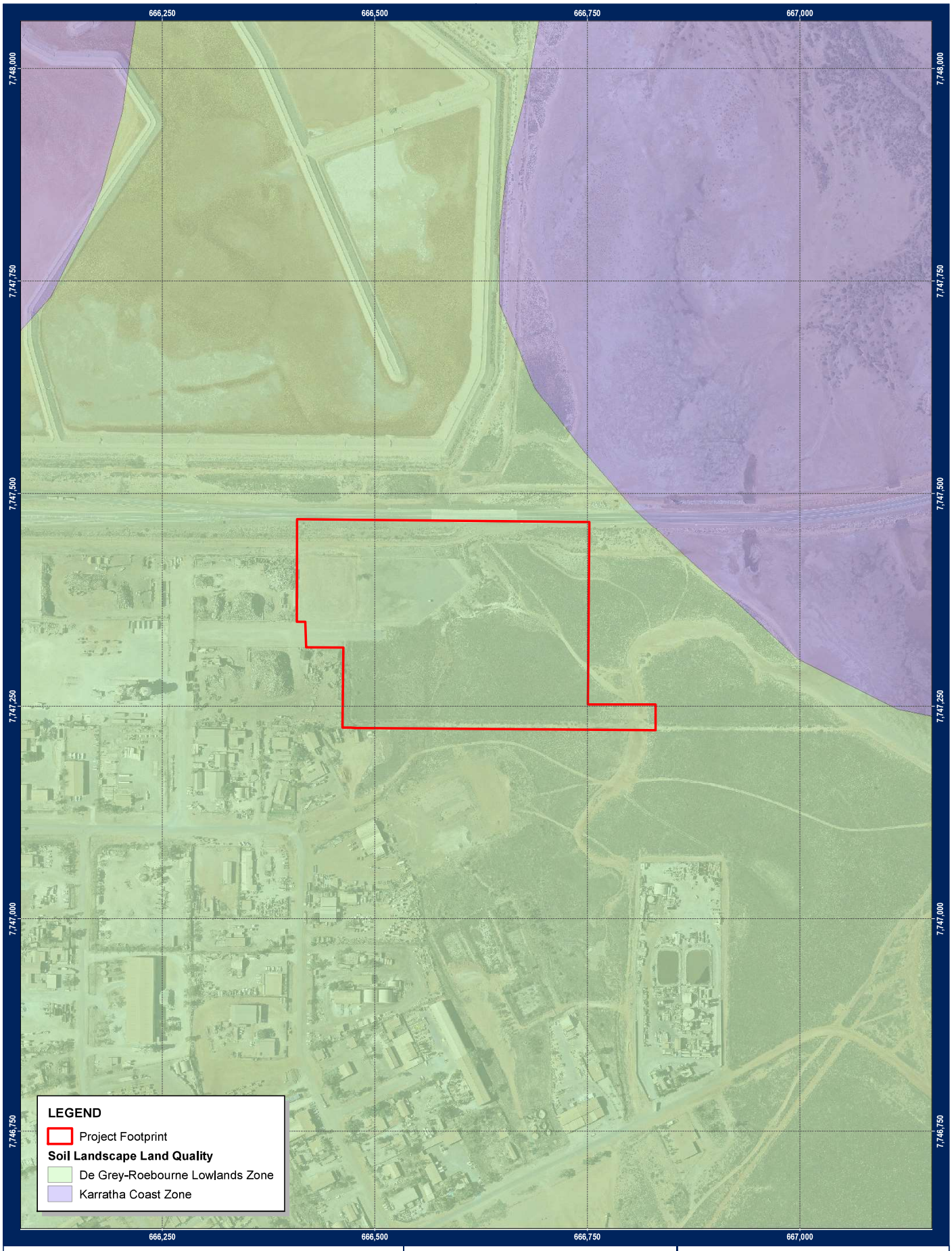
Requested By: Jane Humphrey
Drawn By: Sang Li
Revised By: sanli
Approved By:
Scale: 1:4,000
Coordinate System: GDA 1994 MGA Zone 50
Document Name: P_MP_EN_0178_02_r0

Date: 01/04/2020
Size: A3P
Revision: 0
Confidentiality: 1

Map 2: Land Systems
Wedgefield

Fortescue

Figure 3: WA Soil Groups



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Imagery, FMG, 2020

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Drawn By: Sang Li
Revised By: sanli
Approved By:
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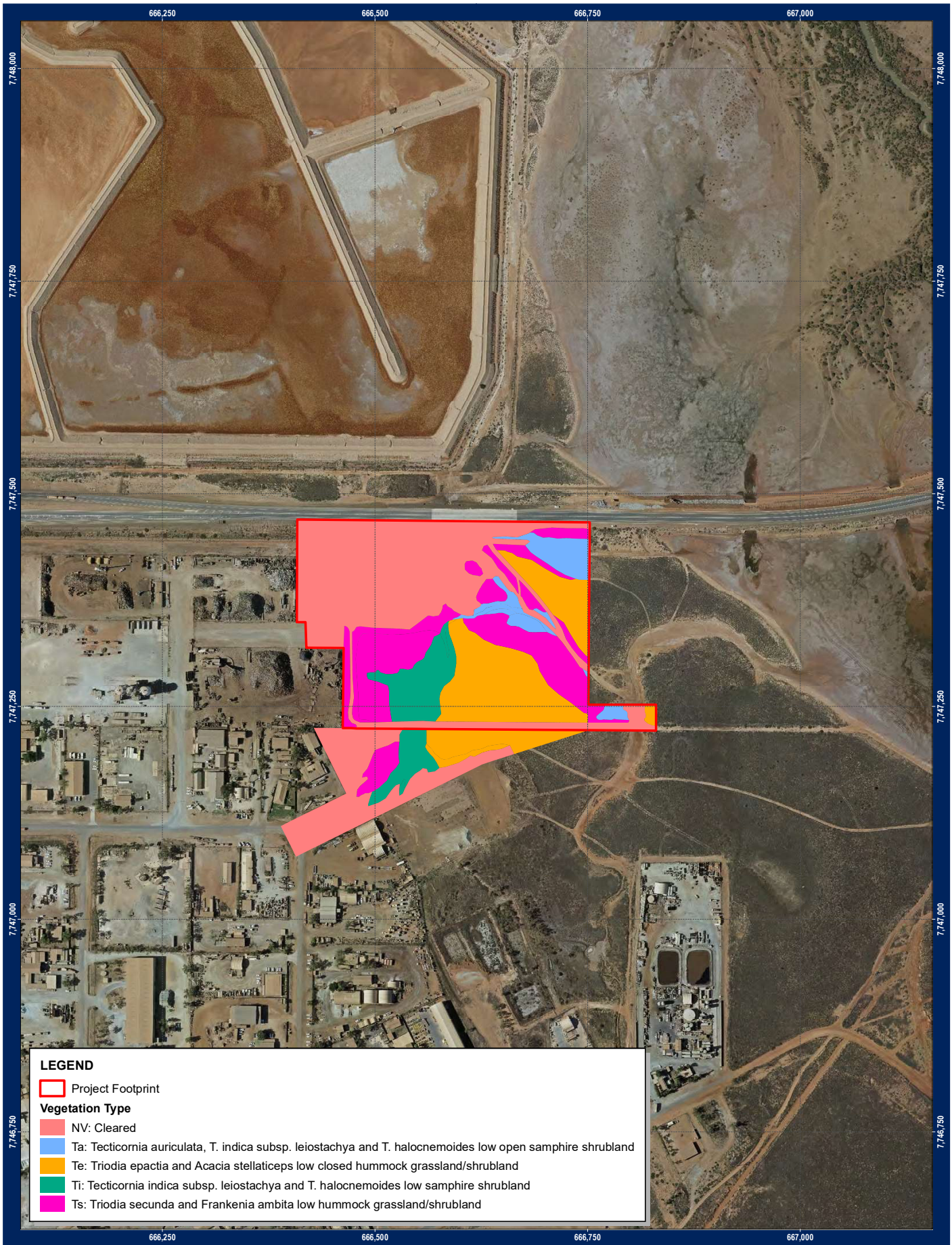
Document Name: P_MP_EN_0178_03_r0

Date: 01/04/2020
Size: A3P
Revision: 0
Confidentiality: 1

Map 3: Soils
Wedgefield

Fortescue

Figure 4: Vegetation Communities



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Data Source(s):
Vegetation Type, Ecoscape, 2020
Aerial Imagery, FMG, 2019
All Other Datasets, FMG, 2020

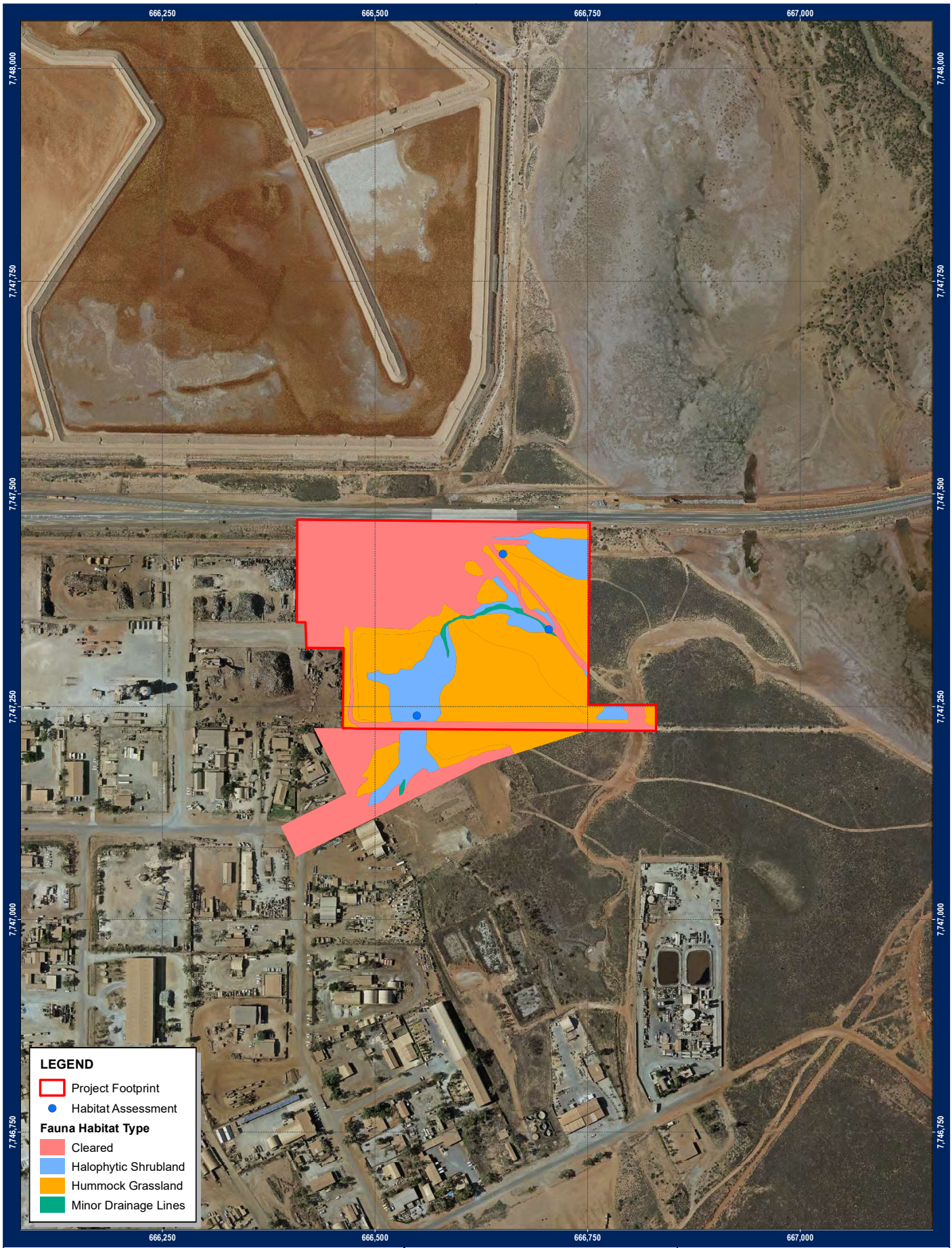
Requested By: J. O'brien
Drawn By: S. Li
Revised By: pkulkarni
Approved By:
Scale: 1:4,000
Coordinate System: GDA 1994 MGA Zone 50
Document Name: P_MP_EN_0178_04_r0

Date: 08/05/2020
Size: A3P
Revision: 0
Confidentiality: 1

Map 4: Vegetation Type
Wedgefield

Fortescue

Figure 5: Fauna Habitats



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Aerial Imagery, FMG, 2019
All Other Datasets, FMG, 2020

Requested By: J. O'brien
Drawn By: S. Li
Revised By: pkulkarni
Approved By:
Scale: 1:4,000
Coordinate System: GDA 1994 MGA Zone 50
Document Name: P_MP_EN_0178_05_r0

Date: 08/05/2020
Size: A3P
Revision: 0
Confidentiality: 1

Map 5: Fauna Habitat Type
Wedgefield

Fortescue

Figure 6: Conservation Significant Fauna

LEGEND

- Wedgefiled Survey Area

Conservation Significant Fauna (DBCA, 2019)

- Critically endangered
- Endangered
- Vulnerable
- Migratory Species
- Priority 3
- Priority 4

DATA SOURCES
SOURCE DATA:
AERIAL: PORT HEDLAND 10CM NOV 2015 (FORTESCUE)
SERVICE LAYERS:

ecoscape

FAUNA DATABSE SEARCH RESULTS

WEDGEFIELD FLORA AND FAUNA SURVEYS

IRONBRIDGE

Fortescue
The New Force in Iron Ore

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

SCALE: 1:25,000 @ A3
0 200 400 600 800 1,000 m

PROJECT NO: 4508-20

REV	AUTHOR	APPROVED	DATE
00	JLT	SK	25/02/2020
01	SMB	SK	24/04/2020

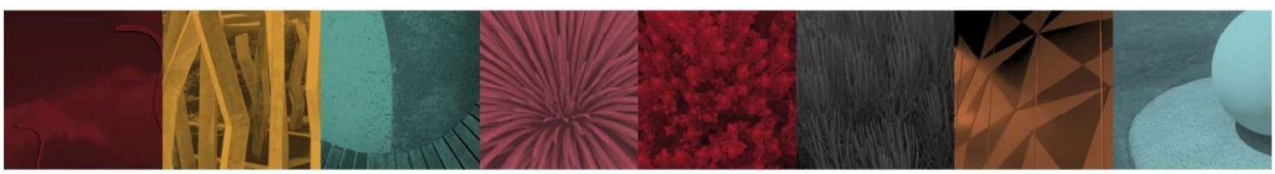
MAP 02

Appendix 1: Wedgefield Flora and Fauna Survey

Wedgefield Flora and Fauna Survey

FMG Iron Bridge (Aust) Pty Ltd

ecoscape



VERSION	AUTHOR	QA REVIEWER	APPROVED	DATE
Draft rev0	Stephen Kern Melinda Henderson	L. atkins. LYN ATKINS Principal Ecologist	L. atkins. LYN ATKINS Principal Ecologist	26/02/2020
Final rev0	Stephen Kern	L. atkins. LYN ATKINS Principal Ecologist	L. atkins. LYN ATKINS Principal Ecologist	5/03/2020
Final rev1	Stephen Kern	L. atkins. LYN ATKINS Principal Ecologist	L. atkins. LYN ATKINS Principal Ecologist	24/04/2020

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9 Stirling Highway • PO Box 50 NORTH FREMANTLE WA 6159
Ph: (08) 9430 8955

This report should be cited as 'Ecoscape (Australia) Pty Ltd (2020) *Wedgefield Flora and Fauna Survey*, report prepared for FMG Iron Bridge (Aust) Pty Ltd'

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FIGURES

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MAPS

SUMMARY

FMG Iron Bridge (Aust.) Pty Ltd (IB) is proposing to develop a laydown and steel fabricated module staging facility for the its iron ore project and has selected a site within the Wedgefield Industrial Estate, comprising blocks W012, W013 and W014. This development will require a Native Vegetation Clearing Permit (NVCP) to be submitted. IB commissioned Ecoscape to undertake a Reconnaissance flora and vegetation survey and a Level 1 fauna survey to support its NVCP.

The desktop assessment identified the following relevant aspects:

- the survey area corresponds with a single pre-European vegetation association (647, Abydos Plain) with 97.8% of its state-wide extent remaining
- One Priority Ecological Community was identified by the database searches (Eighty Mile Land System), located approximately 35 km to the northeast of the survey area
- 14 Priority Flora species have been previously recorded within 50 km of the survey area, none from within it. No Threatened Flora are known from within this radius
- 11 Threatened or Priority Fauna species were identified by the combined database searches; none have been recorded from within the survey area.

The field survey, conducted in February 2020, identified the following:

- 61 vascular flora species recorded from four floristic quadrats/relevés and opportunistic observations
- no Threatened or Priority Flora were recorded within the survey area and none are considered likely to occur based on a revised likelihood assessment
- five introduced flora species (weeds) were recorded; none have any specific significance i.e. they are not Declared Pest plants or Weeds of National Significance
- four vegetation types were recorded, none of which are representative of any currently described Threatened or Priority Ecological Community
- 14 vertebrate fauna species were recorded including three introduced species, none of which were of conservation significance
- three fauna habitat types were recorded, all of which are considered typical for the region and not of conservation significance
- the post-survey significant fauna likelihood assessment identified that the fauna identified by the database searches have a low or very low potential to occur within the survey area.

