Butterfields Services (Aust) Pty Ltd

CSIRO Boolardy Aerodrome Upgrade Works
Biological Assessment

January 2018

Executive summary

The Commonwealth Scientific and Industrial Research Organisation (CSIRO) are seeking to construct four new drains and extend the runways at the Boolardy Aerodrome on Boolardy Station, South Murchison, Western Australia (the Project Area). To facilitate these works, 7.3 hectares (ha) of vegetation clearing is required. The location of the Project Area is provided in Figure 1.

Butterfields (Aust) Services Pty Ltd (Butterfields) on behalf of the CSIRO commissioned GHD Pty Ltd (GHD) to undertake a single season vegetation, flora and fauna assessment of the Project Area. The purpose of this assessment was to delineate key flora, vegetation, fauna, soil, groundwater and surface water values within the Project Area

This report also provides supporting environmental documentation for a clearing permit application.

This report is subject to, and must be read in conjunction with, the limitations set out in Section 1.5 and the assumptions and qualifications contained throughout this report.

Key findings

Vegetation

- The current extents remaining of all vegetation associations are greater than 98 per cent (%) of their pre-European extents at all scales (e.g. State, IBRA Bioregion, IBRA Subregion and LGA).
- The desktop study revealed no Department of Biodiversity, Conservation and Attractions (DBCA)-managed conservation areas located within 10 km of the Project Area.
- No Threatened Ecological Communities (TEC) or Priority Ecological Communities (PEC) were identified within 10 km of the Project Area.
- Four vegetation types (excluding Cleared/Degraded) were identified from the Project Area.
- The field survey recorded 39 flora taxa representing 11 families. This total comprised 39 native flora and one introduced flora taxon.
- Desktop searches identified the presence/potential presence of two conservation significant flora taxa within 10 km of the Project Area.
- No *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), *Wildlife Conservation Act 1950* (WC Act) or DBCA Priority-listed flora were recorded within the Project Area.
- A likelihood of occurrence assessment conducted post-field survey concluded that one taxon is possible to occur and the other considered unlikely to occur in the Project Area.
- Four fauna habitat types were recorded from the Project Area including highly disturbed area.
- The fauna survey recorded 21 vertebrate fauna species including 15 birds, four mammals and two reptiles
- No EPBC Act or WC Act or DBCA listed fauna were recorded within the Project Area
- A likelihood of occurrence assessment conducted post-field survey concluded that one taxon is likely (Rainbow Bee-eater) to occur and remainder are considered unlikely or highly unlikely to occur in the Project Area.

Ten Clearing Principles

The assessment determined that clearing within the Project Area is unlikely to be at variance to any principles.

Recommendations

GHD provides the following recommendations for Butterfields consideration:

- One directional clearing to allow fauna to move into adjacent habitat.
- Implement appropriate land management practices to minimise the risk of water and wind erosion during clearing activities.

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1. Introduction

1.1 Project description

The Commonwealth Scientific and Industrial Research Organisation (CSIRO) are seeking to construct four new drains and extend the runways at the Boolardy Aerodrome on Boolardy Station, South Murchison, Western Australia (the Project Area). To facilitate these works, 7.3 hectares (ha) of vegetation clearing is required. The location of the Project Area is provided in Figure 1.

1.2 Purpose of this report

Butterfields (Aust) Services Pty Ltd (Butterfields) on behalf of the CSIRO commissioned GHD Pty Ltd (GHD) to undertake a single season vegetation, flora and fauna assessment of the Project Area. The purpose of this assessment was to delineate key flora, vegetation, fauna, soil, groundwater and surface water values within the Project Area.

This report also provides supporting environmental documentation for a clearing permit application.

1.3 Scope of works

The scope of works for the detailed flora and fauna survey included:

- A desktop review of publically available information and relevant reports commissioned by the Butterfields was completed to determine the environmental values of the Project Area.
- A single season biological survey of the Project Area was undertaken during Spring 2017 to identify:
  - The presence or potential presence of any Threatened or Priority Flora
  - Vegetation community types present, including presence of any Threatened or Priority Ecological Communities (PECs or TECs).
  - Vegetation condition, including the location of any Weeds of National Significance (WONS) or Declared Weeds
  - Flora species recorded including introduced species
  - Vegetation growing in association with wetlands or watercourses
  - The presence or potential presence of any Threatened or Priority fauna
  - Fauna species recorded including introduced species
- Preparation of a biological survey report (this document) that:
  - Documents the results of the desktop assessment and field survey, including mapping
  - Identifies and discusses potentially occurring significant flora, vegetation and fauna species and their habitat
  - Assesses the project clearing against the 10 Clearing Principles, as outlined in Schedule 5 of the *Environmental Protection Act 1986* (EP Act)
- Provision of spatial files in GIS format.

1.4 Relevant legislation, conservation codes and background information

In Western Australia (WA) significant communities, and flora and fauna are protected under both Federal and State Government legislation. In addition, regulatory bodies also provide a range of guidance and information on expected standards and protocols for environmental surveys.

An overview of key legislation and guidelines, conservation codes and background information relevant to this project are provided in Appendix B.

1.5 Limitations and Assumptions

This report has been prepared by GHD for Butterfields (Aust.) Pty Ltd and may only be used and relied on by Butterfields (Aust.) Pty Ltd for the purpose agreed between GHD and Butterfields (Aust.) Pty Ltd as set out in section 1.3 of this report.

GHD otherwise disclaims responsibility to any person other than Butterfields (Aust.) Pty Ltd arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by Butterfields (Aust.) Pty Ltd and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

The opinions, conclusions and any recommendations in this report are based on information obtained from, and testing undertaken at or in connection with, specific sample points. Site conditions at other parts of the site may be different from the site conditions found at the specific sample points.

Investigations undertaken in respect of this report are constrained by the particular site conditions, such as the location of infrastructure, access tracks and vegetation. As a result, not all relevant site features and conditions may have been identified in this report.