1 INTRODUCTION

1.1 BACKGROUND

FMG Iron Bridge (Aust.) Pty Ltd (IB) is proposing to develop a laydown and steel fabricated module staging facility for its North Star Magnetite Project and has selected a site within the Wedgefield Industrial Estate, comprising blocks identified as W012, W013 and W014. Access to the laydown facility will be from the Great Northern Hwy via Pinga Street and Moorambine Street. Access to W013 will be via an extension of Moorambine Street within an existing dedicated road reserve as an unsealed road, finally passing through Vacant Crown Land (LGE L708221). This development will require a Native Vegetation Clearing Permit (NVCP) to be submitted.

IB commissioned Ecoscape to undertake a Reconnaissance flora and vegetation survey and a Level 1 fauna survey to support NVCP submission.

1.2 SURVEY AREA

The proposed development area, known as the 'survey area' in this report, is located within the Wedgefield Industrial Estate in the Town of Port Hedland (**Figure 1**). It comprises blocks W012, W013 and W014 totalling 10.11 hectares (ha).

Figure 1: Survey area location

1.3 SURVEY REQUIREMENTS

The requirements of the survey were to undertake:

- reconnaissance flora and vegetation survey
- Level 1 fauna survey.

1.4 COMPLIANCE

This environmental assessment was conducted in accordance with Commonwealth and Western Australian legislation and supporting guidelines:

- *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act)
- *Environmental Protection Act 1986* (EP Act)
- *Biodiversity Conservation Act 2016* (BC Act)
- Department of Environment Water Heritage and the Arts (DEWHA 2009) *Matters of National Environmental Significance. Significant impact guidelines 1.1 - Environment Protection and Biodiversity Conservation Act 1999*

As well as those listed above, the assessment complied with Environmental Protection Authority (EPA) requirements for environmental survey and reporting in Western Australia, as outlined in:

- EPA (2016b) *Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment*, known as the Flora and Vegetation Technical Guidance
- EPA (2016c) *Technical Guidance – Terrestrial Fauna Surveys*, known as the Fauna Technical Guidance
- EPA (2016d) *Technical Guidance – Sampling Methods for Terrestrial Vertebrate Fauna*
- EPA (2016a) *Statement of Environmental Principles, Factors and Objectives*.

1.4.1 ENVIRONMENT PROTECTION AND BIODIVERSITY CONSERVATION ACT 1999

At a Commonwealth level, threatened taxa (flora and fauna) are protected under the EPBC Act, which lists species that are considered Critically Endangered (CR), Endangered (EN), Vulnerable (VU), Conservation Dependant (CD), Extinct (EX), or Extinct in the Wild (EW), detailed in **Table 14** in **Appendix One**.

1.4.2 ENVIRONMENTAL PROTECTION ACT 1986

The EP Act was created to provide for an Environmental Protection Authority (the EPA) that has the responsibility for:

- prevention, control and abatement of pollution and environmental harm
- conservation, preservation, protection, enhancement and management of the environment
- matters incidental to or connected with the above.

The EPA is responsible for providing the guidance and policy under which environmental assessments are conducted. It oversees environmental impact assessments (based on the information included in environmental assessments and provided by the proponent), initiates measures to protect the environment and provides advice to the Minister responsible for environmental matters.

1.4.3 BIODIVERSITY CONSERVATION ACT 2016

The *Biodiversity Conservation Act (2016)* (BC Act) provides for the conservation, protection and ecologically sustainable use of biodiversity and biodiversity components in Western Australia. It came into force on 1 January 2019.

Threatened species (both flora and fauna) and ecological communities that meet the categories listed within the BC Act are highly protected and require authorisation by the Minister to take or disturb. These are; Threatened Flora, Threatened Fauna and Threatened Ecological Communities. The conservation categories of Critically Endangered, Endangered and Vulnerable have been aligned with those detailed in the EPBC Act and are detailed in **Table 15** in **Appendix One**.

Flora and fauna species may be listed as being of special conservation interest if they have a naturally low population, restricted natural range, are subject to or recovering from a significant population decline or reduction of range or are of special interest, and the Minister considers that taking may result in depletion of the species. Migratory species and those subject to international agreement are also listed under the Act. These are known as specially protected species in the BC Act.

The most recent flora and fauna listings were published in the *Government Gazette* on 11 September 2018 (Government of Western Australia 2018b).

1.4.4 FLORA

1.4.4.1 Threatened and Priority Flora

Conservation significant flora species are those that are listed as TF (Threatened Flora) and (within Western Australia) as PF (Priority Flora). TF species are listed as Threatened by the Western Australian DBCA and protected under the provisions of the BC Act. Some State-listed TF are provided with additional protection as they are also listed under the Commonwealth EPBC Act.

Flora are listed as PF where populations are geographically restricted or threatened by local processes, or where there is insufficient information to formally assign them to TF categories. Whilst PF are not specifically listed in the BC Act, some may qualify as being of special conservation interest and these have a greater level of protection than unlisted species.

There are seven categories covering State-listed TF and PF species (DBCA 2019) which are outlined in **Table 15** in **Appendix One**. PF for Western Australia are regularly reviewed by the DBCA whenever new information becomes available, with species status altered or removed from the list when data indicates that they no longer meet the requirements outlined in **Table 15**.

1.4.4.2 Other Significant Flora

According to the *Flora and Vegetation Technical Guidance* (EPA 2016b) other than being listed as Threatened or Priority Flora, a species can be considered as significant if it is considered to be:

- locally endemic or association with a restricted habitat type (e.g. groundwater dependent ecosystems, sheet flow dependent vegetation)
- a new species or has anomalous features that indicate a potential new species
- at the extremes of range, recently discovered range extensions (generally considered greater than 100 km or in a different bioregion), or isolated outliers of the main range)
- unusual species, including restricted subspecies, varieties or naturally occurring hybrids
- relictual status, being representative of taxonomic groups that no longer occur widely in the broader landscape.

1.4.4.3 Introduced Flora

Introduced plant species, known as weeds, are plants that are not indigenous to an area and have been introduced either directly or indirectly (unintentionally) through human activity. Species are regarded as introduced if they are listed as 'alien' on *FloraBase* (Western Australian Herbarium [WAH] 1998–2019) and are designated with an asterisk (*) in this document.

Weeds of National Significance

There are 32 weed species listed as Weeds of National Significance (WoNS) (Australian Government & Department of the Environment and Energy [DotEE] 2018; Weeds Australia 2012). The Commonwealth *National Weeds Strategy: A Strategic Approach to Weed Problems of National Significance* (2012) describes broad goals and objectives to manage these species.

Declared Pest Plants

The Western Australian Organism List (WAOL) details organisms listed as Declared Pests under the *Biosecurity and Agriculture Management Act 2007* (BAM Act). Under the BAM Act, Declared Pests are listed as one of the three categories, or exempt:

- C1 (exclusion), that applies to pests not established in Western Australia; control measures are to be taken to prevent their entry and establishment
- C2 (eradication), that applies to pests that are present in Western Australia but in low numbers or in limited areas where eradication is still a possibility

- C3 (management), that applies to established pests where it is not feasible or desirable to manage them in order to limit their damage
- exempt (no category).

1.4.5 ECOLOGICAL COMMUNITIES

1.4.5.1 EPBC-listed Threatened Ecological Communities

Ecological communities are naturally occurring biological assemblages associated with a particular type of habitat (Government of Western Australia 2016). At Commonwealth level, Threatened Ecological Communities (TECs) are protected under the EPBC Act. An ecological community may be categorised into one of the three sub-categories:

- Critically Endangered, if it is facing an extremely high risk of extinction in the wild in the immediate future
- Endangered, if it is not critically endangered and is facing a very high risk of extinction in the wild in the near future
- Vulnerable, if it is not critically endangered or endangered, and is facing a high risk of extinction in the wild in the medium-term future.

1.4.5.2 Western Australian Threatened Ecological Communities

The Western Australian DBCA also maintains a list of TECs which are further categorised into three subcategories much like those of the EPBC Act. The full details of DBCA criteria are shown in **Table 16** in **Appendix One**.

Currently described TECs are listed on the DBCA website, with the most recent list endorsed by the Minister for Environment on 28 June 2018 (DBCA 2018).

1.4.5.3 Western Australian Priority Ecological Communities

DBCA maintains a list of Priority Ecological Communities (PECs). PECs include potential TECs that do not meet survey criteria, or that are not adequately defined.

Currently described PECs are listed on the DBCA website, with the most recent list dated 17 January 2019 (Species and Communities Program, DBCA 2019).

1.4.6 OTHER SIGNIFICANT VEGETATION

1.4.6.1 Groundwater Dependent Ecosystems

Groundwater Definition

Groundwater is water that is found in the saturated zone of the soil, where all soil pores are filled with water. The water table is the upper surface of the saturated zone in an unconfined aquifer. Groundwater may also occur as a perched aquifer located above unsaturated rock formations as a result of a discontinuous permeable layer or held under pressure in a confined aquifer (Goulburn-Murray Water 2010).

Groundwater Dependent Ecosystems Definition

Groundwater Dependent Ecosystems (GDEs) have been defined as ecosystems that are dependent on groundwater for their survival at some stage or stages of their lifecycle, however groundwater use cannot be equated with groundwater dependence (Eamus 2009b). In some contexts, GDEs are also known as Groundwater Dependent Vegetation.

Hatton and Evans (1998) identified four types of GDEs based on their geographic setting: terrestrial vegetation (vegetation communities and dependent fauna that have seasonal or episodic dependence on groundwater), river base flow systems (aquatic and riparian ecosystems that exist in or adjacent to streams that are fed by groundwater base flow), aquifer and cave ecosystems, and wetlands.

Eamus *et al.* (2006) identified three primary classes based on type of groundwater reliance:

1. Aquifer and cave ecosystems.
2. All ecosystems dependent on the surface expression of groundwater:

a) river base flows
b) wetlands, swamplands
c) seagrass beds in estuaries
d) floodplains
e) mound springs
f) riparian vegetation
g) saline discharge to lakes
h) low lying forests.

3. All ecosystems dependent on the subsurface presence of groundwater, often accessed via the capillary fringe (non-saturated zone above the water table) when roots penetrate this zone:
   a) River Red Gum (*Eucalyptus camaldulensis*) forests
   b) Banksia woodlands
   c) Riparian vegetation in the wet/dry tropics.

GDEs in the Pilbara are generally determined to be vegetation associated with riparian areas. GDEs dependent on the surface expression of groundwater (Eamus *et al.* 2006 class 2) includes vegetation associated with wetlands (permanent or semi-permanent pools) within riparian areas, and generally includes *Melaleuca argentea* in association with other species described below. GDEs associated with the subsurface presence of groundwater (Eamus *et al.* 2006 class 3) includes riparian vegetation characterised by the phreatophytic species described below.

Direct impacts on GDEs i.e. clearing, and indirect impacts, including from dewatering and reinjection, frequently feature as being a significant environmental impact in mining approvals documents e.g. (Office of the Appeals Convenor 2016a; 2016b; Rio Tinto 2016).

Phreatophytic Species

Phreatophytic species rely on groundwater sources for water intake (Maunsell Australia Pty Ltd 2006); essentially the water requirements of phreatophytes are greater than can be provided from the surface soil profile (e.g. riparian vegetation) or they are dependent on free water availability (e.g. wetland species). They frequently show low tolerance to extended water stress due to a lack of physiological and/or morphological adaptation to drought, and respond to significant water deficit by a decline in health and eventual death (*ibid.*).

Obligate phreatophytes are dependent on free access to water (i.e. they are wetland species) whereas facultative phreatophytes can switch their water source between the soil surface profile in times of rain, to groundwater in times of drought when the soil surface profile (vadosphere) is depleted (Grierson 2010).

Phreatophytic species likely to occur in the Pilbara include:

- *Eucalyptus camaldulensis* subsp. *refulgens*, which is regarded as a facultative phreatophyte that is dependent on groundwater for part of its lifecycle and/or in times of drought. This species has been reported to be tolerant of groundwater falls of up to 4 m per year (Maunsell Australia Pty Ltd 2006), has both lateral and sinker roots and is tolerant of waterlogging (Grierson 2010).
- *Eucalyptus victrix*, which may be regarded as a facultative phreatophyte. It is considered to be relatively drought tolerant and likely to be tolerant of gradual declines to the water table (to a degree) (Maunsell Australia Pty Ltd 2006). *Eucalyptus victrix* has lateral and sinker roots (i.e. a dimorphic root system) but is not tolerant of waterlogging (Grierson 2010). There is some conjecture that this species is actually a vadophyte (i.e. relies on water from within the soil surface profile, and is independent of groundwater) or, at best, weakly phreatophytic (Resource and Environmental Management Pty Ltd 2007). Depth to groundwater is likely to be an important indicator of groundwater dependence (Equinox Environmental 2017).
- wetland species such as *Melaleuca argentea*
- *Melaleuca xerophila* may be groundwater dependent in some areas (Markey 2016).

Vegetation containing *Eucalyptus camaldulensis* subsp. *refulgens* and *Melaleuca argentea* is generally considered to represent a GDE. However, that there is supporting evidence that, in some circumstances,

Eucalyptus victrix does not always depend on groundwater (Batini 2009; Eamus 2009a; EPA & Hamersley Iron Pty Ltd 2010; Resource and Environmental Management Pty Ltd 2007) and vegetation characterised by this species is considered to be potentially representative of a GDE.

Atlas of Groundwater Dependent Ecosystems

The *Groundwater Dependent Ecosystems Atlas* (Australian Government & Bureau of Meteorology [BoM] 2018) indicates the presence of known GDEs and Inflow Dependent Ecosystems (IDEs) in Australia.

An Inflow Dependent Ecosystem is one in which the vegetation within the landscape is likely to be accessing water in addition to rainfall, from soil or surface water or groundwater, assessed using remotely sensed data. The likelihood of a landscape using additional water is rated from one to 10 (low to high), with a rating above six indicating that a landscape is likely to be inflow dependent (Australian Government & BoM 2018).

1.4.6.2 Other Significant Vegetation

According to the *Flora and Vegetation Technical Guidance* (EPA 2016b), other than being listed as a TEC or PEC, vegetation can be considered as significant if it is considered to:

- have a restricted distribution
- have a degree of historical impact from threatening processes
- provide a role as a refuge
- provide an important function required to maintain ecological integrity of a significant ecosystem.

1.4.7 FAUNA

1.4.7.1 EPBC-listed Threatened Fauna

At a Commonwealth level, Threatened Fauna are protected under the EPBC Act, which lists species and ecological communities that are considered Critically Endangered, Endangered, Vulnerable, Conservation Dependant, Extinct, or Extinct in the Wild (detailed in **Table 14** in **Appendix One**).

Migratory species subject to international agreements are also protected under the EPBC Act. The definition of a migratory species under the Act follows that prescribed by the *Convention on the Conservation of Migratory Species of Wild Animals* (Bonn Convention) (DotEE 2019):

> *Migratory species are the entire population or any geographically separate part of the population of any species or lower taxon of wild animals, a significant proportion of whose members cyclically and predictably cross one or more national jurisdictional boundaries.*

Species listed by the following international agreements are currently protected under the EPBC Act:

- *Convention on the Conservation of Migratory Species of Wild Animals* (Bonn Convention)
- *China-Australia Migratory Bird Agreement* (CAMBA)
- *Japan-Australia Migratory Bird Agreement* (JAMBA)
- *Republic of Korea-Australia Migratory Bird Agreement* (ROKAMBA).

1.4.7.2 Western Australian-listed Threatened Fauna

Threatened fauna that meet the categories listed within the BC Act are protected and require authorisation by the Minister to take or disturb. The conservation categories of Critically Endangered, Endangered and Vulnerable have been aligned with those detailed in the EPBC Act.

Fauna species may be listed as being of special conservation interest if they have a naturally low population, restricted natural range, are subject to or recovering from a significant population decline or reduction of range or are of special interest, and the Minister considers that taking may result in depletion of the species. These are known as Specially Protected Species in the BC Act. The categories covering State-listed threatened fauna species are outlined in **Table 15** in **Appendix One**.

1.4.7.3 Western Australian Priority Fauna

Conservation significant fauna species are listed by the DBCA as Priority Fauna where populations are geographically restricted or threatened by local processes, or where there is insufficient information to formally

assign them to threatened fauna categories. Whilst Priority Fauna are not specifically listed in the BC Act, these have a greater level of significance than other native species. The categories covering Priority Fauna species are outlined in **Table 15** in **Appendix One**.

1.4.8 ENVIRONMENTALLY SENSITIVE AREAS

There are a number of areas around Western Australia identified as being of environmental significance within which the exemptions to the Native Vegetation Clearing Regulations do not apply. These are referred to as Environmentally Sensitive Areas (ESAs), and are declared under section 51B of the EP Act and described in the Environmental Protection (Environmentally Sensitive Areas) Notice (Government of Western Australia 2005)

1.4.9 CONSERVATION ESTATE

The National Reserve System is a network of protected areas managed for conservation under international guidelines. The objective of placing areas of bushland into the Conservation Estate is to achieve and maintain a comprehensive, adequate and representative reserve system for Western Australia. The Conservation and Parks Commission is the vesting body for conservation lands, forest and marine reserves that are managed by DBCA (Government of Western Australia 2018a).