Site conditions may change after the date of this report. GHD does not accept responsibility arising from, or in connection with, any change to the site conditions. GHD is also not responsible for updating this report if the site conditions change.

This report has assessed the flora and fauna values within the Project Area, as shown in Figure 1. Should the Project Area change or be refined, further assessment may be required.

2. Methodology

2.1 Desktop assessment

The desktop assessment involved a review of:

- The Department of the Environment and Energy (DEE) Protected Matters Search Tool (PMST) to identify communities and species listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) potentially occurring within 10 km of the Project Area (DEE 2017a) (Appendix C).
- The DBCA *NatureMap* database for flora, fauna, PEC and TEC species previously recorded within 10 km of the Project Area (DBCA 2007–) (Appendix C).
- Existing datasets including previous vegetation mapping of the Project Area (Beard 1976), aerial photography, geology/soils and hydrology information to provide background information on the variability of the environment, likely vegetation units and fauna habitats and to identify areas with potential to contain TECs, PECs, and Threatened and Priority listed flora and fauna species.

The environmental constraints identified in the desktop assessment are mapped in Figure 2.

2.2 Field survey

2.2.1 Vegetation and flora

As part of the biological survey a single season reconnaissance vegetation and flora assessment of the Project Area was conducted by GHD Environmental Scientists (Steven Petts (Flora licence: SL012046) and Christopher Rigby) on 25 November 2017. The field survey was undertaken to:

- Verify the results of the desktop assessment.
- Identify and describe the dominant vegetation units and assess vegetation condition.
- Identify and record vascular flora taxa present at the time of survey.

Searches for conservation significant or other significant ecological communities and flora taxa were also undertaken during the field survey.

The survey methodology employed by GHD was undertaken with reference to the Environmental Protection Authority (EPA) *Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016a).

Data collection

Field survey methods involved a combination of sampling quadrats located in identified vegetation units and traversing the Project Area by foot. Four non-permanent quadrats were described throughout the Project Area (refer to Appendix D and mapped in Figure 3).

Quadrats (measuring 20 m x 20 m – area of 400 m^2) were located within each identified vegetation unit. Due to the limited size of the Project Area, one quadrat was located within each identified vegetation unit. Field data at each quadrat was recorded on a pro-forma data sheet and included the parameters detailed in Table 1. Quadrat data is provided in Appendix D.

Table 1 Data collected during the flora and vegetation field survey

Aspect	Measurement
Collection attributes	Personnel/recorder; date, quadrat dimensions, photograph of the quadrat.
Physical features	Aspect, soil attributes, ground surface cover, leaf and wood litter.
Location	Coordinates recorded in GDA94 datum (Zone 50) using a hand-held Global Positioning System (GPS) tool to accuracy approximately ± 5 m.
Vegetation condition	Vegetation condition was assessed and mapped in accordance with the vegetation condition rating scale for the Eremaean and Northern Botanical Provinces (EPA 2016a).
Disturbance	Level and nature of disturbances (e.g. weed presence, fire and time since last fire, impacts from grazing, exploration activities).
Flora	List of dominant flora from each structural layer. List of all species within the quadrat including average height and cover (using NVIS).

A flora inventory was compiled from taxa listed in described quadrats and from opportunistic floristic records throughout the Project Area.

Vegetation units

Vegetation units were identified and boundaries delineated using a combination of aerial photography, topographical features and field data/observations.

Vegetation units were described based on structure, dominant taxa and cover characteristics as defined by quadrat data and field observations. Vegetation unit descriptions follow the NVIS and are consistent with NVIS Level V (Association). At Level V, three (or more) taxa per stratum are used to describe the association (ESCAVI 2003).

Vegetation condition

The vegetation condition of the Project Area was assessed and mapped in accordance with the vegetation condition rating scale for the Eremaean and Northern Botanical Provinces. The scales recognise the intactness of vegetation and consists of six rating levels as outlined in Appendix B.

Flora identification and nomenclature

Species that were well known to the survey botanist were identified in the field; all other species were collected and assigned a unique collection number to facilitate tracking. All specimens collected during the field assessment were dried and processed in accordance with the requirements of the Geraldton Herbarium. Species were identified by the use of taxonomic literature, electronic keys and online electronic databases.

The conservation status of all recorded flora was compared against the current lists available on *FloraBase* (WA Herbarium 1998–) and the EPBC Act Threatened species database provided by DEE (2017b).

Nomenclature used in this report follows that used by the WA Herbarium as reported on *FloraBase* (WA Herbarium 1998–).

Surveys for conservation significant flora

Prior to the field survey, information obtained from the desktop assessments (e.g. aerial photography, geology, soils and topography data, EPBC Act PMST, *NatureMap* search results) was reviewed to determine conservation significant flora taxa potentially present within 10 km of the Project Area and locations. Additionally, ecological information (e.g. habitat, associated flora

taxa and phenology) was sourced from *FloraBase* (WA Herbarium 1998–) and other relevant publications where available, to provide further details.

Potential habitats were searched for the presence of conservation significant flora. Locations within the survey areas with differing hydrology, fire or disturbance history to the surrounding areas were also searched where identified.

When any known or potential Threatened, Priority or significant flora was located, the following data was collected: GPS location, height, number of plants and corresponding area of population, reproductive state and plant condition.

2.2.2 Fauna

As part of the biological survey, a single season fauna survey (reconnaissance survey) of the Project Area on 25 November 2017. The fauna assessment was undertaken concurrently with the vegetation and flora assessment and with reference to the EPA *Technical Guidance – Terrestrial Fauna Surveys* (EPA 2016b). The purpose of the reconnaissance survey was to verify the accuracy of the desktop study and to delineate, and characterise fauna assemblages present in the Project Area.