2 DESKTOP ASSESSMENT

2.1 PHYSICAL ENVIRONMENT

2.1.1 CLIMATE

The survey area is located within the Pilbara region, which includes two broad climatic zones. Coastal areas, as well as some higher rainfall inland areas, have a semi-desert tropical climate which experience 9-11 months of dry weather, with hot humid summers and warm winters. The remaining inland areas have a dry desert climate, typically with higher temperatures and lower rainfall, and often experience up to 12 months of dry weather, with hot dry summers and mild winters (Leighton 2004). The survey area is within the coastal area.

The closest Bureau of Meteorology (BoM) station with long term records is Port Hedland Airport (station number 4032, operating since 1942) located approximately 4 km southeast of the survey area. The mean annual rainfall is 319.3 mm, 65.4% of which falling during the three-month period of January to March (**Figure 2**).

March is the hottest month with a mean maximum temperature of 36.8° and minimum of 25.5°. July is the coldest month with a mean maximum of 27.3° and minimum of 12.4° (**Figure 2**).

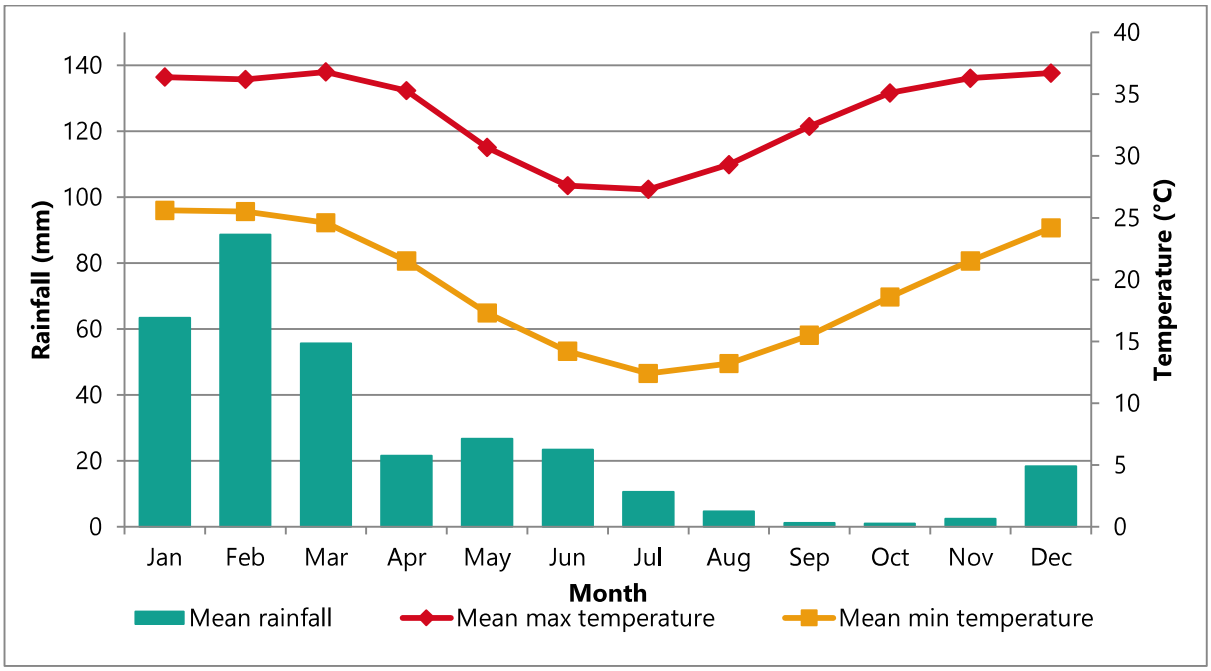

Figure 2: Rainfall and temperature data from the Port Hedland Airport BoM station (BoM 2019a)

2.1.2 LAND SYSTEMS

According to Department of Primary Industries and Rural Development (DPIRD 2018b), the survey area corresponds with the Uaroo Land System (mapping unit 281Ua) described as *Broad sandy plains, pebbly plains and drainage tracts supporting hard and soft spinifex hummock grasslands with scattered acacia shrubs*.

2.1.3 GROUNDWATER DEPENDENT ECOSYSTEMS

The *Groundwater Dependent Ecosystems Atlas* (BoM 2019b) indicates that the survey area is considered as moderate potential for terrestrial GDEs to occur.

2.1.4 ENVIRONMENTALLY SENSITIVE AREAS

The survey area does not intersect any mapped ESA's. The nearest ESA is located approximately 15 km east of the survey area.

2.1.5 CONSERVATION LANDS

There is no DBCA managed land within a 100 km radius of the survey area.

2.2 BIOLOGICAL ENVIRONMENT

2.2.1 BIOGEOGRAPHIC REGION

Biogeographic regions are delineated on the basis of similar climate, geology, landforms, vegetation and fauna and are defined in the Interim Biogeographical Regionalisation for Australia (IBRA) (DotEE 2016).

The survey area is located in the Pilbara IBRA region in the Roebourne subregion (PIL4), described by Kendrick (2002) as:

> *Quaternary alluvial and older colluvial coastal and subcoastal plains with a grass savannah of mixed bunch and hummock grasses, and dwarf shrub steppe of Acacia stellaticeps or A. pyrifolia and A. inaequilatera. Uplands are dominated by Triodia hummock grasslands. Ephemeral drainage lines support Eucalyptus victrix or Corymbia hamersleyana woodlands. Samphire, Sporobolus and mangal occur on marine alluvial flats and river deltas. Resistant linear ranges of basalts occur across the coastal plains, with minor exposures of granite. Islands are either Quaternary sand accumulations, or composed of basalt or limestone, or combinations of any of these three. Climate is arid (semi-desert) tropical with highly variable rainfall, falling mainly in summer. Cyclonic activity is significant, with several systems affecting the coast and hinterland annually. Subregional area is 2,008,983ha.*

2.2.2 PRE-EUROPEAN VEGETATION

During the 1970s, John Beard and associates conducted a systematic survey of native vegetation, describing the vegetation systems in Western Australia at a scale of 1:250 000 in the south-west and at a scale of 1:1 000 000 in less developed areas.

Beard's vegetation maps attempted to depict the native vegetation as it was presumed to be at the time of settlement, and is known as the pre-European vegetation type and extent and has since been developed in digital form by Shepherd *et al.* (2002) and updated by DPIRD (2018a). Extents are updated annually by DBCA (Government of Western Australia 2019). This mapping indicates that the survey area occurs entirely within Association 647, Abydos Plain, described as *Hummock grassland with scattered shrubs or mallee, Triodia spp., Acacia spp., Grevillea spp. Eucalyptus spp.*

The pre-European vegetation association identified from the survey area (DPIRD 2018a) and its pre-European and current extents are listed in **Table 1** (Government of Western Australia 2019). At all scales, vegetation association has greater than 97% of its original extent remaining.

Table 1: Pre-European vegetation association representation (Government of Western Australia 2019)

Region	Vegetation association	Original extent (ha)	Current extent (ha)	% Remaining
Western Australia	647	195,860.89	191,711.41	97.88
IBRA biographic region (Pilbara)		195,860.89	191,711.41	97.88
IBRA biographic sub-region (Roebourne)		188,901.32	184,774.70	97.82
LGA (Town of Port Hedland)		180,908.49	176,759.02	97.71

2.2.3 THREATENED AND PRIORITY ECOLOGICAL COMMUNITIES

The DBCA database search (search reference 20-0120EC, using a 50 km buffer) identified no known TECs and one PEC (Eighty Mile Land System) within the search area. The Eighty Mile Land System PEC (Priority 3) is described as 'Beach foredunes, longitudinal coastal dunes and sandy plains with tussock grasslands and spinifex grasslands'. This PEC is more typical of the Kimberley region and the nearest occurrence is approximately 35 km to the northeast.

2.2.4 THREATENED AND PRIORITY FLORA

A search of DBCA's databases was conducted (search reference 20-0120FL) using a 50 km buffer around the supplied shapefiles (TPFL List, taken from Threatened and Priority Flora Report Forms and DBCA surveys, and WA Herb, taken from vouchered specimens held in the Western Australian Herbarium).

The DBCA database searches identified 14 PF taxa including two P1, one P2, eight P3 and three P4, listed in **Table 2**; none have been previously recorded from within it. Fortescue's significant flora database did not return any additional flora of conservation significance.

Table 2: Flora database search results (DBCA database search), likelihood and flora survey records

Species name	Description and Habitat from *FloraBase* (WAH 1998-2019)	Distance from survey area	Desktop Likelihood of occurrence
DBCA Priority 1			
Atriplex eremitis	Small bushy shrub with grey foliage to 0.3 m high. Flowers during August. Recorded from level sand plains and mosaic saline plains.	45 km	Highly unlikely
Tephrosia rosea var. Port Hedland (A.S. George 1114)	Erect, shrub, spindly shrub (broom-like) to 1.7 m high with red-maroon flowers. Flowers in July, August and September. Typically recorded from coastal sandy areas.	0.2 km	Possible
DBCA Priority 2			
Gomphrena pusilla	Slender branching annual herb to 0.2 m high with white flowers in March to April or June. Recorded from fine beach sand behind foredunes, typically on limestone.	7.6 km	Possible
DBCA Priority 3			
Abutilon sp. Pritzelianum (S. van Leeuwen 5095)	Perennial shrub to 3 m tall with yellow flowers. Flowers from June to November. Recorded from coastal and near coastal sand dunes and plains and also clay. Commonly recorded from road verges.	14.7 km	Possible
Eragrostis crateriformis	Annual grass to 0.4 m high. Flowers from January to May or July. Recorded from clayey loam or clay along creek banks or depressions.	9.2 km	Possible
Euphorbia clementii	Erect herb to 0.6 m high. Recorded from gravelly hillsides or stony grounds.	49 km	Highly unlikely
Gomphrena leptophylla	Prostrate or spreading annual herb to 0.15 m high with white flowers from March to September. Recorded from sand, sandy to clayey loam on granite and quartzite. Known to occur on open flats, sandy creek beds, edges of salt pans & marshes or stony hillsides.	10.6 km	Unlikely
Gymnanthera cunninghamii	Erect shrub to 2 m high with cream-yellow-green flowers year round. Recorded from sandy soils.	0.3 km	Possible
Heliotropium muticum	Ascending to spreading perennial herb to 0.3 m high. Recorded from red silt on low lying floodplains or from calcareous plains with quartz/granite.	9.3 km	Possible
Rothia indica subsp. *australis*	Prostrate annual herb to 0.3 m high densely covered in spreading hairs. Flowering from April to August. Recorded from sandhills and sandy flats.	10.9 km	Possible
Triodia chichesterensis	Perennial grass (spinifex) to 0.5 m tall. Occurs on sand or loam over rocky or gravelly substrates.	37 km	Highly unlikely
DBCA Priority 4			
Bulbostylis burbidgeae	Tufted, erect to spreading annual sedge to 0.25 m high. Flowers during March or June to August. Occurs on granitic soils, associated with granite outcrops or cliff bases.	2.5 km	Highly unlikely
Goodenia nuda	Erect to ascending herb to 0.5 m high with yellow flowers from April to August. Recorded from seasonally inundated clay soils and drainage lines as well as scoured river beds and hillsides.	7.5 km	Possible
Ptilotus mollis	Compact, perennial shrub to 0.5 m high with soft grey foliage and white/pink flowers during May or September. Recorded from stony hills and scree slopes.	32 km	Highly Unlikely

2.2.4.1 Threatened and Priority Flora Likelihood Assessment

Ecoscape conducted a likelihood assessment to identify TF and PF species that have potential to occur within the survey area. The likelihood of a species occurring is based on the following attributes, as listed on *FloraBase* (WAH 1998-2020) tailored to local populations, and information from recent nearby surveys. The attributes were:

- broad soil type usually associated with the species
- broad landform usually associated with the species
- usual vegetation (characteristic species) with which the species is usually associated
- species having previously been recorded from within approximately 20 km of the survey area (considered as 'nearby') taking age of record and locational accuracy into account
- nearby records recent, considered as within the previous 25 years.

The likelihood rating is assigned using the categories listed in **Table 3**.

Table 3: Categories for likelihood of occurrence of TF and PF

Likelihood	Categories
Recorded	Species recorded within the survey area
Possible	May occur within the survey area (but has not been recorded); broadly, 2-4 of the required attributes (but always including records from nearby) are present in the survey area
Unlikely	Could occur but is not expected; 1-3 of the required attributes are present in the survey area but: • it is not known from nearby, or • it is known from nearby but has no other required attributes, or • it is known from nearby but has at least one well-defined attribute that does not occur in the survey area (e.g. it is associated with a specific landform or soil type that does not occur in the survey area) • it is known from nearby but the record is old (>25 years) or the locational data is potentially inaccurate or the area has been significantly cleared at and around the location of the record and survey area and as such the habitat almost certainly no longer occurs within the survey area.
Highly unlikely	The species characteristics include only one or none of the required attributes of soil, landform, associated vegetation and having previously been recorded nearby, or a critical element (often landform) is not within the survey area and as such it almost certainly does not occur.

The likelihood assessment is incorporated into **Table 2** above. Eight taxa were identified as having a Possible likelihood of occurring based on the information available during the desktop assessment. These were considered the most likely to occur and were prioritised for field survey.

2.2.5 THREATENED AND PRIORITY FAUNA

Exclusively marine species (e.g. whales, sea turtles etc.) and marine migratory birds and waders are not included in the Threatened and Priority Fauna lists as their habitat does not occur within the survey area.

2.2.5.1 Protected Matters Search

The Protected Matters Search Tool (PMST) (Australian Government & DAWE, search reference PMST_B0WXKE 2020)database search was used to identify conservation significant fauna and/or fauna habitat suitable for such species within the search area buffer (5 km). The PMST search identified:

- four mammals: three 'species or species habitat likely to occur within area', one 'species or species habitat may occur within area',
- one birds: one 'species or species habitat may occur within area',
- one reptile: one 'species or species habitat may occur within area'.

The PMST results are incorporated in **Table 12**. Not all species identified by the PMST search have DBCA/Western Australian Museum (WAM) records (*NatureMap*, see below). The following species were identified by the PMST search but not by the *NatureMap* search:

- Ghost Bat (*Macroderma gigas*) – VU (EPBC Act, BC Act)

- Greater Bilby (*Macrotis lagotis*) – VU (EPBC Act, BC Act)
- Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*) – VU (EPBC Act, BC Act)
- Night Parrot (*Pezoporus occidentalis*) – EN (EPBC Act), CR (BC Act)
- Olive Python (*Liasis olivaceus barroni*) – VU (EPBC Act, BC Act).

Habitat suitable for this species may or is likely or known to occur.

2.2.5.2 NatureMap

NatureMap (DBCA 2007-2019) is maintained collaboratively by the DBCA and the WAM. Records listed on *NatureMap* represent a combination of vouchered museum specimens and records obtained via the Fauna Survey Returns Database maintained by the DBCA. The *NatureMap* report is included in **Appendix Two**.

The *NatureMap* search identified 143 vertebrate fauna species previously recorded within the applied 5 km buffer area:

- 12 mammals (3 introduced, 9 native)
- 102 birds
- 19 reptiles
- six amphibians
- two fish
- two invertebrates.

Four conservation significant fauna were identified:

- Brush-tailed Mulgara (*Dasycercus blythi*) – P4 (BC Act)
- Northern Quoll (Dasyurus hallucatus) – EN (EPBC Act, BC Act)
- Banded hare-wallaby (*Lagostrophus fasciatus* subsp. *Fasciatus)* – EN (EPBC Act, BC Act)
- Airlie Island Ctenotus (*Ctenotus angusticeps)* – VU (EPBC Act), P4 (BC Act).

The conservation significant species identified by the *NatureMap* search are incorporated into **Table 12**.

2.2.5.3 DBCA Database Searches

The DBCA database search (search reference FAUNA#6240 using a 6 km buffer) returned the following:

- five mammals
- one bird.

The list of threatened and priority fauna is incorporated in **Table 12**. Exclusively marine species (e.g. whales, sea turtles, etc.) and marine migratory birds and waders were not included in this list as their habitat does not occur within the survey area.

2.2.5.4 Threatened and Priority Fauna Likelihood Assessment

The likelihood of occurrence of significant fauna species identified by the database and literature searches was assessed using the following criteria:

- suitability of habitats present within the survey area
- distance between previous record of significant species and the survey area
- frequency and number of records in the region
- date of record of significant species (recent or historical).

The sufficiency of information and behavioural and ecological characteristics, such as cryptic behaviours were also taken into account. Using the above criteria, the categories of likelihood of occurrence are shown in **Table 4**.