The Project Area was traversed on foot over one day to identify and describe the dominant fauna habitat types present and their condition, assess habitat connectivity and identify, and record fauna species within the Project Area. An assessment of the likelihood of conservation significant fauna and their habitats occurring within the Project Area was also undertaken.

Habitat assessment

A field data sheet was used to document the type and extent of habitats within the survey areas. The following information was collected and considered representative of the fauna habitat:

- Habitat structure (e.g. vegetation type, presence/absence of structural layers such as ground cover and mid storey)
- Presence/absence of refuge including: density of ground covers, fallen timber, hollow-bearing trees and rocks/boulder piles, and the type and extent of each refuge
- Location of the habitat within the Project Area in comparison to the habitat within the surrounding landscape
- Habitat connectivity and identification of wildlife corridors within and immediately adjacent to the survey areas
- Current land use and disturbance history
- Identification and evaluation of key habitat features and types identified during the desktop assessment relevant to fauna of conservation significance
- Evaluation of the Likelihood of Occurrence of conservation significant fauna within the habitat (based on presence of suitable habitat and observations)
- A representative photograph of each habitat type.

Opportunistic fauna searches

Opportunistic fauna searches were also conducted across the Project Area. The majority of opportunistic searches were undertaken at habitat assessment locations and focussed on the following:

- Searching the Project Area for tracks, scats, bones, diggings and feeding areas for both native and feral fauna

- Searching through microhabitats (i.e. racking dense leaf litter)
- Visual and aural surveys. The *Michael & Stewart Guide to Birds of Australia* – phone application (Morcombe and Steward 2016) and binoculars were used to assist visual observations. Pre-recorded calls from Morcombe and Steward (2016) were used to assist with aural identification of bird species.

Fauna species identification

Identification of fauna species was made in the field using available field guides and electronic guides (e.g. Morcombe 2004). Where identification was not possible, photographs of specimens were collected to be later identified.

Nomenclature used in this report follows that used by the WA Museum and the DBCA *NatureMap* database (DBCA 2007–) with the exception of birds, where by Christidis and Boles (2008) was used.

2.3 Limitations

2.3.1 Desktop limitations

The EPBC Act PMST is based on bioclimatic modelling for the potential presence of species. As such, this does not represent actual records of the species within the area. The records from the *NatureMap* searches of threatened flora and fauna provide more accurate information for the general area. However, some records of collections, sightings or trappings cannot be dated and often misrepresent the current range of threatened species.

2.3.2 Field survey limitations

The EPA (2016a) Technical Guide states that flora and fauna survey reports for environmental impact assessment in WA should contain a section describing the limitations of the survey methods used. The limitations and constraints associated with this field survey are discussed in Table 2. Based on this assessment, the present survey effort has not been subject to any constraints which affect the thoroughness of the assessment and the conclusions which have been formed.

Table 2 Field survey limitations

Aspect	Constraint	Comment
Sources of information and availability of contextual information.	Nil	Adequate information is available for the Project Area, this includes: • Broad scale (1:250,000) mapping by Beard (1976) and digitised by Shepherd *et al.* (2002) • Regional biogeography (Desmond and Chant 2001 & Desmond *et al.* 2001).
Scope (what life forms were sampled etc.)	Nil	Vascular flora and terrestrial vertebrate fauna were sampled during the survey. Non-vascular flora, invertebrate and aquatic fauna were not surveyed.
Proportion of flora collected and identified (based on sampling, timing and intensity) Proportion of fauna identified, recorded and/or collected	Minor	The vegetation and flora survey was undertaken over a single season, in Spring 2017. The flora recorded from the field survey is detailed in 4.1.3 and a full flora species list is provided in Appendix D. The portion of flora collected and identified was considered high. It is likely the survey under-recorded some grass species (Poaceae) and herbs due to poor flowering material during the field assessments. Grasses and annuals were observed during the spring assessment, however due to a lack of flowering and/or fruiting bodies were not identifiable and as such, are likely to be underrepresented in the flora collected. The fauna survey was undertaken in Spring 2017. The survey included a reconnaissance and sampled those species that can be easily seen, heard or have distinctive signs, such as tracks, scats, diggings, etc. Many cryptic species would not have been identified during a reconnaissance survey and seasonal variation within species often requires targeted surveys at a particular time of the year. Of the fauna species recorded during the survey, all species were identified to species level. The fauna assessment was aimed at identifying habitat types and terrestrial vertebrate fauna utilising the survey area. No sampling for invertebrates or aquatic species occurred. The information available on the identification, distribution and conservation status of invertebrates is generally less extensive than that of vertebrate species.
Flora determination	Minor	Flora determination was undertaken by Steven Petts in the field and at the Geraldton Herbarium. One taxon could be identified to genus level only due to lack of flowering and/or fruiting material required for identification. Some species, particularly grasses and herbs, may have been overlooked due to lack of material. The taxonomy and conservation status of the WA flora is dynamic. This report was prepared with reliance on taxonomy and conservation status current at the time report development, but it should be noted this may change in response to ongoing research and review of International Union for Conservation Nature criteria.
Completeness and further work which might be needed (e.g. was the relevant area fully surveyed)	Minor	The Project Area were accessed on foot. Information gained from the survey was extrapolated across those sections of the survey areas not accessed on foot during the field survey to assist with determining the vegetation and habitat types for the entire Project Area.

Aspect	Constraint	Comment
Mapping reliability	Minor	The vegetation was mapped at a scale of 1:2,500 using high-resolution ESRI aerial imagery obtained from Landgate, topographical features, previous broad scale mapping (Beard 1976) and field data. Data was recorded in the field using hand-held GPS tools (e.g. Garmin GPS). Certain atmospheric factors and other sources of error can affect the accuracy of GPS receivers. The Garmin GPS units used for this survey are accurate to within ±5 metres on average. Therefore the data points consisting of coordinates recorded from the GPS may contain inaccuracies.
Timing/weather/ season/cycle	Moderate	The field surveys were conducted during spring (25 November 2017). In the three months prior to the spring survey (August to October), the Murchison weather recording station (No. 006099, Bureau of Meteorology (BoM) 2017) recorded a total of 66.5 mm of rainfall. This total is above of the recorded long-term average for the same period (August - October; 32.3 mm) (BoM 2017). The weather conditions during the spring field survey were hot (temperature ranged from 24.0°C to 40°C) and no rain was recorded. The weather conditions recorded during the survey period may have impacted upon the fauna survey. The survey timings were considered appropriate for the flora and fauna field survey.
Disturbances (e.g. fire, flood, accidental human intervention)	Nil	No disturbance were experienced during the survey.
Intensity (in retrospect, was the intensity adequate)	Nil	The vascular flora of the survey areas were sampled in accordance with EPA (2016a) and terrestrial fauna sampled in accordance to EPA (2016b). The survey areas were sufficiently covered by the survey team during the survey.
Resources	Nil	Adequate resources were employed during the field survey. Two person days were spent undertaking the survey using one ecologist and botanist.
Access restrictions	Nil	No access problems were encountered during the survey.
Experience levels	Nil	The ecologist who executed the survey are practitioners suitably qualified and experienced in their respective fields. Steven Petts (Environmental Scientist) has over six years experience undertaking vegetation, flora and fauna surveys within WA. Chris Rigby has over two years experience undertaking flora surveys within WA.

3. Desktop assessment

3.1 Previous studies

A review of existing assessment that have been undertaken adjacent to the Project Area is provided in Table 3.

Table 3 Previous environmental assessment nearby the Project Area

Project	Location and key results
AECOM (2014) Square Kilometre Array (SKA) Ecological Assessment.	Study area is on Boolardy Station. The key findings include: • Fifteen vegetation communities including eight on hard wash plains, three associated with granite outcrops and breakaways. Eight considered locally significant. • No PEC/TEC were recorded from the study area. • No species listed under the EPBC Act or WC Act were recorded from the study area. • Seven DBCA priority flora were recorded. • Western Spiny-tailed Skink (EPBC Act listed) was recorded from three granite outcrops. • Potential Shield-backed Trapdoor Spiders recorded from the study area.
Bamford Consulting (2016) Square Kilometre Array (SKA) Main Roads Upgrade Fauna Assessment. February 2016.	Study area is on Boolardy Station and includes nine material pits. The key findings include: • Significant fauna habitats recorded including: – Rocky, lateritic hills supporting dense Acacia shrublands which supports the Malleefowl and Shield-backed Trapdoor Spider. – Gnamma holes: support a concentrated fauna assemblage especially birds – Major Drainage lines: the Murchison and Roderick Rivers are fringed with lard trees providing roosting and breeding site for several species. – Granite Outcrop: support the Western Spiny-tailed Skink and Wooley's Pseudantechinus.
Bamford Consulting (2017) Square Kilometre Array (SKA) Main Roads Upgrade Fauna Assessment. January 2017.	Study area is on Boolardy Station and includes nine material pits. The key findings from the follow-up survey include: • Six conservation significant fauna species were recorded from the study area (Western Spiny-tailed Skink, Malleefowl, Major Mitchell's Cockatoo, Peregrine Falcon and Bush Stone-curlew. • Ancient Western Pebble-mound Mouse mound was recorded with the study area and therefore likely locally extinct.

Project	Location and key results
Phoenix Environmental Services (2015) Reconnaissance survey for the Shield-backed Trapdoor Spider (*Idiosoma nigrum)* for the Square Kilometre Array. February 2015.	Study area is on Boolardy Station and includes nine material pits. The key findings include: • Five trapdoor spiders were recorded from the study area and in rocky groundcover areas with sparse mulga thicket.

3.2 Climate

The climate of the Project Area is classified as desert to semi-desert with a bimodal (summer and winter) rainfall pattern (Beard 1976). The BoM Murchison station (site number 006099) is the most central weather station to the Project Area that has reliable long-term data. Climatic data from this site indicates:

- Mean maximum temperature ranges from 21.1 °C in July to 39.3 °C in January
- Mean minimum temperature ranges from 6.4 °C in July to 23.3 °C in February
- Mean annual rainfall is 230.8 mm with an average of 44.2 rain days per year (BoM 2017).

Climate statistics for the region are summarised in Plate 1.