Table 4: Categories for likelihood of occurrence of significant vertebrate fauna

Likelihood	Categories
Recorded	Species recorded within the survey area within a reasonable timeframe (0-5 years)
High	Species recorded in close proximity to the survey area (<5 km) within the past 10 years; suitable habitat occurs within the survey area
Medium	Species historically recorded in close proximity (<5 km) to the survey area, more than 10 years ago; suitable habitat may exist within the survey area
Low	Species not recorded in the proximity of the survey area or rarely recorded within 10 km of the survey area; suitable habitat unlikely to occur within the survey area
Very Low	Species not recorded by multiple surveys/databases within 20 km of the survey area and suitable habitat does not occur within the survey area, however, species or suitable habitat is listed as potentially occurring in the wider region

Two species have been previously identified from within the survey area or are considered to have a High likelihood of occurring based on the criteria above:

- Brush-tailed Mulgara (*Dasycercus blythi*) – P4 (BC Act)
- Airlie Island Ctenotus (*Ctenotus angusticeps)* – VU (EPBC Act), P4 (BC Act).

The likelihood of species occurring within the survey area are indicated in **Table 12.**

2.3 PREVIOUS SURVEYS

The survey area is located within an area that has been subject to a previous flora and fauna assessments by GHD (2009): *Report for Port Hedland Industrial Land LIA 3,4,5 General Industry/Transport Part A and Part B: Preliminary Environmental Impact Assessment and Biological Survey*. The previous survey included a Level 2 flora and vegetation assessment and Level 1 fauna assessment and identified the following:

- 123 flora taxa, none of which were conservation significant
- four vegetation types with vegetation condition ranging from Excellent to Completely Degraded. None of the vegetation types were identified as conservation significant.
- 20 bird, four mammal and three reptile species were recorded. Potential unused Mulgara burrows were also identified.

3 METHODS

3.1 GUIDING PRINCIPLES

3.1.1 FLORA AND VEGETATION

The flora and vegetation survey was conducted as a Reconnaissance in accordance with the requirements outlined in the Flora and Vegetation Technical Guidance (EPA 2016b). The EPA recommends a Reconnaissance survey should:

- provide context and gather broad information
- verify the findings of the desktop assessment
- include low intensity sampling of the flora and vegetation to describe the general vegetation characteristics and condition
- clarify if the area may support any significant flora and vegetation
- identify if a detailed survey is required.

Targeted searches were also conducted in areas of habitat suitable for significant flora identified during the desktop assessment and previous surveys as having potential to occur.

3.1.2 FAUNA

The following were taken into account when developing the survey methodology:

- EPA (2016c) Fauna Technical Guidance
- EPA (2016d) *Technical Guidance – Sampling Methods for Terrestrial Vertebrate Fauna*
- background information on the survey area, fauna species and habitat likely to occur (i.e. desktop assessment, aerial imagery and other data).

The Fauna Technical Guidance recommends the following for a Level 1 fauna survey:

- desktop assessment to gather contextual information on the survey area from previous surveys, literature, database searches and map-based information
- site visit to be conducted to verify the accuracy of the desktop study, delineate and characterise the fauna and faunal assemblages present in the survey area
- survey to include low intensity sampling of fauna and faunal assemblages.

3.2 FLORA AND VEGETATION FIELD SURVEY

3.2.1 FIELD SURVEY METHODS

The methods utilised during the field survey followed those outlined in the Flora and Vegetation Technical Guidance (EPA 2016c), conducted as a single phase survey. The survey was just prior to the period considered optimal for a primary season of survey within the bioregion.

Conservation criteria used in this assessment are included in **Table 14** and **Table 15** in **Appendix One**.

3.2.1.1 Floristic Quadrats/Relevés

Floristic quadrat and relevé locations were placed in the best examples of each vegetation type occurring within the survey area. The two quadrats were 50 m by 50 m in dimension, as required according to the Flora and Vegetation Technical Guidance 2016. Due to the small spatial extent, the relevés were based on polygons to avoid crossing the boundary of another vegetation type. One of the relevés was so restricted in extent that the total area sampled approximated a 20 m by 20 m area.

The following information was collected from within each quadrat:

- observer
- date
- quadrat/site number
- GPS location (GDA94) of the northwest corner

- digital photograph (spatially referenced with a reference number), taken from the northwest corner, looking diagonally across the quadrat
- soil type and colour
- topography
- list of flora species recorded with the average height and total cover within the quadrat for each species
- vegetation description (as per below)
- vegetation condition.

One quadrat/relevé per vegetation type was recorded to document the vegetation within the survey area for the Reconnaissance survey.

All quadrat locations are displayed on **Map 3**.

3.2.1.2 Targeted Searches

Priority Flora identified during the desktop analysis and previous surveys as known or having potential to occur were targeted for searches in areas of potential habitat. The entire survey area was searched using a systematic grid search at 30-40 m intervals or less.

The locations of all targeted taxa collected were recorded using a handheld GPS with the following data recorded:

- observer, date and time
- reproductive status and other features such as health of plants, percentage flowering and fruiting
- local abundance/population size and/or population boundary, including outside the development envelopes where possible
- landform
- brief vegetation community description
- representative photos of each species and habitat
- collection of representative specimens.

3.2.1.3 Introduced Species

Introduced species (weeds) were recorded during the collection of the overall flora inventory.

The field survey included searches for WONS and Declared Pest plants. Their locations and numbers/extents were recorded where noted during the field survey, and each WONS or Declared Pest plant species photographed.

3.2.1.4 Vegetation Description and Classification

Vegetation was described from each of the quadrats/relevés using the height and estimated cover of dominant and characteristic species of each stratum based on the National Vegetation Information System, recorded at Level V (NVIS Technical Working Group 2017) (**Table 17** and **Table 18** in **Appendix One**). Up to three species per stratum from each stratum (upper, mid and ground) were used to formulate vegetation descriptions for each quadrat/relevé and each vegetation type.

Vegetation type descriptions were created using the quadrat/relevé descriptions. Vegetation codes for these were formulated using the first letter of genus and species names of the dominant species of each stratum e.g. **Ts** refers to ***T**riodia **s**ecunda* low hummock grassland.

3.2.1.5 Vegetation Condition Assessment

Vegetation condition was assessed broadly and continuously throughout the survey area and at each quadrat/relevé using the Vegetation Condition Scale for the Eremaean Botanical Provinces (EPA 2016b) (**Table 19** in **Appendix One**). As quadrats/relevés are located in the best condition parts of a vegetation type, the condition rating of the quadrat/relevé may not match that of the broader vegetation type due to the scale of mapping.

3.2.2 ADEQUACY OF SAMPLING

In order to demonstrate adequacy of sampling, a species accumulation curve was generated by the software Species Diversity and Richness (Pisces Conservation Ltd 2010) using five random selections of sample order, and using quadrat data only. However, for a reconnaissance survey with low intensity sampling, the species inventory is not anticipated to be comprehensive.

3.3 LEVEL 1 FAUNA SURVEY

3.3.1 FAUNA FIELD SURVEY

The fauna field assessment included identifying fauna and fauna habitat within the survey area. Techniques used to locate fauna included:

- opportunistic bird observations while moving through the survey area
- turning of surface debris (rocks, logs, vegetation spoil heaps) that reptiles and mammals may shelter beneath
- tracks, scats and other traces of terrestrial fauna were recorded and identified where possible.

Fauna species were identified opportunistically based on sightings, calls, remains, diggings and other signs. Potential habitats for conservation significant species were identified and evaluated and their likelihood of occurrence assessed.

3.3.1.1 Timing of the Field Survey

The fauna survey was conducted during February 2020 which falls within the optimal prescribed season as per the Fauna Technical Guidance (EPA 2016f).

The Guidance states that fauna surveys within the Eremaean Province are optimally conducted between September and April to ensure sampling during peak activity of reptiles, amphibians and birds. Survey timing for these fauna groups is dependent on warm temperature and/or rainfall events. Mammal activity is not dependent on weather and is therefore not constrained. In the case of Amphibians and Birds in particular, episodic rain events trigger activity.

3.3.1.2 Fauna Habitat Mapping

Fauna habitat types were assessed continuously throughout the survey and at each observation of fauna, in particular when conservation significant species were recorded. Fauna habitats were described as an area which is distinguishable from its surrounding area by its landform, vegetation structure and composition, soil characteristics and fauna assemblage that occur in the area. In addition, the likelihood of the habitat to harbour specialised fauna species that are not found in adjacent areas was taken into consideration. The spatial extent of each habitat type was mapped using GIS software.

4 RESULTS

4.1 FIELD SURVEY TIMING

The field survey was conducted during February 2020, just outside the optimal period for a primary survey within the bioregion according the Flora and Vegetation Technical Guidance (EPA 2016b). The rainfall in the four months prior to the field survey was significantly below the mean (53.5% of the mean) for this period (**Figure 3**). Flora limitations associated with below average rainfall are described in **Section 4.2.3**. Weather and season were optimal for the detection of all fauna assemblages.

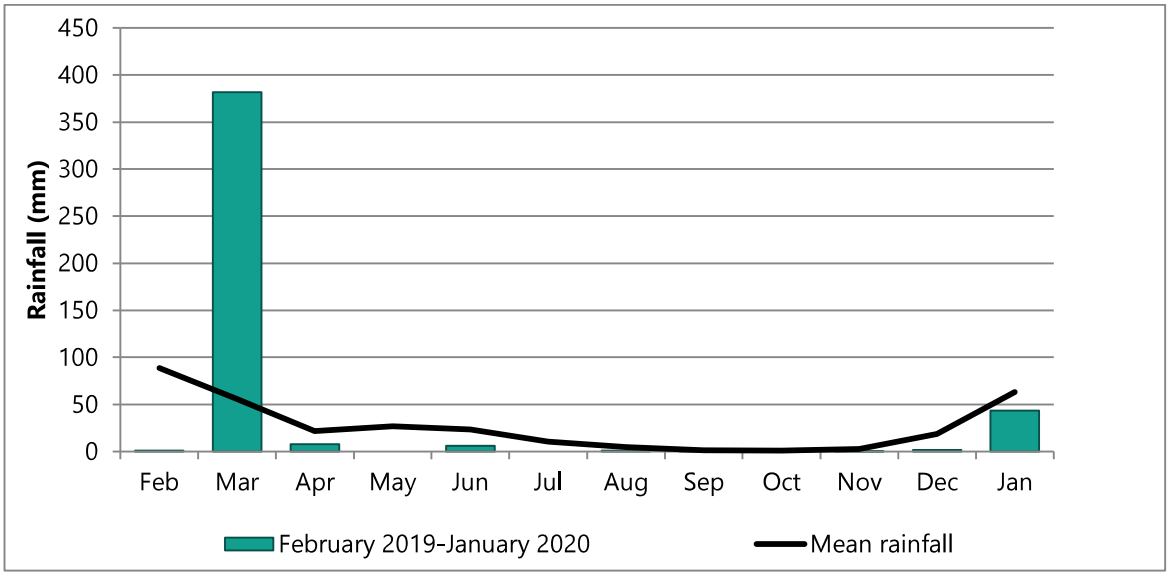

Figure 3: Mean rainfall and rainfall prior to the field survey (Port Hedland Airport, 1942-2020) (Bureau of Meteorology 2020)

4.2 FLORA AND VEGETATION SURVEY

The field survey was conducted by Stephen Kern (Associate Botanist, Flora Collecting Permit FB62000001) during February 2020.

4.2.1 FLORA

Sixty one vascular flora from 46 genera and 23 families were recorded from within the survey area from two floristic quadrats and two relevés, opportunistic observations and during conservation significant flora searches. Five were introduced (8.2%) and four (6.56%) could not be identified to species level due to insufficient diagnostic reproductive material.

The most commonly represented families were Fabaceae (13 taxa including two introduced), Poaceae (12 including two introduced) and Chenopodiaceae (five). The most commonly represented genera were *Acacia* (four taxa), *Eragrostis*, *Tecticornia* and *Trianthema* (three each).

The number of species per quadrat/relevé ranged from five (WF1901 and WF1904) to 23 (WF1902). The average species diversity per quadrat/relevé was 10.75.

The combined flora inventory is presented in **Table 20** in **Appendix Three**. Quadrat data is presented in **Appendix Four**.

4.2.1.1 Conservation Significant Flora

No EPBC Act or BC Act-listed TF were recorded during the field survey, nor were anticipated to occur as none have been previously recorded from within 50 km of the survey areas. No Priority-listed flora were recorded.

4.2.1.2 Revised Likelihood Assessment

Following field survey, when additional information is available regarding actual habitat availability and searches have been conducted, the likelihood of conservation significant flora occurring in the survey area was revised. This revised likelihood, that took into account vegetation condition and other disturbances, actual habitat availability and taking search effort into consideration, is included in **Table 5**. The survey area was extensively traversed on foot and all areas of remaining native vegetation were subject to a systematic grid search at intervals of 30-40 m or less. Based on these extensive searches and habitat present, it is considered unlikely or highly unlikely that any of the species identified by the DBCA database searches would have the potential to occur within the survey area (**Table 5**).

Table 5: Revised PF likelihood assessment

Species name	Likelihood of occurrence	
	Desktop	Post-survey
DBCA Priority 1		
Atriplex eremitis	Highly unlikely	Highly unlikely
Tephrosia rosea var. Port Hedland (A.S. George 1114)	Possible	Unlikely
DBCA Priority 2		
Gomphrena pusilla	Possible	Unlikely
DBCA Priority 3		
Abutilon sp. Pritzelianum (S. van Leeuwen 5095)	Possible	Highly unlikely
Eragrostis crateriformis	Possible	Unlikely
Euphorbia clementii	Highly unlikely	Unlikely
Gomphrena leptophylla	Unlikely	Unlikely
Gymnanthera cunninghamii	Possible	Highly unlikely
Heliotropium muticum	Possible	Unlikely
Rothia indica subsp. *australis*	Possible	Unlikely
Triodia chichesterensis	Highly unlikely	Highly unlikely
DBCA Priority 4		
Bulbostylis burbidgeae	Highly unlikely	Highly unlikely
Goodenia nuda	Possible	Unlikely
Ptilotus mollis	Highly Unlikely	Highly Unlikely

4.2.1.3 Other Significant Flora

No other flora taxa of significance according to the criteria outlined in the Flora and Vegetation Technical Guidance (EPA 2016b) were recorded during the field survey.

A taxon known in this report as *Tephrosia rosea* sens. lat (meaning 'in the broadest sense) was recorded during the survey. This taxon had appressed hairs on its foliage, which means it cannot represent the Priority 1 listed variety known from nearby, *Tephrosia rosea* var. Port Hedland (A.S. George 1114), which has appressed a 'crispy' or 'curled' indumentum of hairs on its foliage. The *Tephrosia rosea* sens. lat. recorded from the survey area, whilst an unresolved species complex, is understood to be known to the Western Australian Herbarium and not considered to be of specific conservation significance.

4.2.1.4 Introduced Flora

Five introduced flora species (weeds), representing 8.33% of the total flora species, were recorded during the field survey including **Aerva javanica* (Kapok), **Cenchrus ciliaris* (Buffel Grass), *Chloris barbata* (Purpletop Chloris), **Indigofera oblongifolia* and **Stylosanthes hamata* (Verano Stylo). None of the recorded introduced species have any specific significance i.e. they are not Declared Pest plants or WONs species.

4.2.2 VEGETATION

Four vegetation types were recorded from within the survey area (**Table 6**), based on a combination of structural vegetation type as identified in the field and subsequent desktop review. The extents of the vegetation types and representative quadrat locations are shown on **Map 3**.

The vegetation types recorded from the survey area can be broadly grouped based on the following landform types:

- flat, sandplains: **Te**, **Ts**
- flat, sandy clay depressions: **Ta**, **Ti**.

The two sandplain vegetation types are dominated by *Triodia* spp. (Spinifex) whilst the two vegetation types in depressions are dominated by *Tecticornia* spp. (samphire).

Table 6: Vegetation types

Landform	Mapping Unit	Vegetation Type	Floristic Quadrats/ Relevés	Representative Photograph	Other Characteristic Species	Area (ha) and Extent (%) of Survey Area
Flat, sandplain	**Te**	*Triodia epactia* and *Acacia stellaticeps* low closed hummock grassland/shrubland	WF2002		*Bonamia alatisemina* *Bonamia media* *Cassytha capillaris* *Commelina ensifolia* *Crotalaria ramosissima* *Cyperus blakeanus* *Eriachne obtusa* *Hybanthus aurantiacus* *Panicum decompositum* *Pluchea rubelliflora* *Pterocaulon sphaeranthoides* *Rhynchosia minima* *Solanum diversiflorum* *Tephrosia rosea* *Trianthema turgidifolium*	2.15 ha 21.28%
	Ts	*Triodia secunda* and *Frankenia ambita* low hummock grassland/shrubland	WF2001		*Commelina ensifolia* *Eragrostis cumingii* *Trianthema turgidifolium*	2.00 ha 19.81%

Landform	Mapping Unit	Vegetation Type	Floristic Quadrats/ Relevés	Representative Photograph	Other Characteristic Species	Area (ha) and Extent (%) of Survey Area
Flat, sandy clay depressions	**Ta**	*Tecticornia auriculata, T. indica* subsp. *leiostachya* and *T. halocnemoides* low open samphire shrubland	WF2004		*Eragrostis falcata* *Salsola australis*	0.54 ha 5.32%
	Ti	*Tecticornia indica* subsp. *leiostachya* and *T. halocnemoides* low samphire shrubland	WF2003		*Eragrostis falcata* *Eriachne obtusa* *Euphorbia coghlanii* *Frankenia ambita* *Neobassia astrocarpa* *Sesbania cannabina* *Surreya diandra*	0.84 ha 8.33%
	Not vegetated (cleared)					4.57 ha 45.26%
	TOTAL					10.11 ha

4.2.2.1 Vegetation Significance

There were no TEC's or PEC's identified by the database search and none of the vegetation types recorded are considered representative of any currently described TEC or PEC.