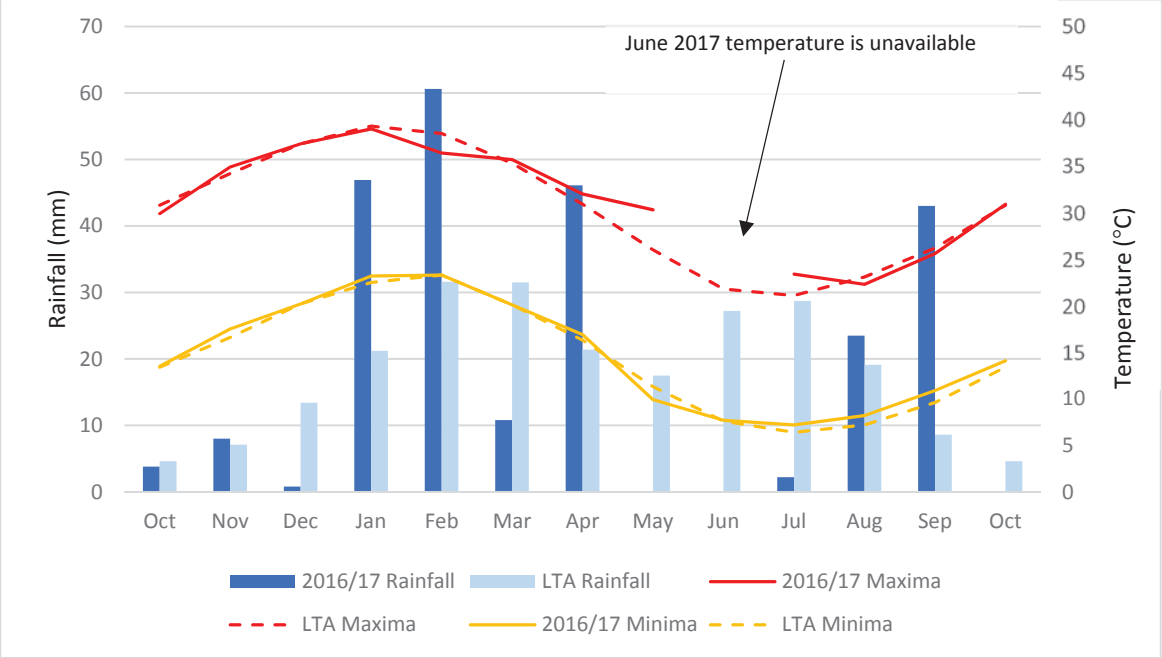


Plate 1 Mean climate statistics for Murchison (BoM 2017)

3.3 Regional biogeography

The Project Area is located within the Murchison Interim Biogeographic Regionalisation of Australia (IBRA) bioregion and Western Murchison sub-region (DEE 2017c).

The Western Murchison subregion has terrains of the Yilgarn Craton and low mulga woodlands that are often rich in ephemerals (usually with bunch grasses) on outcrop and fine textured Quaternary alluvial and eluvial surfaces. Extensive hardpan washplains dominate and characterise the subregion with mantling granitic and greenstone strata in the northern part of the Yilgarn Craton. Surfaces associated with occluded drainage occur throughout with hummock grasslands on Quaternary sandplains, saltbush shrublands on calcareous soils and *Halosarcia* [*Tecticornia*] low shrublands on saline alluvia (Desmond *et al.* 2001).

3.4 Land systems, landforms and soils

The Project Area is located within the Upper Murchison landscape zone in the Murchison Province, which is described as “Hardpan wash plains (with stony plains, sandplains, hills and mesas) on granite and gneiss of the Yilgarn Craton (Narryer Terrane and Murchison Domain). Red-brown hardpan shallow loams and Red shallow loams with Red loamy earths and Red deep and some Red shallow sands and Red deep sandy duplexes” (Tillle 2006).

The Department of Agriculture and Food Western Australia (DAFWA) completed a survey of the Murchison region (Hennig *et. al.* 1994). The condition and susceptibility report of land systems within the survey areas is summarised in Table 4.

Table 4 Land systems within the survey areas

Land system	Description	Land type	Susceptibility to erosion	Area
Yanganoo Land System	Almost flat hardpan wash plains, with or without small wanderrie banks and weak groving; supporting mulga shrublands and wanderrie grasses on banks.	Wash plains and sandy banks on hardpan, with mulga shrublands and wanderrie grasses or spinifex	Mildly to moderately susceptible to erosion where degraded.	12,433 km^2
Ero Land System	Tributary floodplains with shallow, erodible duplex soils on red-brown hardpan, more or less saline and supporting acacia shrublands with halophytic and non-halophytic undershrubs; grazed preferentially and widely degraded and eroded.	Alluvial plains with halophytic shrublands	Mildly to moderately susceptible to erosion where degraded.	195 km^2

3.5 Hydrology

A review of the Department of Water and Environmental Regulation (DWER) Hydrology data layers (Government of Western Australia 2017) indicates the Project Area is within the DWER Mid-West Gascoyne Region. A review for the Project Area is provided in Table 5.

Table 5 Hydrology aspects for the survey areas

Aspect	Details	Result
Groundwater area	Groundwater areas proclaimed under the *Rights in Water and Irrigation Act 1914* (RIWI Act).	Gascoyne Groundwater Area
Groundwater subareas	Groundwater subareas proclaimed under the RIWI Act.	None present
Surface water areas	Surface water areas proclaimed under the RIWI Act.	None present
Irrigation district	Irrigation Districts proclaimed under the RIWI Act.	None present
Rivers	Rivers proclaimed under the RIWI Act.	None present
Public Drinking Water Source Areas (PDWSA)	PDWSAs is a collective term used for the description of Water Reserves, Catchment Areas and Underground Pollution Control Areas declared (gazetted) under the provisions of the *Metropolitan Water Supply, Sewage and Drainage Act 1909* or the *Country Area Water Supply Act 1947*.	None present
Waterway Management Areas	Areas proclaimed under the *Waterway Conservation Act 1976*.	None present

3.5.1 Ephemeral drainage lines

No major watercourses or ephemeral drainage lines intersect the survey areas.

3.5.2 Wetlands

There are no wetlands within or in the vicinity of the Project Area.

3.6 Land use

3.6.1 DBCA managed lands

There are no DBCA managed lands within or within the vicinity of the Project Area.

3.6.2 Environmentally Sensitive Areas

There are no Environmentally Sensitive Areas (ESA) within or in the vicinity of the Project Area.

3.7 Vegetation and flora

3.7.1 Broad vegetation mapping and extents

Broad scale (1:1,000,000) pre-European vegetation mapping of the Murchison region was completed by Beard (1976) at an association level. The mapping indicates there is one vegetation association present within the Project Area:

- Vegetation Association 29 – Sparse low woodland; mulga, discontinuous in scattered groups.

3.7.1 Vegetation extent and status

The pre-European vegetation mapping has been adapted and digitised by Shepherd *et al.* (2002). The extents of the vegetation associations have been determined by the State-wide vegetation remaining extent calculations maintained by the DBCA (current as of October 2016 – Government of WA (GoWA) 2016). As shown in Table 6, the current extents remaining of all vegetation associations are greater than 90 per cent (%) of their pre-European extents at all scales (e.g. State, IBRA Bioregion, IBRA Subregion and Local Government Area (LGA)).

Table 6 Extents of vegetation associations mapped with the Project Area (GoWA 2016)

Vegetation association	Scale	Pre-European extent (ha)	Current extent (ha)	Remaining (%)	% Current extent in all DBCA managed lands
MUR IBRA bioregion		28,120,586.77	28,044,823.42	99.73	7.80
YAL IBRA bioregion		5,057,325.85	4,923,840.46	97.36	32.02
Murchison 2 IBRA sub-region		6,985,502.81	6,978,855.87	99.90	6.42
Tallering IBRA sub-region		3,498,943.53	3,387,092.96	96.80	25.07
29	State: WA	7,903,991.47	7,900,200.44	99.95	6.29
	IBRA bioregion: Murchison (MUR)	2,956,382.07	2,955,695.35	99.98	3.16
	IBRA sub-region: Western Murchison (MUR02)	2,160,146.80	2,159,669.31	99.98	0.43
	LGA: Shire of Murchison	1,297,282.39	1,297,265.74	100	0

3.7.1 Conservation significant ecological communities

MNES, EPBC Act or State-listed TECs and PECs have not been recorded in the Project Area.

3.7.2 Flora diversity

The *NatureMap* database search results within 10 km of Project Area is summarise below and searches provided in Appendix C:

- 52 native flora and 3 naturalised species have been previously recorded
- The dominant families are:
  - Fabaceae (40 taxa).
  - Poaceae (18 taxa).
  - Chenopodiaceae (14 taxa).
  - Scrophulariaceae (14 taxa).

3.7.3 Conservation significant flora

Desktop searches of the EPBC Act PMST database and *NatureMap* database identified the presence/potential presence of two DBCA priority listed (Priority 2 and Priority 3) conservation significant flora taxa within 10 km of the Project Area. The searches are provided in Appendix C.

3.8 Fauna

3.8.1 Fauna diversity

The *NatureMap* database search results for 10 km of Project Area are summarised below and searches provided in Appendix C. The search results indicate that 48 birds, one mammal and four reptiles have been previously recorded within 10 km of the area.

3.8.2 Conservation significant fauna

The EPBC Act PMST and *NatureMap* database identified the presence or potential presence of conservation significant fauna species within 10 km of Project Area including:

- 1 Threatened – listed under the WC Act.
- 1 Vulnerable – listed under the WC Act.
- 1 Other Significant – listed under the WC Act.
- 1 International Agreement - listed under the WC Act.
- 1 Endangered – listed under the EPBC Act.
- 8 Vulnerable – listed under the EPBC Act.
- 4 Migratory – listed under the EPBC Act.
- 3 Priority 4 – DBCA listed.

The search results are provided in Appendix C.

4. Field survey results

4.1 Vegetation and flora

4.1.1 Vegetation types

Four vegetation types (VT) were identified and described for the Project Area (Table 7 and mapped in Figure 3). This total excludes cleared and degraded areas.

The vegetation types for each Project Area were:

- Scattered Shrubs on artificial drainage line.
- Mixed Shrubland.
- Scattered Trees over Open Shrubland.
- Low Open Woodland over low to tall Shrubland.

The vegetation types identified within the Project Area are considered to be well represented outside the Project Area, based on field observations and aerial photography. The vegetation is also consistent with vegetation associations identified for the area (Beard 1976), with one exception being association 29 (Sparse low woodland; mulga, discontinuous in scattered groups).

Table 7 Vegetation types recorded from the Project Area

Type	Short Description	NVIS Level V Association Description	NVIS code	Photo	Location and area	Sample Sites	Vegetation Condition
1	Scattered Shrubs on artificial drainage line	*Acacia tetragonophylla, Scaevola spiniscens* over *Eremophila georgei, Senna artemisoides* subsp. x *Sturtii, S.* sp. Meekatharra (E. Bailey 1-26) Scattered Shrubs over *Maireana triptera, Sclerolaena cuneata* chenopod with *Aristida contorta* grassland and *Ptilotus obovatus* on artificial drainage line.	M+^*Acacia tetragonophila, Scaevola spiniscens, Eremophila georgei, Senna artemisoides* subsp. x sturtii, S. sp. Meekatharra\ ^shrubs\5\i;G+^*Maireana triptera, Sclerolaena cuneata, Aristida contorta, Ptilotus obovatus*\^grass, chenopod\4\i		North-eastern area on artificial drainage line. 0.84 hectares	Q4	Poor
2	Mixed Shrubland	*Acacia pteranerua, Eremophila fraseri* over *Eremophila forrestii* subsp. *forrestii, Eremophila spathufolia* Mixed Shrubland over *Rhagodia eremaea. Marieana triptera, Sclerolaena triptera, S. eurotioides, Salsola Australia chenopod* with *Aristida contorta, Eragrostis eriopoda* grassland with *Ptilotus obovatus*.	M+^*Acacia pteraneura, Eremophila fraseri, E. forrestii subsp. forrestii, E. spathufolia*\^shrubs\4\r;G+^*Ptilotus obovatus, Rhagodia ?eremaea, Maireana triptera, Sclerolaena triptera, S. eurotioides, Salsola australis, Aristida contorta, Eragrostis eriopoda*\^grass, chenopod\8\i		Southern area of runway extension 15/33 1.97 hectares	Q1	Good to Poor
3	Scattered Trees over Open Shrubland on Sandy Soils	*Acacia pteraneura* Scattered Srees over *Acacia tetragonophylla, A. synchronicia over Eremophila spathufolia, E. georgei* Open Shrubland over *Aristida contorta* Grassland with *Solanum lasiophyllum, Sclerolaena cuneata, Sasola australis, Maireana triptera, Atriplex codonocarpus* Chenopods	U+^*Acacia pteraneura*\trees\1\M+^*Acacia tetragonophylla, A. synchronicia, Eremophila spathufolia, E. george*\^shrubs\4\i;G^*Aristida contorta, Solanum lasiophyllum, Sclerolaena cuneata, Ptilotus polystachyus, Ptilotus obovatus, Sasola australis, Maireana triptera, Atriplex*		Proposed drain between the two runways 0.87 hectares	Q3	Poor