4.2.2.2 Vegetation Condition

A total of 4.57 ha (45.26%) of the survey area was cleared or devoid of native vegetation (**Map 4**). The vegetated portions of the survey area ranged from Very Good to Completely Degraded condition (**Table 7**, **Map 4**). A total of 4.55 ha (45.02%) of the survey area was in Good or Very Good condition. The main factors influencing vegetation condition were existing clearing and informal tracks as well as weed infestations and general edge effects.

Table 7: Vegetation condition extents

Vegetation condition	Extent (ha)	Extent (%)
Excellent	-	-
Very Good	1.85	18.32
Good	2.70	26.69
Degraded	0.91	8.98
Completely Degraded	0.08	0.75
N/A (not vegetated)	4.57	45.26

4.2.2.3 Adequacy of Survey

Adequacy of survey can be demonstrated using a species accumulation curve; if the curve has reached (or almost reached) an asymptote it is considered that most species are likely to have been recorded from the survey area. However, it should not be expected that a reconnaissance flora and vegetation survey would record a complete flora inventory.

Species accumulation curves were generated using quadrat data (**Figure 4**). Opportunistic observations, which increase the number of species recorded, are not included in the analysis.

The species accumulation curve suggests that additional survey would have recorded additional species, expected for a reconnaissance survey which does not require replication of flora quadrats. However, the Michaelis-Menten estimate of species richness is 66.61 which, when taking opportunistic observations into account, is similar to the number of species recorded (61). Additionally, considering the relatively intensive coverage of the entire survey area, it is unlikely the many perennial taxa would have avoided detection. Therefore, it is considered that most species present at the time of survey would have been recorded, although it would be anticipated that more ephemeral taxa would be present following significant rainfall events.

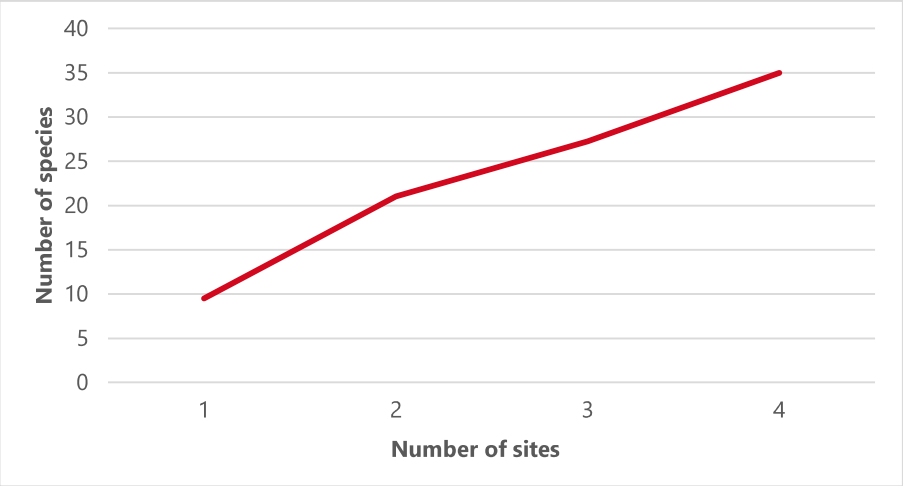

Figure 4: Species accumulation curve using quadrat/relevé data

4.2.3 BOTANICAL LIMITATIONS

Survey design: Single phase, quadrat/relevé-based flora and vegetation survey with extensive traverses searching for conservation significant flora. Results from previous surveys were considered as part of survey design and the desktop assessment.

Survey type: Reconnaissance flora and vegetation survey with extensive searches for significant flora searches conducted over a single phase.

Type of vegetation classification system: Vegetation classified at NVIS Level V (NVIS Technical Working Group 2017) using largely structural vegetation types defined using dominant and characteristic species and vegetation structure as recorded during the field surveys.

A full summary of botanical limitations is presented in **Table 8**.

Table 8: Botanical limitations

Possible limitations	Constraints (yes/no): Significant, moderate or negligible	Comment
Availability of contextual information at a regional and local scale	No	The flora and vegetation of the Port Hedland area is well documented and has been extensively surveyed
Competency/experience of the team conducting the survey, including experience in the bioregion surveyed	No	The lead botanist conducting the field survey has over 14 years' experience conducting flora and vegetation surveys in Western Australia, including the Pilbara region.
Proportion of the flora recorded and/or collected, and any identification issues	No	A total of 61 flora taxa were recorded during the field survey of which four (6.56% of the total) were not identifiable to due to lack of reproductive material. None are similar to any currently listed TF or PF. The proportion of unidentified taxa is not considered a limitation for the purpose of a reconnaissance survey.
Was the appropriate area fully surveyed (effort and extent)	No	The survey area was surveyed adequately to describe the flora, vegetation types and vegetation for the purpose of a reconnaissance survey.
Access restrictions within the survey area	No	The entire survey area was fully accessible and extensively traversed on foot.
Survey timing, rainfall, season of survey	No	The field survey was conducted in February, which is just outside the optimal season for survey in the Eremaean region of Western Australia, though not considered a limitation for the purpose of a reconnaissance survey. The rainfall during the four months prior to the field survey was approximately 53.5% of the long term (**Figure 3**). However, the purpose of the survey was a reconnaissance level survey and the revised likelihood assessment for conservation significant flora identified that all species identified by the database searches were unlikely or highly unlikely to occur. Therefore rainfall is not considered a significant constraint.
Disturbance that may have affected the results of the survey e.g. fire, flood, clearing	No	There were no recent disturbances that would have affected the results of the survey. The survey area is located adjacent to cleared land and vegetation has been impacted by weeds and tracks, however this is not considered a limitation relating to the survey undertaken.

4.3 FAUNA SURVEY

The fauna survey was conducted by Melinda Henderson during February 2020. The entire site was traversed on foot; all habitats were assessed for quality and capability of supporting both locally common and significant fauna species. The survey was conducted as a Level 1 survey according to the *Technical Guidance – Sampling Methods for Terrestrial Vertebrate Fauna* (EPA 2016d).

4.3.1 FAUNA HABITAT

The field survey identified three fauna habitat types – Hummock Grassland, Halophytic Shrubland and Minor Drainage Lines (**Table 9**). Habitat quality was assessed as good with the extent of the fauna habitats totalling 4.57 ha (remaining areas were cleared).

Habitat quality is based on the field surveyors experience, the level of disturbance due to weeds, road/tracks, clearing or other human disturbances, and the context of the habitat with the surrounding landscape.

Table 9: Fauna habitat types

Habitat type	Description	Photo
Hummock Grassland	Low grassland of *Triodia*, small shrubs, herbs and grasses on sandy soil. **Extent:** 4.15 ha **Percentage of survey area:** 41.07% Habitat suitable for small birds (particularly granivores), mammals and reptiles.	
Halophytic Shrubland	Scattered samphire shrubs over sandy soil, ephemerally inundated. **Extent:** 1.31 ha **Percentage of survey area:** 12.93% Habitat suitable for small bird and reptile species.	

Habitat type	Description	Photo
Minor Drainage Line	Seasonally wet drainage lines with bare sandy soil and scattered samphire shrubs. **Extent:** 0.08 ha **Percentage of survey area:** 0.75% Habitat suitable as a water source for most fauna groups when inundated. Habitat marginally suitable only for reptiles when dry.	

Hummock Grassland (4.15 ha)

Scattered *Acacia stellaticeps* shrubs over *Triodia epactia/ Triodia secunda* and other herbs and grasses on sandy soil. Habitat quality was assessed as good and provides the most diverse environment within the survey area occupying 4.15 ha (41.07%). This habitat provides food and shelter for small mammals, birds (particularly granivorous species) and reptiles.

Halophytic Shrubland (1.31 ha)

Low lying open *Tecticornia auriculata* shrubs over sandy soil, ephemerally inundated. This habitat occupies 1.31 ha (12.93%) providing seasonal water resources for mammals, birds and reptiles when inundated. When dry, it is likely only to support reptiles and some birds. It is unlikely to support mammals due to lack of shelter due to reduced ground cover, and is not suitable for sedentary burrowing species due to seasonal inundation.

Minor drainage lines (0.08 ha)

Seasonally wet drainage lines with bare sandy soil with some scattered *Tecticornia auriculata* shrubs along edges and in sand bars. When water is absent this habitat creates avenues for the movement of feral species such as Cats, Dogs and Foxes through the survey area. This habitat occupies 0.08 ha (0.75%) providing water resources for most fauna groups when inundated but has little habitat value when dry.

A representative location (recording site) of each of these fauna habitat types is recorded below in **Table 10**.

Table 10: Fauna sites (GDA94, Zone 50)

Site Name	Site Type	Easting	Northing
WF01	Tussock grassland	666650.25	7747429.55
WF02	Halophytic shrubland	666549.02	7747239.33
WF03	Minor drainage lines	666704.20	7747340.68

4.3.2 FAUNA ASSEMBLAGE

Fourteen vertebrate fauna species were recorded during the field survey (**Table 11**). No conservation significant species were identified.

Table 11: Recorded fauna species

Species	Common name
Mammals	
Felis catus	Cat
Canis lupus subsp. familiaris	Dog
Oryctolagus cuniculus	Rabbit
Birds	
Ocyphaps lophotes	Crested Pigeon
Taeniopygia guttata	Zebra Finch
Haliastur sphenurus	Whistling Kite
Anthus novaeseelandiae australis	Australian Pipit
Mirafra javanica	Horsfield's Bushlark
Artamus leucorynchus	White-breasted Woodswallow
Taeniopygia guttata	Zebra Finch
Ptilotula penicillata subsp. *carteri*	Carter's White-plumed Honeyeater
Lichmera indistincta	Brown Honeyeater
Haliastur sphenurus	White-winged Fairy-wren
Reptiles	
Ctenophorus isolepis subsp. *gularis*	Central Military Dragon

4.3.3 SIGNIFICANT FAUNA AND ASSOCIATED HABITAT

The significant fauna species identified through the desktop investigation are discussed below with respect to each species habitat requirements within the survey area and their likelihood of occurrence considering the results of the field survey.

4.3.3.1 Likelihood of Occurrence

Two species, detailed below, have been previously identified from within the survey area or are considered to have a High likelihood of occurring based on the criteria above:

- Brush-tailed Mulgara (*Dasycercus blythi*) – P4 (BC Act)
- Airlie Island Ctenotus (*Ctenotus angusticeps)* – VU (EPBC Act), P4 (BC Act).

The likelihood of species occurring within the survey area are indicated in **Table 12**.

Brush-tailed Mulgara (*Dasycercus blythi*)

Brush-tailed Mulgara is listed as a Priority 4 species by DBCA. Known habitat in the Pilbara consists of sandy plains vegetated with spinifex up to 1 m high but can also include sparsely vegetated areas. It can be difficult to identify the presence of Brush-tailed Mulgara in highly vegetated areas and burrows are difficult to identify definitively without tracks, scat or visual identification (Thompson & Thompson 2014).

It is likely that, due to the presence of Feral cats within the survey area, Brush-tailed Mulgara are no longer present, corroborating the findings of the GHD (2009) survey, wherein only unused and presumably abandoned burrows were recorded. No burrow or scat evidence was observed within the survey area. However, the amount of ground cover within the Tussock Grassland, where they would most likely occur, makes the identification of burrows difficult.

Airlie Island Ctenotus (*Ctenotus angusticeps*)

Airlie Island Ctenotus occurs in unique and fragmented populations which do not occur within any protected reserves on the mainland, and is strongly associated with samphire shrublands on the edges of salt marshes. Prior to 2012, only three locations were recorded but it is now known from approximately 12 locations in north-

west WA including Airlie Island (SPRAT). However, it is unlikely that the survey area provides the appropriate habitat (i.e. it is not on the edge of a salt marsh or significantly similar site) for this species to occur.

Table 12: Conservation significant vertebrate fauna likelihood of occurrence (blue shading indicates high desktop likelihood)

Species	Common name	EPBC◦Act◦ ranking	BC Act ranking	Desktop likelihood	Post survey likelihood	Database
Dasycercus blythi	Brush-tailed Mulgara		P4	High	Low	*NatureMap*, DBCA
Dasyurus hallucatus	Northern Quoll	EN	EN	Low	Very Low	*NatureMap*, PMST, DBCA
Lagostrophus fasciatus subsp. *fasciatus*	Banded Hare-wallaby	EN	EN	Medium	Very Low	*NatureMap*, DBCA
Macroderma gigas	Ghost Bat	VU	VU	Low	Very Low	PMST
Macrotis lagotis	Greater Bilby	VU	VU	Low	Very Low	PMST
Mormopterus cobourgianus	North-western Free-tailed bat		P1	Low	Very Low	DBCA
Rhinonicteris aurantia	Pilbara Leaf-nosed Bat	VU	VU	Low	Very Low	PMST
Falco peregrinus	Peregrine Falcon		OS	Low	Low	DBCA
Pezoporus occidentalis	Night Parrot	EN	CR	Very Low	Very Low	PMST
Ctenotus angusticeps	Airlie Island Ctenotus	VU	P4	High	Low	*NatureMap*
Liasis olivaceus barroni	Olive Python	VU	VU	Very Low	Very Low	PMST

4.3.4 POST SURVEY LIKELIHOOD ASSESSMENT RESULTS

Brush-tailed Mulgara and Airlie Island Ctenotus was assessed as having a post survey likelihood of occurrence of low based on the results of the field habitat assessment survey. As listed in **Table 4,** the low category is allocated to species rarely recorded within 10 km of the survey area and without suitable habitat within the survey area

The remaining conservation significant fauna species assessed as medium from the desktop assessment were allocated to Very Low based on the record being historical but within 5km of the survey area. The species, the Banded Hare-wallaby is now presumed extinct on the mainland.

4.3.5 FAUNA SURVEY LIMITATIONS

The fauna survey limitations are outlined below (**Table 13**).

Table 13: Summary of survey limitations

Possible limitations	Constraints (yes/possible/no)	Comment
Competency/experience of the consultant conducting the survey	No	Completed by a qualified and experienced Zoologist with prior experience completing Level 1 surveys
Scope (what faunal groups were sampled and were some sampling methods not able to be employed because of constraints such as weather conditions).	No	All items in the scope were investigated
Proportion of fauna identified, recorded and/or collected.	No	Level 1 opportunistic event does not allow for a full fauna species inventory to be collected
Sources of information (previously available information as distinct from new data).	No	Both State and Commonwealth sources readily available
The proportion of the task achieved and further work which might be needed.	No	All tasks achieved
Timing/weather/season/cycle.	No	Weather and season were optimal for the detection of all assemblages.
Disturbances which affected results of the survey (e.g. fire, flood, accidental human intervention).	No	No disturbances to the survey occurred
Intensity (in retrospect was the intensity adequate).	No	The size of the survey area and the expected level of disturbance warranted a level 1 reconnaissance survey appropriate
Completeness (e.g. was relevant area fully surveyed), remoteness and/or access problems	No	Entire survey area was traversed on foot
Resources (e.g. degree of expertise available in animal identification to taxon level).	No	No access problems encountered

5 DISCUSSION

5.1 FLORA SIGNIFICANCE

Sixty one vascular flora species recorded from two floristic quadrats, two relevés and opportunistic searches. Five (8.2%) of these were introduced species and four could not be identified with certainty due to lack of diagnostic reproductive material; none were similar to any currently described conservation significant species. The survey area was entirely traversed at 30-40 m grid spacings or less and it is considered that the majority of flora species present would have been recorded, with the exception of some ephemeral taxa.

A previous survey (GHD 2009) recorded 123 flora taxa from a much larger area that entirely includes the present survey area.

5.1.1 CONSERVATION SIGNIFICANT FLORA

No TF species listed for protection under the Commonwealth EPBC Act or Western Australian BC Act were recorded from the survey area. No TF species are known to occur within 50 km of the survey area, therefore no TF species were likely to occur within the survey area.

No Priority-listed flora were recorded and all that were identified by the database searches were considered unlikely or highly unlikely based on a revised (post field survey) likelihood assessment (**Table 5**).

5.1.2 OTHER SIGNIFICANT FLORA

No other flora taxa of significance according to the criteria outlined in the Flora and Vegetation Technical Guidance (EPA 2016b) were recorded during the field survey.

The *Tephrosia rosea* sens. lat. recorded from the survey area, whilst an unresolved species complex, is understood to be known to the Western Australian Herbarium and not considered to be of specific conservation significance.

5.1.3 INTRODUCED FLORA

Five introduced flora were recorded during the field survey, none are listed as WONs or Declared Pest plants and do not have any further management implications.

5.2 VEGETATION SIGNIFICANCE

Four vegetation types were recorded as occurring in the survey area, corresponding with sandplains (two vegetation types dominated by *Triodia* spp.[spinifex]) and sandy clay depressions (two vegetation types dominated by *Tecticornia* spp. [samphire]).

5.2.1 SIGNIFICANT ECOLOGICAL COMMUNITIES

None of the vegetation types are considered to represent any currently described TEC or PEC based on the results of the DBCA database search and current lists of TECs and PECs from the Pilbara (Species and Communites Program, DBCA 2019).

5.2.2 OTHER SIGNIFICANT VEGETATION

None of the vegetation types are considered significant according to the Flora and Vegetation Technical Guidance (EPA 2016b).

5.2.3 LOCAL AND REGIONAL SIGNIFICANCE

The vegetation types recorded within the survey area were observed to extend outside of the survey area and are considered typical of vegetation from the Port Hedland region. The survey area corresponds with a pre-European vegetation association (647) that has over 97% extent remaining at all scales. Therefore it is considered unlikely that the vegetation types recorded would be considered of local or regional significance.

5.2.4 VEGETATION CONDITION

A total of 4.57 ha (45.26%) of the survey area was cleared or devoid of native vegetation and a further 0.91 ha (8.98%) was in Degraded or Completely Degraded condition. Vegetation in Good or Very Good condition accounted for 4.55 ha (45.02%) of the survey area. The main factors influencing vegetation condition were existing clearing and informal tracks as well as weed infestations and general edge effects.

5.3 FAUNA SIGNIFICANCE

5.3.1 SIGNIFICANT FAUNA HABITAT TYPES

Three habitat types were recorded within the survey area: Tussock Grassland, Halophytic shrubland and Minor drainage line. Each of these habitat types supports a suite of birds, mammals and reptiles some of which have specific requirements unique to a particular habitat, although all observed species were common and have no particular significance. Small birds were observed moving through the survey area to drink at a manmade depression in the south of the survey area holding water from recent rains (mapped as Minor drainage line habitat).

Feral cat tracks were observed within the Minor drainage line habitat. This area is open with little to no vegetation and allows for easy movement of feral species through the survey area. The presence of feral predators will have an impact on native species, especially small mammals and reptiles within the survey area.

None of the recorded habitat types is considered of particular significance.

5.3.2 FAUNA ASSEMBLAGE

Fourteen vertebrate fauna species were recorded during the field survey (three feral mammals, one reptile and 10 birds). No conservation significant species were recorded.

The survey area is within proximity to Industry and the Great Northern Highway. This will impact the use of the area by the fauna species identified through the database searches and those recorded in the field due to noise and the presence of feral predators.

The survey timing was appropriate for the Eremaean Province falling within the summer period between September to April.

5.3.3 OTHER CONSERVATION SIGNIFICANT FAUNA

Eleven conservation significant fauna species were identified as potentially occurring within the survey area. Two were identified during the desktop assessment as having a high likelihood of occurrence: Brush-tailed Mulgara and Airlie Island Ctenotus. This likelihood was decreased due to the presence of Feral cats, proximity to Great Northern Highway, surrounding human disturbance (industry), and lack of suitable habitat occurring within the survey area. Neither is considered likely to occur. This is despite evidence of previous occupation by Brush-tailed Mulgara, which had vanished from the site by 2009 (GHD 2009).

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MAPS

LEGEND

Wedgefiled Survey Area

Conservation Significant Flora (FMG, 2019)

- Priority 1
- Priority 4

Conservation Significant Flora (DBCA, 2019)

- Priority 1
- Priority 3
- Priority 4

Taxon	Code
Goodenia nuda	Gn
Tephrosia rosea var. Port Headland (A.S. George 1114)	Tr

DATA SOURCES
SOURCE DATA:
AERIAL: PORT HEDLAND 10CM NOV 2015 (FORTESCUE)
SERVICE LAYERS:

ecoscape

FLORA DATABASE SEARCH RESULTS

WEDGEFIELD FLORA AND FAUNA SURVEYS

IRONBRIDGE

FMG Fortescue
The New Force in Iron Ore

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

SCALE: 1:25,000 @ A3
0 200 400 600 800 1,000 m

PROJECT NO: 4508-20

REV	AUTHOR	APPROVED	DATE
00	JLT	SK	25/02/2020
01	SMB	SK	24/04/2020

MAP 01

LEGEND

- Wedgefiled Survey Area

Conservation Significant Fauna (DBCA, 2019)

- Critically endangered
- Endangered
- Vulnerable
- Migratory Species
- Priority 3
- Priority 4

DATA SOURCES
SOURCE DATA:
AERIAL: PORT HEDLAND 10CM NOV 2015 (FORTESCUE)
SERVICE LAYERS:

ecoscape

FAUNA DATABSE SEARCH RESULTS

WEDGEFIELD FLORA AND FAUNA SURVEYS

IRONBRIDGE

Fortescue
The New Force in Iron Ore

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

SCALE: 1:25,000 @ A3
0 200 400 600 800 1,000 m

PROJECT NO: 4508-20

REV	AUTHOR	APPROVED	DATE
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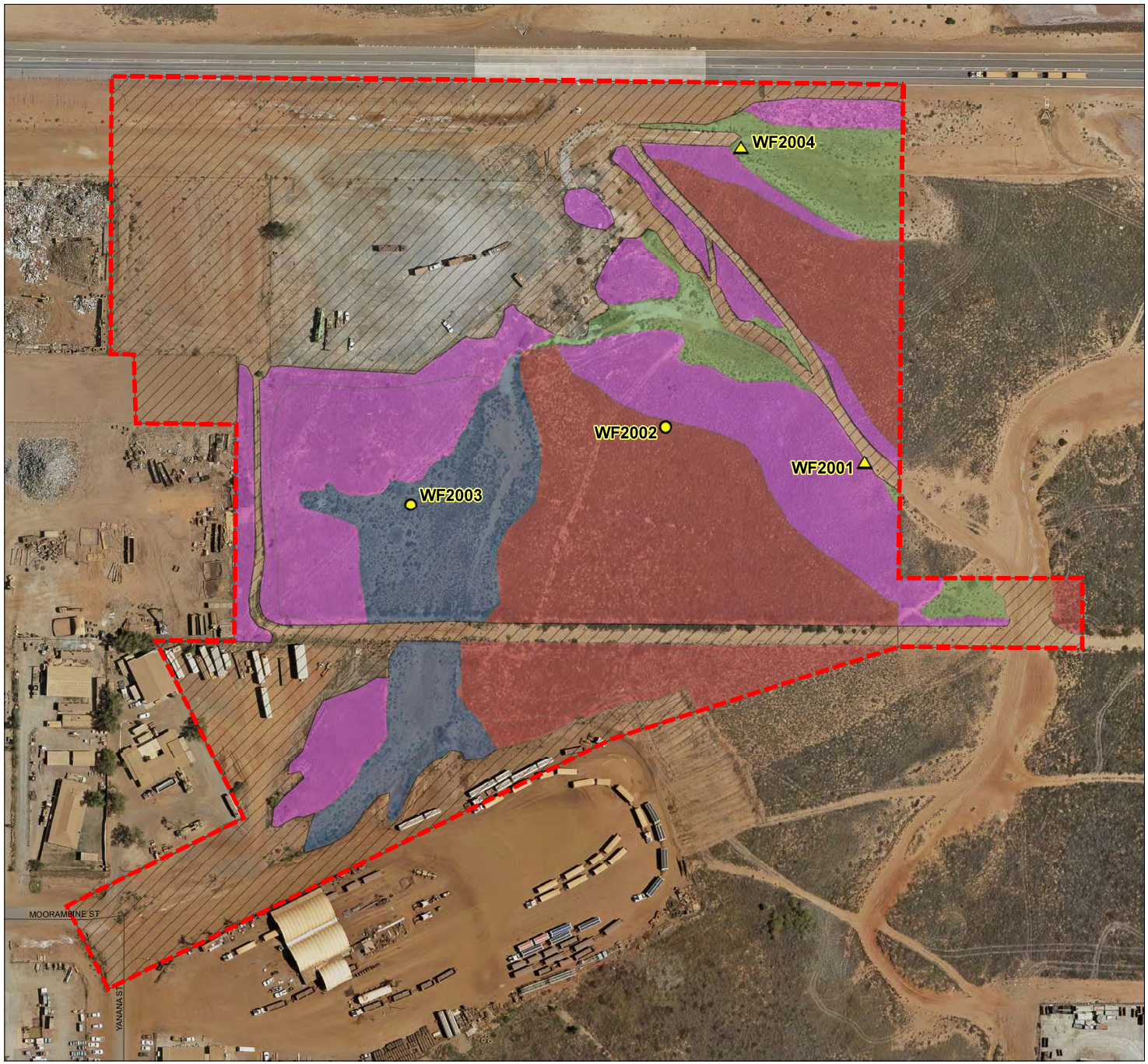
01	SMB	SK	24/04/2020

MAP 02



LEGEND

- Wedgefiled Survey Area
- Quadrat
- Releve

Vegetation Type

- Ta: *Tecticornia auriculata*, *T. indica* subsp. *leiostachya* and *T. halocnemoides* low open samphire shrubland
- Te: *Triodia epactia* and *Acacia stellaticeps* low closed hummock grassland/shrubland
- Ti: *Tecticornia indica* subsp. *leiostachya* and *T. halocnemoides* low samphire shrubland
- Ts: *Triodia secunda* and *Frankenia ambita* low hummock grassland/shrubland
- N/A: Cleared of Native Vegetation

DATASOURCES
SOURCE DATA: VEGETATION TYPE (ECOSCAPE 2020)
AERIAL: PORT HEDLAND 10CM NOV 2015 (FORTESCUE)
SERVICE LAYERS:

ecoscape

VEGETATION TYPES QUADRATS AND RELEVÉS

WEDGEFIELD FLORA AND FAUNA SURVEYS

IRONBRIDGE

FMG Fortescue
The New Force in Iron Ore

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

N

SCALE: 1:1,700 @ A3
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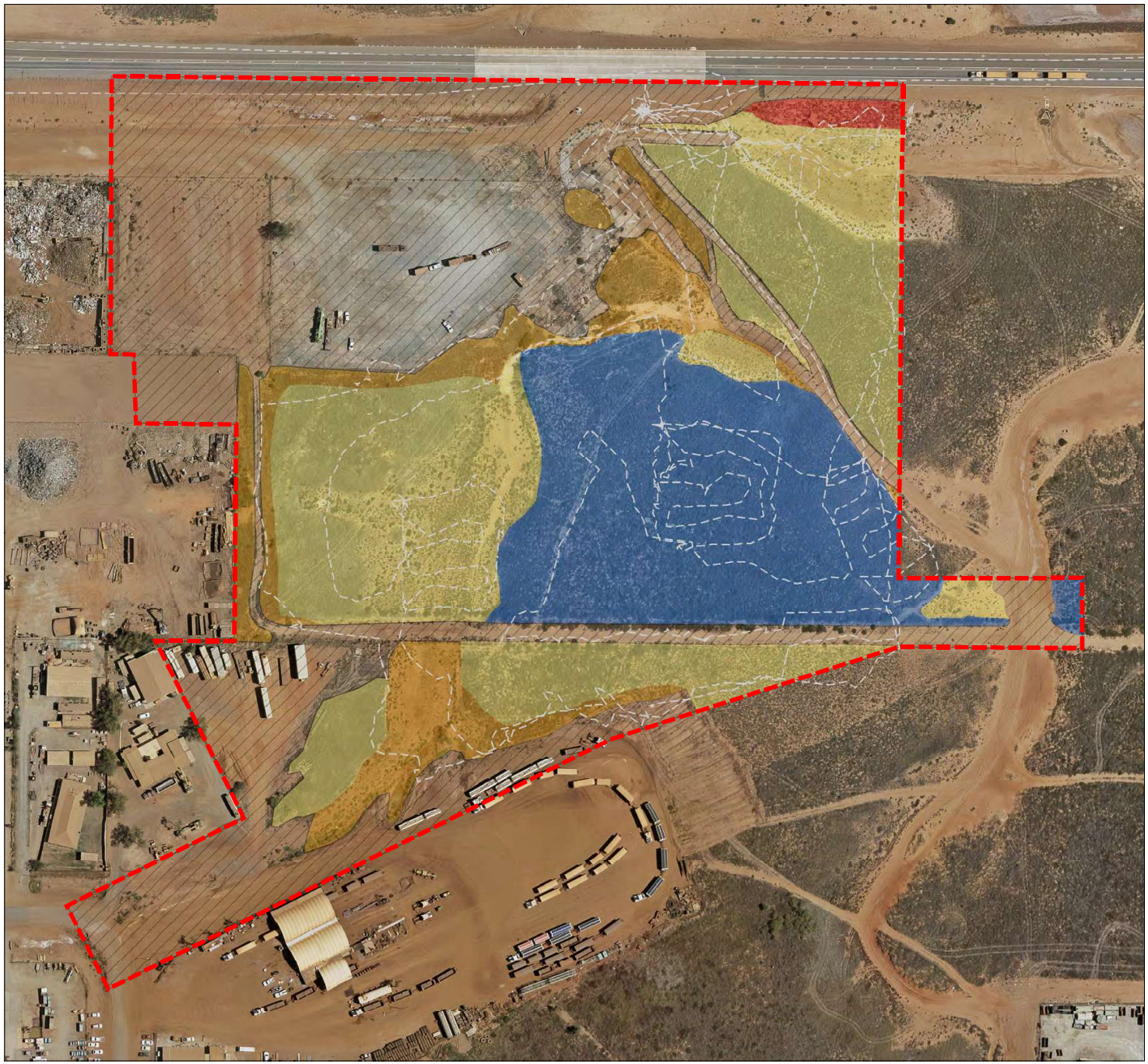
PROJECT NO: 4508-20

REV	AUTHOR	APPROVED	DATE
00	JLT	SK	25/02/2020
01	SMB	SK	24/04/2020

MAP
03



LEGEND

- Wedgefield Study Area
- Survey Tracks

Vegetation Condition

- Good
- Very Good
- Degraded
- Completley Degraded
- Not Vegetated

DATASOURCES
SOURCE DATA: VEGETATION CONDITION (ECOSCAPE, 2020)
AERIAL: PORT HEDLAND 10CM NOV 2015 (FORTESCUE)
SERVICE LAYERS:

ecoscape

VEGETATION CONDITION AND SURVEY TRACKS

WEDGEFIELD FLORA AND FAUNA SURVEYS

IRONBRIDGE

FMG Fortescue
The New Force in Iron Ore

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

N

SCALE: 1:1,700 @ A3

0 10 20 30 40 50 m

PROJECT NO: 4508-20

REV	AUTHOR	APPROVED	DATE
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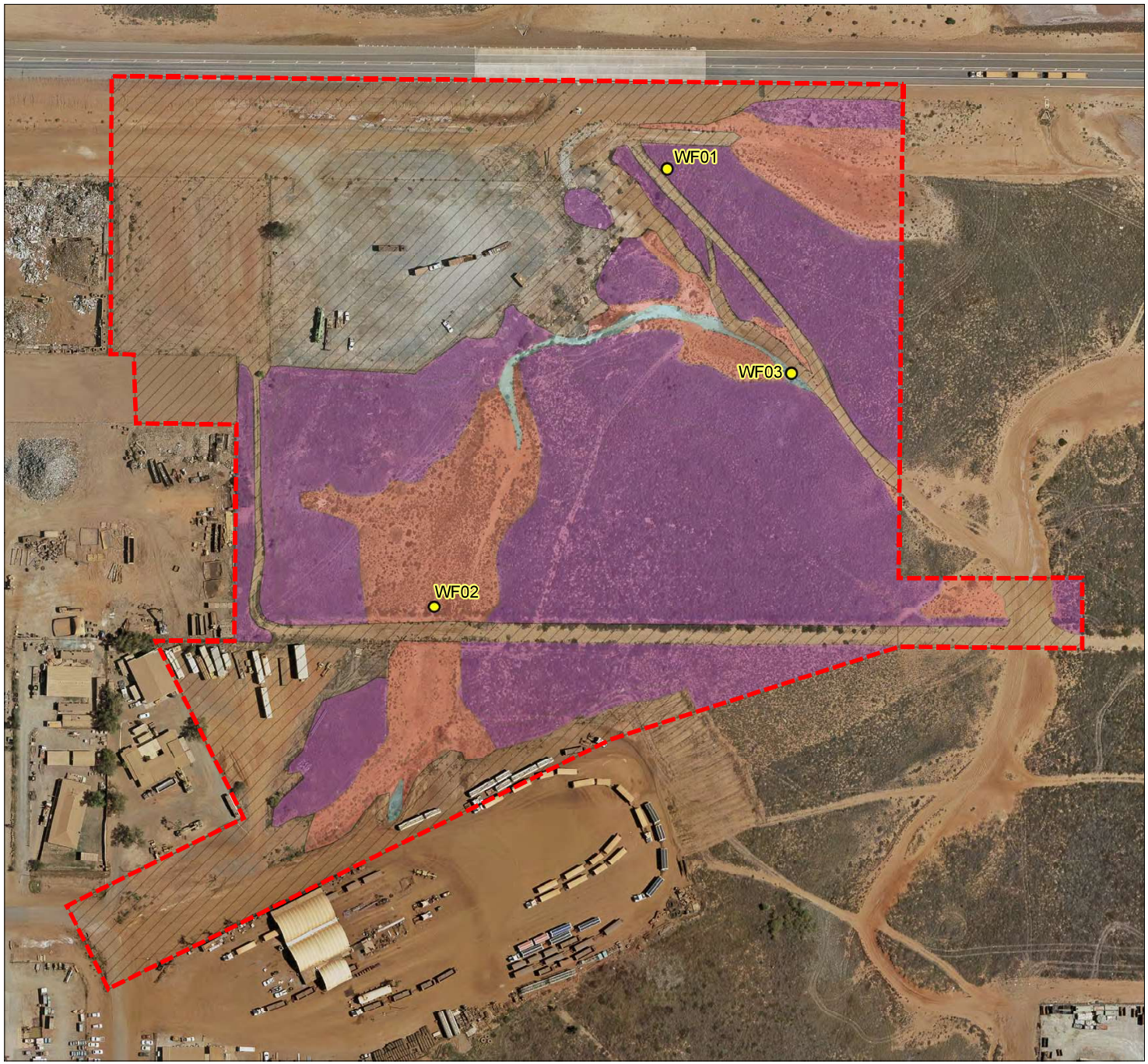
01	SMB	SK	24/04/2020