Type	Short Description	NVIS Level V Association Description	NVIS code	Photo	Location and area	Sample Sites	Vegetation Condition
		with Ptilotus polystachyus, Ptilotus obovatus.	*codonocarpus*\^grass, chenopod\8\ir				
4	Low Open Woodland	*Acacia fuscaneura, A. incurvaneura,* Low Open Woodland over A. *tetragonophylla, A. grasbyi, Eremophila forrestii* subsp. *forrestii* over *Eremophila spathufolia, Senna* sp. Meekatharra (E. Bailey 1-26), *S. artemisioides subsp.* x *sturtii* Scattered Shrubs over *Aristida contora* Grassland with *Solanum lasiophyllum* and *Sclerolaena cuneata.*	U+^*Acacia fuscaneura, A. incurvaneura*\^trees\2\i;M^*A. tetragonophylla, A. grasbyi, Eremophila spathufolia, E. forrestii, Senna* sp. Meekatharra (E. Bailey 1-26), *S. artemisioides* subsp. x *sturtii*/^shrubs/7/i: G^*Aristida contorta, Ptilotus polystachyus, Solanum lasiophyllum, Sclerolaena cuneata*\^Grass chenopod\4		Southern Area of Runway 03/21 extension 3.60 hectares	Q2	Good to Completely Degraded
N/A	Cleared/ Degraded	Cleared areas with isolated shrubs, grasses and herbs from adjacent vegetation. Includes the runways, tracks and areas immediately adjacent to the runway.	N/A		Southern area of runway extensions and northern areas. 4.27 hectares	N/A	Degraded to Completely Degraded

4.1.2 Vegetation condition

The vegetation condition within the Project Area was rated from Completely Degraded to Good in condition. The extents of the vegetation condition ratings mapped within the Project Area are detailed in Table 8 and mapped in Figure 4. Drought affected and overgrazing of vegetation was evident within the Project Area with limited groundcover being recorded.

The Degraded to Completely Degraded areas included the following:

- Areas immediately adjacent to the runway

Table 8 Extent of vegetation condition ratings mapped within the Project Area

Vegetation rating	Area (ha)
Good	3.86
Poor	2.53
Degraded	0.90
Completely Degraded	4.26

4.1.1 Conservation significant ecological communities

No conversation significant ecological communities were recorded from the Project Area.

4.1.2 Other significant vegetation

No other significant vegetation was recorded from the Project Area.

4.1.3 Flora diversity

Thirty-nine flora taxa (including subspecies and varieties) representing 11 families were recorded from the Project Area during the field survey. This total comprises 38 native flora taxa and one introduce flora species. The dominant family recorded included:

- Fabaceae 11 taxa.
- Chenopodiaceae 10 taxa.

A full list of the flora recorded from the Project Area is provided in Appendix D.

4.1.4 Conservation significant flora

No EPBC Act or WC Act or DBCA Priority-listed flora were recorded within the Project Area.

Likelihood of occurrence

A likelihood of occurrence assessment was conducted post-field survey for all conservation significant flora taxa identified in the desktop assessment (Appendix D). This assessment took into account previous records, habitat requirements, intensity of the survey, flowering times and the cryptic nature of species.

The likelihood of occurrence assessment post-field survey concluded that one taxon is likely to occur and the other unlikely to occur within 10 km of the Project Area. The following was considered possible to occur:

- *Eremophila simulans* subsp. *megacalyx* - Not recorded however the Project Area supports suitable habitat.

4.1.5 Introduced flora

One introduced flora (*Cenchrus ciliaris)* was recorded from the Project Area.

4.2 Fauna

4.2.1 Fauna habitats

The survey identified three fauna habitat types (including highly disturbed) within the Project Area (Table 9) and these closely aligned to the vegetation types described in Section 4.1.1.

Fauna habitat connectivity and disturbance

The fauna habitats of the Project Area are located in a largely intact region of WA. The runways and fence lines (located at the northern and southern portion of the runways) creates an artificial barrier for fauna moving between habitats. The fauna habitat present within the Project Area are well represented in the broader area with high connectivity to the surrounds.

Disturbance

The habitats within the Project Area have been impacted by tracks, previous grazing of livestock, feral animals and historical clearing associated with the runway. There was no sign of fire impacts in the Project Area, being unburnt (<10 years).

Habitat value

The Project Area primarily consist of Low Woodland and Shrubland. The overall value of the habitat was consider to be low to moderate due to the quality of habitat types (e.g. low to moderate structural diversity within each habitat type) and connectivity with the broader region.

Following a review of aerial photography and corresponding native vegetation associations, the habitats of the Project Area are considered to be well represented within the greater area.