MAP
04



LEGEND

- Wedgefield Study Area
- Habitat Assessment

Habitat Type

- Halophytic Shrubland
- Hummock Grassland
- Minor Drainage Lines
- Cleared of Native Vegetation

DATASOURCES
SOURCE DATA: HABITAT TYPE (ECOSCAPE, 2020)
AERIAL: PORT HEDLAND 10CM NOV 2015 (FORTESCUE)
SERVICE LAYERS:

ecoscape

FAUNA HABITAT TYPES AND SITE LOCATIONS

WEDGEFIELD FLORA AND FAUNA SURVEY

IRONBRIDGE

FMG Fortescue
The New Force in Iron Ore

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

N

SCALE: 1:1,700 @ A3

0 10 20 30 40 50 m

PROJECT NO: 4508-20

REV	AUTHOR	APPROVED	DATE
00	JLT	SK	25/02/2020
01	SMB	SK	24/04/2020

MAP
05

APPENDIX ONE DEFINITIONS AND CRITERIA

Table 14: EPBC Act categories for flora and fauna

EPBC Act category	Definition
Extinct	A native species is eligible to be included in the extinct category at a particular time if, at that time, there is no reasonable doubt that the last member of the species has died.
Extinct in the wild	A native species is eligible to be included in the extinct in the wild category at a particular time if, at that time: (a) it is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; or (b) it has not been recorded in its known and/or expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.
Critically Endangered (CE)	A native species is eligible to be included in the critically endangered category at a particular time if, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.
Endangered (EN)	A native species is eligible to be included in the endangered category at a particular time if, at that time: (a) it is not critically endangered; and (b) it is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria.
Vulnerable (VU)	A native species is eligible to be included in the vulnerable category at a particular time if, at that time: (a) it is not critically endangered or endangered; and (b) it is facing a high risk of extinction in the wild in the medium term future, as determined in accordance with the prescribed criteria.
Conservation Dependent	A native species is eligible to be included in the conservation dependent category at a particular time if, at that time: (a) the species is the focus of a specific conservation program the cessation of which would result in the species becoming vulnerable, endangered or critically endangered; or (b) the following subparagraphs are satisfied: (i) the species is a species of fish; (ii) the species is the focus of a plan of management that provides for management actions necessary to stop the decline of, and support the recovery of, the species so that its chances of long term survival in nature are maximised; (iii) the plan of management is in force under a law of the Commonwealth or of a State or Territory; (iv) cessation of the plan of management would adversely affect the conservation status of the species.

Table 15: Conservation codes for Western Australian flora and fauna (DBCA 2019)

Conservation Codes for Western Australian Flora and Fauna	
Threatened, Extinct and Specially Protected fauna or flora[1] are species[2] which have been adequately searched for and are deemed to be, in the wild, threatened, extinct or in need of special protection, and have been gazetted as such. **The *Wildlife Conservation (Specially Protected Fauna) Notice 2018* and the *Wildlife Conservation (Rare Flora) Notice 2018* have been transitioned under regulations 170, 171 and 172 of the *Biodiversity Conservation Regulations 2018* to be the lists of Threatened, Extinct and Specially Protected species under Part 2 of the *Biodiversity Conservation Act 2016*.** Categories of Threatened, Extinct and Specially Protected fauna and flora are:	
T	**Threatened species** Listed by order of the Minister as Threatened in the category of critically endangered, endangered or vulnerable under section 19(1), or is a rediscovered species to be regarded as threatened species under section 26(2) of the *Biodiversity Conservation Act 2016* (BC Act). Threatened fauna is that subset of 'Specially Protected Fauna' listed under schedules 1 to 3of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* for Threatened Fauna. Threatened flora is that subset of 'Rare Flora' listed under schedules 1 to 3of the *Wildlife Conservation (Rare Flora) Notice 2018* for Threatened Flora. The assessment of the conservation status of these species is based on their national extent and ranked according to their level of threat using IUCN Red List categories and criteria as detailed below.
CR	**Critically endangered species** Threatened species considered to be "*facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with criteria set out in the ministerial guidelines*". Listed as critically endangered undersection 19(1)(a) of the BC Act in accordance with the criteria set out in section 20 and the ministerial guidelines. Published under schedule 1 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* for critically endangered fauna or the *Wildlife Conservation (Rare Flora) Notice 2018* for critically endangered flora.
EN	**Endangered species** Threatened species considered to be "*facing a very high risk of extinction in the wild in the near future, as determined in accordance with criteria set out in the ministerial guidelines*". Listed as endangered under section 19(1)(b) of the BC Act in accordance with the criteria set out in section 21 and the ministerial guidelines. Published under schedule 2 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* for endangered fauna or the *Wildlife Conservation (Rare Flora) Notice 2018* for endangered flora.
VU	**Vulnerable species** Threatened species considered to be "*facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with criteria set out in the ministerial guidelines*". Listed as vulnerable undersection 19(1)(c) of the BC Act in accordance with the criteria set out in section 22 and the ministerial guidelines. Published under schedule 3of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* for vulnerable fauna or the *Wildlife Conservation (Rare Flora) Notice 2018* for vulnerable flora.
Extinct species Listed by order of the Minister as extinct under section 23(1) of the BC Act as extinct or extinct in the wild.	
EX	**Extinct species** Species where "*there is no reasonable doubt that the last member of the species has died*", and listing is otherwise in accordance with the ministerial guidelines (section 24 of the BC Act). Published as presumed extinct under schedule 4of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* for extinct fauna or the *Wildlife Conservation (Rare Flora) Notice 2018* for extinct flora.
EW	Extinct in the wild species Species that "*is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; and it has not been recorded in its known habitat or expected habitat, at appropriate seasons, anywhere in its past range, despite surveys over a time frame appropriate to its life cycle and form*", and listing is otherwise in accordance with the ministerial guidelines (section 25of the BC Act). Currently there are no threatened fauna or threatened flora species listed as extinct in the wild. If listing of a species as extinct in the wild occurs, then a schedule will be added to the applicable notice.
Specially protected species Listed by order of the Minister as specially protected under section 13(1) of the BC Act. Meeting one or more of the following categories: species of special conservation interest; migratory species; cetaceans; species subject to international agreement; or species otherwise in need of special protection. Species that are listed as threatened species (critically endangered, endangered or vulnerable) or extinct species under the BC Act cannot also be listed as Specially Protected species.	

Conservation Codes for Western Australian Flora and Fauna	
MI	**Migratory species** Fauna that periodically or occasionally visit Australia or an external Territory or the exclusive economic zone; or the species is subject of an international agreement that relates to the protection of migratory species and that binds the Commonwealth; and listing is otherwise in accordance with the ministerial guidelines (section 15of the BC Act). Includes birds that are subject to an agreement between the government of Australia and the governments of Japan (JAMBA), China (CAMBA) and The Republic of Korea (ROKAMBA), and fauna subject to the *Convention on the Conservation of Migratory Species of Wild Animals* (Bonn Convention), an environmental treaty under the United Nations Environment Program. Migratory species listed under the BC Act are a subset of the migratory animals that are known to visit Western Australia, protected under the international agreements or treaties, excluding species that are listed as Threatened species. Published as migratory birds protected under an international agreement under schedule 5 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018.
CD	**Species of special conservation interest (conservation dependent fauna)** Fauna of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as threatened, and listing is otherwise in accordance with the ministerial guidelines (section 14of the BC Act). Published as conservation dependent fauna under schedule 6 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018*.
OS	**Other specially protected species** Fauna otherwise in need of special protection to ensure their conservation, and listing is otherwise in accordance with the ministerial guidelines (section 18of the BC Act). Published as other specially protected fauna under schedule 7of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018*.
P	**Priority species** Possibly threatened species that do not meet survey criteria, or are otherwise data deficient, are added to the Priority Fauna or Priority Flora Lists under Priorities 1, 2 or 3. These three categories are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as threatened fauna or flora. Species that are adequately known, are rare but not threatened, or meet criteria for near threatened, or that have been recently removed from the threatened species or other specially protected fauna lists for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring. Assessment of Priority codes is based on the Western Australian distribution of the species, unless the distribution in WA is part of a contiguous population extending into adjacent States, as defined by the known spread of locations.
1	**Priority 1: Poorly-known species** Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.
2	**Priority 2: Poorly-known species** Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.
3	**Priority 3: Poorly-known species** Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.
4	**Priority 4: Rare, Near Threatened and other species in need of monitoring** (a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection but could be if present circumstances change. These species are usually represented on conservation lands. (b) Near Threatened. Species that are considered to have been adequately surveyed and that are close to qualifying for vulnerable but are not listed as Conservation Dependent. (c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

[1] The definition of flora includes algae, fungi and lichens.
[2] Species includes all taxa (plural of taxon - a classificatory group of any taxonomic rank, e.g. a family, genus, species or any infraspecific category i.e. subspecies or variety, or a distinct population).

Table 16: DBCA definitions and criteria for TECs and PECs (DEC 2013)

Criteria	Definition
Threatened Ecological Communities	
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
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).
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. 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).

Criteria	Definition
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 ecological communities	
Priority One	*Poorly known ecological communities* Ecological communities with apparently few, small occurrences, all or most not actively managed for conservation (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) and for which current threats exist. 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	*Poorly known ecological communities* Communities that are known from few small occurrences, all or most of which are actively managed for conservation (e.g. within national parks, conservation parks, nature reserves, state forest, unallocated Crown land, water reserves, etc.) and not under imminent 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	*Poorly known ecological communities* i. 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; ii. Communities known from a few widespread occurrences, which are either large or within significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat, or; iii. 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.
Priority Four	Ecological communities that are adequately known, rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list. These communities require regular monitoring. i. 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. ii. 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. iii. Ecological communities that have been removed from the list of threatened communities during the past five years.
Priority Five	*Conservation Dependent 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.

Table 17: NVIS structural formation terminology, terrestrial vegetation (NVIS Technical Working Group 2017)

	Cover characteristics							
	Foliage cover *	70-100	30-70	10-30	<10	» 0 (scattered)	0-5 (clumped)	unknown
	Cover code	d	c	i	r	bi	bc	unknown
Growth Form	**Height Ranges (m)**	**Structural Formation Classes**						
tree, palm	<10,10-30, >30	closed forest	open forest	woodland	open woodland	isolated trees	isolated clumps of trees	tree, palm
tree mallee	<3, <10, 10-30	closed mallee forest	open mallee forest	mallee woodland	open mallee woodland	isolated mallee trees	isolated clumps of mallee trees	tree mallee
shrub, cycad, grass-tree, tree-fern	<1,1-2,>2	closed shrubland	shrubland	open shrubland	sparse shrubland	isolated shrubs	isolated clumps of shrubs	shrub, cycad, grass-tree, tree-fern
mallee shrub	<3, <10, 10-30	closed mallee shrubland	mallee shrubland	open mallee shrubland	sparse mallee shrubland	isolated mallee shrubs	isolated clumps of mallee shrubs	mallee shrub
heath shrub	<1,1-2,>2	closed heathland	heathland	open heathland	sparse heathland	isolated heath shrubs	isolated clumps of heath shrubs	heath shrub
chenopod shrub	<1,1-2,>2	closed chenopod shrubland	chenopod shrubland	open chenopod shrubland	sparse chenopod shrubland	isolated chenopod shrubs	isolated clumps of chenopod shrubs	chenopod shrub
samphire shrub	<0.5,>0.5	closed samphire shrubland	samphire shrubland	open samphire shrubland	sparse samphire shrubland	isolated samphire shrubs	isolated clumps of samphire shrubs	samphire shrub
hummock grass	<2,>2	closed hummock grassland	hummock grassland	open hummock grassland	sparse hummock grassland	isolated hummock grasses	isolated clumps of hummock grasses	hummock grass
tussock grass	<0.5,>0.5	closed tussock grassland	tussock grassland	open tussock grassland	sparse tussock grassland	isolated tussock grasses	isolated clumps of tussock grasses	tussock grass
other grass	<0.5,>0.5	closed grassland	grassland	open grassland	sparse grassland	isolated grasses	isolated clumps of grasses	other grass
sedge	<0.5,>0.5	closed sedgeland	sedgeland	open sedgeland	sparse sedgeland	isolated sedges	isolated clumps of sedges	sedge
rush	<0.5,>0.5	closed rushland	rushland	open rushland	sparse rushland	isolated rushes	isolated clumps of rushes	rush
herb	<0.5,>0.5	closed herbland	herbland	open herbland	sparse herbland	isolated herbs	isolated clumps of herbs	herb
fern	<1,1-2,>2	closed fernland	fernland	open fernland	sparse fernland	isolated ferns	isolated clumps of ferns	fern
bryophyte	<0.5	closed bryophyte-land	bryophyte-land	open bryophyteland	sparse bryophyteland	isolated bryophytes	isolated clumps of bryophytes	bryophyte
lichen	<0.5	closed lichenland	lichenland	open lichenland	sparse lichenland	isolated lichens	isolated clumps of lichens	lichen
vine	<10,10-30, >30	closed vineland	vineland	open vineland	sparse vineland	isolated vines	isolated clumps of vines	vine

Table 18: NVIS height classes (NVIS Technical Working Group 2017)

Height		Growth form				
Height Class	**Height Range (m)**	**Tree, vine (M & U), palm (single-stemmed)**	**Shrub, heath shrub, chenopod shrub, ferns, samphire shrub, cycad, tree-fern, grass-tree, palm (multi-stemmed)**	**Tree mallee, mallee shrub**	**Tussock grass, hummock grass, other grass, sedge, rush, forbs, vine (G)**	**Bryophyte, lichen, seagrass, aquatic**
8	>30	tall	NA	NA	NA	NA
7	10-30	mid	NA	tall	NA	NA
6	<10	low	NA	mid	NA	NA
5	<3	NA	NA	low	NA	NA
4	>2	NA	tall	NA	tall	NA
3	1-2	NA	mid	NA	tall	NA
2	0.5-1	NA	low	NA	mid	tall
1	<0.5	NA	low	NA	low	low
						Source: (based on Walker & Hopkins 1990)

Table 19: Vegetation Condition Scale for the Eremaean and Northern Botanical Provinces (EPA 2016b)

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

APPENDIX TWO FAUNA NATUREMAP RESULTS

NatureMap
Mapping Western Australia's biodiversity

NatureMap Species Report

Created By Guest user on 21/01/2020

Kingdom Animalia
Current Names Only Yes
Core Datasets Only Yes
Method 'By Circle'
Centre 118° 35' 46" E,20° 21' 54" S
Buffer 5km

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
1.	41323	*Actitis hypoleucos (Common Sandpiper)*		IA	
2.	30833	*Amphibolurus longirostris (Long-nosed Dragon)*			
3.	24312	*Anas gracilis (Grey Teal)*			
4.	24316	*Anas superciliosa (Pacific Black Duck)*			
5.	25557	*Ardea garzetta (Little Egret)*			
6.	24610	*Ardeotis australis (Australian Bustard)*			
7.	25566	*Artamus cinereus (Black-faced Woodswallow)*			
8.	25567	*Artamus leucorynchus (White-breasted Woodswallow)*			
9.	24354	*Artamus leucorynchus subsp. leucopygialis (White-breasted Woodswallow)*			
10.	24318	*Aythya australis (Hardhead)*			
11.	25715	*Cacatua roseicapilla (Galah)*			
12.	25716	*Cacatua sanguinea (Little Corella)*			
13.	24779	*Calidris acuminata (Sharp-tailed Sandpiper)*		IA	
14.	24786	*Calidris melanotos (Pectoral Sandpiper)*		IA	
15.	24788	*Calidris ruficollis (Red-necked Stint)*		IA	
16.	24789	*Calidris subminuta (Long-toed Stint)*		IA	
17.	24181	*Chaerephon jobensis (Greater Northern Freetail-bat, Northern Mastiff Bat)*			
18.	41332	*Chlidonias leucopterus (White-winged Black Tern, white-winged tern)*		IA	
19.		*Chroicocephalus novaehollandiae*			
20.	24288	*Circus approximans (Swamp Harrier)*			
21.	24289	*Circus assimilis (Spotted Harrier)*			
22.	25675	*Colluricincla harmonica (Grey Shrike-thrush)*			
23.	25568	*Coracina novaehollandiae (Black-faced Cuckoo-shrike)*			
24.	24416	*Corvus bennetti (Little Crow)*			
25.	25593	*Corvus orru (Torresian Crow)*			
26.	25701	*Coturnix ypsilophora (Brown Quail)*			
27.	25595	*Cracticus tibicen (Australian Magpie)*			
28.	25459	*Ctenophorus isolepis (Crested Dragon, Military Dragon)*			
29.	25024	*Ctenotus angusticeps (Airlie Island Ctenotus, Northwestern coastal Ctenotus)*		P3	
30.	25044	*Ctenotus hanloni*			
31.	25045	*Ctenotus helenae*			
32.	25062	*Ctenotus piankai*			
33.	25073	*Ctenotus saxatilis (Rock Ctenotus)*			
34.	25077	*Ctenotus serventyi*			
35.	24322	*Cygnus atratus (Black Swan)*			
36.	25547	*Dacelo leachii (Blue-winged Kookaburra)*			
37.	30903	*Dasycercus blythi (Brush-tailed Mulgara, Ampurta)*		P4	
38.	24089	*Dasycercus cristicauda (Crest-tailed Mulgara, minyiminyi)*		P4	
39.	24091	*Dasykaluta rosamondae (Little Red Kaluta)*			
40.	24093	*Dasyurus hallucatus (Northern Quoll)*		T	
41.	25002	*Delma pax*			
42.	24324	*Dendrocygna arcuata (Wandering Whistling Duck, Chestnut Whistling Duck)*			
43.	24325	*Dendrocygna eytoni (Plumed Whistling Duck)*			
44.		*Egretta garzetta*			
45.		*Elanus axillaris*			
46.	25540	*Elanus caeruleus (Black-shouldered Kite)*			
47.	47937	*Elseyornis melanops (Black-fronted Dotterel)*			
48.	24631	*Emblema pictum (Painted Finch)*			
49.		*Eolophus roseicapillus*			
50.	24653	*Eopsaltria pulverulenta (Mangrove Robin)*			
51.	25578	*Ephippiorhynchus asiaticus (Black-necked Stork)*			
52.	41409	*Eremiascincus musivus (Mosaic Desert Skink)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
53.	24379	*Erythrogonys cinctus (Red-kneed Dotterel)*			
54.	25621	*Falco berigora (Brown Falcon)*			
55.	25622	*Falco cenchroides (Australian Kestrel, Nankeen Kestrel)*			
56.	25623	*Falco longipennis (Australian Hobby)*			
57.	24041	*Felis catus (Cat)*	Y		
58.	25727	*Fulica atra (Eurasian Coot)*			
59.	24793	*Gallinago stenura (Pin-tailed Snipe)*		IA	
60.	24959	*Gehyra variegata*			
61.	47954	*Gelochelidon nilotica (Gull-billed Tern)*		IA	
62.	24401	*Geopelia cuneata (Diamond Dove)*			
63.	24402	*Geopelia humeralis (Bar-shouldered Dove)*			
64.	25585	*Geopelia striata (Zebra Dove)*			
65.	24276	*Gerygone tenebrosa (Dusky Gerygone)*			
66.	24481	*Glareola maldivarum (Oriental Pratincole)*		IA	
67.		*Glossamia aprion*			
68.	24443	*Grallina cyanoleuca (Magpie-lark)*			
69.	24293	*Haliaeetus leucogaster (White-bellied Sea-Eagle)*			
70.	25541	*Haliastur indus (Brahminy Kite)*			
71.	24295	*Haliastur sphenurus (Whistling Kite)*			
72.	25734	*Himantopus himantopus (Black-winged Stilt)*			
73.	24491	*Hirundo neoxena (Welcome Swallow)*			
74.	25630	*Hirundo rustica (Barn Swallow)*		IA	
75.		*Holoplatys meda*			
76.	48587	*Hydroprogne caspia (Caspian Tern)*		IA	
77.	24128	*Lagostrophus fasciatus subsp. fasciatus (Banded hare-wallaby, Mernine)*		T	
78.	24367	*Lalage tricolor (White-winged Triller)*			
79.	25637	*Larus novaehollandiae (Silver Gull)*			
80.		*Latrodectus hasseltii*			
81.	25125	*Lerista bipes*			
82.	25661	*Lichmera indistincta (Brown Honeyeater)*			
83.	25380	*Litoria caerulea (Green Tree Frog)*			
84.	25391	*Litoria rothii (Northern Laughing Tree Frog)*			
85.	25392	*Litoria rubella (Little Red Tree Frog)*			
86.	24135	*Macropus robustus subsp. erubescens (Euro, Biggada)*			
87.	25652	*Malurus leucopterus (White-winged Fairy-wren)*			
88.	24583	*Manorina flavigula (Yellow-throated Miner)*			
89.	24736	*Melopsittacus undulatus (Budgerigar)*			
90.	24598	*Merops ornatus (Rainbow Bee-eater)*			
91.	25542	*Milvus migrans (Black Kite)*			
92.	25545	*Mirafra javanica (Horsfield's Bushlark, Singing Bushlark)*			
93.	24223	*Mus musculus (House Mouse)*	Y		
94.	25422	*Neobatrachus aquilonius (Northern Burrowing Frog)*			
95.	25685	*Neochmia ruficauda (Star Finch)*			
96.	24969	*Nephrurus levis subsp. pilbarensis*			
97.	25430	*Notaden nichollsi (Desert Spadefoot)*			
98.	24224	*Notomys alexis (Spinifex Hopping-mouse)*			
99.	24798	*Numenius madagascariensis (Eastern Curlew)*		T	
100.	24799	*Numenius minutus (Little Curlew, Little Whimbrel)*		IA	
101.	25742	*Numenius phaeopus (Whimbrel)*		IA	
102.	24407	*Ocyphaps lophotes (Crested Pigeon)*			
103.	24620	*Pachycephala lanioides (White-breasted Whistler)*			
104.	25678	*Pachycephala melanura (Mangrove Golden Whistler)*			
105.	48591	*Pandion cristatus (Osprey, Eastern Osprey)*		IA	
106.	25682	*Pardalotus striatus (Striated Pardalote)*			
107.	48060	*Petrochelidon ariel (Fairy Martin)*			
108.	48061	*Petrochelidon nigricans (Tree Martin)*			
109.	24667	*Phalacrocorax sulcirostris (Little Black Cormorant)*			
110.	24842	*Platalea regia (Royal Spoonbill)*			
111.	24747	*Platycercus spurius (Red-capped Parrot)*			
112.	42306	*Platyplectrum spenceri (Centralian Burrowing Frog)*			
113.	24681	*Poliocephalus poliocephalus (Hoary-headed Grebe)*			
114.	24769	*Porzana fluminea (Australian Spotted Crake)*			
115.	25261	*Pseudechis australis (Mulga Snake)*			
116.	24234	*Pseudomys delicatulus (Delicate Mouse)*			
117.	24235	*Pseudomys desertor (Desert Mouse)*			
118.	24237	*Pseudomys hermannsburgensis (Sandy Inland Mouse)*			
119.	25263	*Pseudonaja modesta (Ringed Brown Snake)*			
120.	24776	*Recurvirostra novaehollandiae (Red-necked Avocet)*			
121.	48096	*Rhipidura albiscapa (Grey Fantail)*			
122.	25614	*Rhipidura leucophrys (Willie Wagtail)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
123.	24457	*Rhipidura phasiana (Mangrove Grey Fantail)*			
124.	25305	*Simoselaps anomalus (Desert Banded Snake)*			
125.	30948	*Smicrornis brevirostris (Weebill)*			
126.	24482	*Stiltia isabella (Australian Pratincole)*			
127.	24932	*Strophurus jeanae*			
128.	25705	*Tachybaptus novaehollandiae (Australasian Grebe, Black-throated Grebe)*			
129.	30870	*Taeniopygia guttata (Zebra Finch)*			
130.	24845	*Threskiornis spinicollis (Straw-necked Ibis)*			
131.	25202	*Tiliqua multifasciata (Central Blue-tongue)*			
132.	42351	*Todiramphus pyrrhopygius (Red-backed Kingfisher)*			
133.	25549	*Todiramphus sanctus (Sacred Kingfisher)*			
134.	24803	*Tringa brevipes (Grey-tailed Tattler)*		P4	
135.	24806	*Tringa glareola (Wood Sandpiper)*		IA	
136.	24808	*Tringa nebularia (Common Greenshank, greenshank)*		IA	
137.	24851	*Turnix velox (Little Button-quail)*			
138.	25446	*Uperoleia talpa (Ratcheting Toadlet)*			
139.	25577	*Vanellus miles (Masked Lapwing)*			
140.	25209	*Varanus acanthurus (Spiny-tailed Monitor)*			
141.	25524	*Varanus panoptes (Yellow-spotted Monitor)*			
142.	24040	*Vulpes vulpes (Red Fox)*	Y		
143.		*Zabidius novemaculeatus*			
144.	24857	*Zosterops luteus (Yellow White-eye)*			

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

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

APPENDIX THREE FIELD SURVEY RESULTS

Table 20: Flora inventory (site x species)

Family	Species	Naturalised	WF2001	WF2002	WF2003	WF2004	Opportunistic
Aizoaceae	*Trianthema pilosum*						X
	Trianthema triquetrum						X
	Trianthema turgidifolium		X	X			
Amaranthaceae	*Aerva javanica*	*					X
	Ptilotus fusiformis						X
	Ptilotus polystachyus			X			X
	Surreya diandra				X		X
Asteraceae	*Pluchea dunlopii*			X			
	Pluchea rubelliflora			X			X
	Pterocaulon sphaeranthoides			X			X
Chenopodiaceae	*Neobassia astrocarpa*				X		
	Salsola australis					X	X
	Tecticornia auriculata					X	X
	Tecticornia halocnemoides				X	X	
	Tecticornia indica				X	X	
Cleomaceae	*Cleome viscosa*						X
Commelinaceae	*Commelina ensifolia*		X	X			
Convolvulaceae	*Bonamia alatisemina*			X			
	Bonamia media			X			
	Evolvulus alsinoides var. *villosicalyx*					X	
	Ipomoea muelleri						X
Cucurbitaceae	*Cucumis variabilis*						X
Cyperaceae	*Cyperus blakeanus*			X			
Euphorbiaceae	*Euphorbia coghlanii*				X		X
Fabaceae	*Acacia ampliceps*						X
	Acacia colei						X
	Acacia stellaticeps			X			
	Acacia trachycarpa						X
	Crotalaria ramosissima			X			
	Indigofera oblongifolia	*					X
	Rhynchosia minima			X			
	Senna notabilis						X
	Sesbania cannabina				X		X
	Stylosanthes hamata	*					X
	Tephrosia leptoclada						X
	Tephrosia rosea sens. lat.			X			X
	Vigna lanceolata var. *lanceolata*						X
Frankeniaceae	*Frankenia ambita*		X		X		
Goodeniaceae	*Goodenia armitiana*						X

Family	Species	Naturalised	WF2001	WF2002	WF2003	WF2004	Opportunistic
Lauraceae	*Cassytha capillaris*			X			
Malvaceae	*Sida* sp.			X			
Molluginaceae	*Trigastrotheca molluginea*						X
Myrtaceae	*Eucalyptus* sp.						X
Nyctaginaceae	*Boerhavia gardneri*						X
Poaceae	*Aristida* sp.			X			
	Cenchrus ciliaris	*		X			X
	Chloris barbata	*					X
	Eragrostis cumingii		X	X			
	Eragrostis falcata				X	X	X
	Eragrostis speciosa						X
	Eriachne aristidea						X
	Eriachne obtusa			X	X		
	Panicum decompositum			X			
	Sorghum sp.				X		
	Triodia epactia			X			
	Triodia secunda		X				
Rubiaceae	*Synaptantha tillaeacea* var. *tillaeacea*					X	
Solanaceae	*Solanum diversiflorum*			X			
Violaceae	*Hybanthus aurantiacus*			X			
Zygophyllaceae	*Tribulus occidentalis*						X
	Tribulopis angustifolia						X

APPENDIX FOUR FLORISTIC QUADRAT DATA

WF2001

Staff SOK **Date** 3/02/2020 **Season** A

Revisit

Type R 50 m x 50 m

Location Eastern boundary

MGA Zone 50 666736 **mE** 7747302 **mN** **Lat.** -20.3651 **Long.** 118.5975

Habitat Flat

Aspect N/A **Slope** N/A

Soil Type Light reddish brown sand

Rock Type Nil

Loose Rock 0 % cover **Litter** <5 % cover ; <1 cm in depth

Bare ground 35 % cover **Weeds** <1 % cover

Vegetation G+ ^*Triodia secunda*,^*Frankenia ambita*\^hummock grass,shrub\1\c

Veg. Condition Very Good

Disturbance Tracks, nearby clearing

Fire Age >5 years

Notes Best example of this vegetation, relevant based on a narrow strip and avoiding adjacent vegetation types

Species	WA Cons.	Height (m)	Cover (%)	Count
Commelina ensifolia		0.3	<1	
Eragrostis cumingii		0.2	<1	
Frankenia ambita		0.3	2	
Trianthema turgidifolium		0.3	<1	
Triodia secunda		0.3	65	

Wedgefield Flora and Fauna

WF2002

Staff SOK **Date** 3/02/2020 **Season** A

Revisit

Type Q 50 m x 50 m

Location Centre of survey area

MGA Zone 50 666649 **mE** 7747318 **mN** **Lat.** -20.3650 **Long.** 118.5967

Habitat Flat

Aspect N/A **Slope** N/A

Soil Type Light reddish brown sand

Rock Type Nil

Loose Rock 0 % cover **Litter** <5 % cover ; 0-1 cm in depth

Bare ground 20 % cover **Weeds** <1 % cover

Vegetation G+ ^*Triodia epactia*,^*Acacia stellaticeps*\^hummock grass,shrub\1\d

Veg. Condition Very Good

Disturbance Tracks nearby

Fire Age >5 years

Notes

Species	WA Cons.	Height (m)	Cover (%)	Count
Acacia stellaticeps		0.6	5	
Aristida sp.		0.5	<1	
Bonamia alatisemina		0.2	<1	
Bonamia media			<1	
Cassytha capillaris		0.3	7	
**Cenchrus ciliaris*		0.5	<1	
Commelina ensifolia		0.3	2	

Wedgefield Flora and Fauna

Crotalaria ramosissima	0.3	<1
Cyperus blakeanus	0.5	<1
Eragrostis cumingii	0.1	<1
Eriachne obtusa	0.4	1
Hybanthus aurantiacus	0.5	<1
Panicum decompositum	0.5	1
Pluchea dunlopii	0.3	<1
Pluchea rubelliflora	0.3	<1
Pterocaulon sphaeranthoides	0.2	<1
Ptilotus polystachyus	0.3	<1
Rhynchosia minima	0.2	<1
Sida sp.	0.2	<1
Solanum diversiflorum	0.3	<1
Tephrosia rosea	0.5	<1
Trianthema turgidifolium	0.5	<1
Triodia epactia	0.5	70

Wedgefield Flora and Fauna

WF2003

Staff SOK **Date** 3/02/2020 **Season** A

Revisit

Type Q 50 m x 50 m

Location Central west of survey area

MGA Zone 50 666539 **mE** 7747284 **mN** **Lat.** -20.3653 **Long.** 118.5956

Habitat Flat

Aspect N/A **Slope** N/A

Soil Type Light reddish brown sandy clay

Rock Type Nil

Loose Rock 0 % cover **Litter** <5 % cover ; 0-1 cm in depth

Bare ground 55 % cover **Weeds** <1 % cover

Vegetation G+ ^*Tecticornia indica* subsp. *leiostachya*,^*Tecticornia halocnemoides*\^samphire shrub\1\c

Veg. Condition Good

Disturbance Tracks, edge effects, rubbish

Fire Age >5 years

Notes

Species	WA Cons.	Height (m)	Cover (%)	Count
Eragrostis falcata		0.3	5	
Eriachne obtusa		0.5	2	
Euphorbia coghlanii		0.3	<1	
Frankenia ambita		0.3	<1	
Neobassia astrocarpa		0.3	<1	
Sesbania cannabina		1.8	<1	
Sorghum sp.		1	<1	

		Wedgefield Flora and Fauna
Surreya diandra	0.3	<1
Tecticornia halocnemoides	0.3	15
Tecticornia indica subsp. *leiostachya*	0.3	25

WF2004

Staff SOK **Date** 3/02/2020 **Season** A

Revisit

Type R 20 m x 20 m

Location Northeast of survey area

MGA Zone 50 666682 **mE** 7747439 **mN** **Lat.** -20.3639 **Long.** 118.5970

Habitat Flat

Aspect N/A **Slope** N/A

Soil Type Light reddish brown sandy clay

Rock Type Nil

Loose Rock 0 % cover **Litter** 0 % cover ; 0 cm in depth

Bare ground 75 % cover **Weeds** 0 % cover

Vegetation G+ ^*Tecticornia auriculata*,^*Tecticornia indica* subsp. *leiostachya*,*Tecticornia halocnemoides*\^samphire shrub\1\i

Veg. Condition Good

Disturbance Edge effects

Fire Age >5 years

Notes Area not large enough for a full size quadrat

Species	WA Cons.	Height (m)	Cover (%)	Count
Eragrostis falcata		0.3	<1	
Salsola australis		0.5	<1	
Tecticornia auriculata		0.5	20	
Tecticornia halocnemoides		0.3	2	
Tecticornia indica subsp. *leiostachya*		0.3	3	