Table 9 Fauna habitat type description recorded within the Project Area

Habitat type	Indicative photograph
Low Open Woodland over Open Shrubland This habitat type incorporates vegetation type VT3 and VT4 This habitat type comprises Low Open Woodland of *Acacia fuscaneura, A. incurvaneura* in the over-storey (10% cover). The mid-storey and under-storey comprises *Acacia grasbyi, Eremophila* spp., *Senna* spp. (5-10% cover). Groundcover comprises *Aristida Contorta* grassland with scattered chenopods (30-70% cover). Bare-ground is 50% comprising sandy clayey loam. There is very limited leaf and wood litter present (<5%); where present the litter was usually thin layer around the base of the trees. The habitat has obvious signs of impacts from previous grazing activities. The habitat is likely to provide a linkage to more structurally diverse habitat types within the local area. As such this habitat is likely to provide foraging opportunities for birds, reptiles and mammals. ***Conservation significant species*** No conservation significant species were recorded. The habitat provides a low to moderate value to conservation significant species. The habitat provides potential foraging/dispersal for Rainbow Bee-eater. As the habitat is part of a contiguous area of remnant vegetation extending through and beyond the Project Area, it is unlikely for the Rainbow Bee-eater to exclusively use habitat within the Project Area.	
Shrubland This habitat type incorporates vegetation type VT2. This habitat type comprises Shrubland of *Acacia* species, *Eremophila* species, *Senna* species in the over-storey and mid-storey (2-10% cover). The ground-cover comprises chenopod species and native grasses (10 – 30% cover). Bare-ground is 60% comprising sandy clayey loam. There is very limited leaf litter (<5%) but moderate amount of wood litter present within this habitat type. The habitat has obvious signs of impacts from previous grazing activities. The habitat is likely to provide a linkage to more structurally diverse habitat types within the local area. As such this habitat is likely to provide foraging opportunities for birds, reptiles and mammals. ***Conservation significant species*** No conservation significant species were recorded. The habitat provides a low to moderate value to conservation significant species. The habitat provides potential foraging/dispersal for Rainbow Bee-eater. As the habitat is part of a contiguous area of remnant vegetation extending through and beyond the Project Area, it is unlikely for the Rainbow Bee-eater to exclusively use habitat within the Project Area.	

Habitat type	Indicative photograph
Scattered Shrubs on Artificial Drainage line This habitat type incorporates vegetation type VT1. This habitat comprises Scattered Shrubs *Acacia tetragonophylla, Scaevola spinescens, Senna* species in the over-storey and mid-storey (10% cover). Ground-cover comprises chenopod species and tussock grasses (native and introduced). The habitat type would flow following heavy and persistent rainfall, as a result prolonging the life of native grasses. The habitat has obvious signs of impacts from previous grazing and clearing. The habitat is likely to provide a linkage to more structurally diverse habitat types within the local area. As such this habitat is likely to provide foraging opportunities for birds, reptiles and mammals. **Conservation significant species:** No conservation significant species were recorded. The habitat provides a low to moderate value to conservation significant species. The habitat provides potential foraging/dispersal for Rainbow Bee-eater. As the habitat is part of a contiguous area of remnant vegetation extending through and beyond the Project Area, it is unlikely for the Rainbow Bee-eater to exclusively use habitat within the Project Area.	
Highly disturbed This represent areas considered Cleared/Degraded. Highly disturbed areas provide very little to fauna species but can be used by common insectivorous bird species for foraging and by avian and ground dwelling species as corridors.	

4.2.2 Fauna diversity

The fauna survey recorded 21 vertebrate fauna including 15 birds, four mammals and two reptiles. A full list of the fauna recorded from the Project Area is provided in Appendix E.

4.2.3 Introduced fauna

Three introduced fauna species were recorded during the field survey including, European Cattle (*Bos taurus),* Dog (*Canis lupis)* and Rabbit (*Ocyctolagus cuniculus)*. All three species are known from the region.

4.2.4 Conservation significant fauna

No fauna species of conservation significance were recorded during the field survey.

Searches of the EPBC Act PMST and *NatureMap* database identified the presence/potential presence of 22 conservation significant fauna species. This total includes species identified by the database searches, as a result of a review of the species listed under Schedules 1-4 of the WC Act (revised February 2017). An assessment of the Likelihood of Occurrence for conservation significant fauna in the Project Area was conducted (Appendix E). This assessment was based on species biology, habitat requirements, the quality and availability of suitable habitat and records of the species in the survey and surrounding areas (e.g. DBCA 2007–).

One conservation significant fauna species was considered likely to occur within 10 km of the Project Area:

- Rainbow Bee-eater - There is suitable foraging habitat within the Project Area. However, there is no suitable breeding habitat within the Project Area

5. Environmental approvals and referrals

This section provides advice on potential environmental approvals and referrals required based on the ecological values identified within the Project Area. Should the final project alignment and disturbance footprint be altered this advice may need to be revisited.

5.1 Federal Government

Referral to DEE under the EPBC Act is triggered if a proposed action has or potentially has a significant impact on any Matters of National Environmental Significance (MNES). MNES are factors that require legislated protection in order to conserve biodiversity, protect world and national heritage places, and comply with international treaties. Table 10 shows an assessment of this Project against MNES.

Table 10 Assessment of Matters of National Environmental Significance

Matter of National Environmental Significance	Present	Need for referral to DEE under EPBC Act
World Heritage Properties	None	Not required
National Heritage Places	None	Not required
Wetlands of International Significance	None	Not required
Listed Threatened Species and Ecological Communities	None	Not required
Migratory Species	None	Not required
Commonwealth Marine Areas	None	Not required

5.2 Western Australian Government

5.2.1 Environmental Protection Authority

Significant proposals must be referred to the EPA under Section 38 of the *Environmental Protection Act 1986* (EP Act). In deciding whether a proposal will be subject to the formal environmental impact assessment process, the EPA takes into account the environmental significance of any potential impacts that may result from the implementation of the scheme or proposal.

In the absence of a broader environmental assessment, the majority of the potential biological impacts associated with the Project Area are linked to native vegetation clearing and loss of fauna habitat. The potential impacts from the loss of native vegetation and loss of fauna habitat may be effectively assessed through the Environmental Protection (Clearing of Native Vegetation) Regulations 2004. Therefore, with consideration of the biological values discussed in this report, it is considered unlikely that the project would require referral to the EPA under Section 38 of the EP Act based solely on biological considerations.

5.2.2 Department of Water and Environmental Regulation

Clearing of native vegetation is regulated by the DWER and requires a clearing permit under Part V of the EP Act, except when a project is assessed under Schedule 6 of the Act or is prescribed by regulation in the Environmental Protection (Clearing Native Vegetation) Regulations 2004 and not in an ESA.

When preparing a native vegetation clearing application an assessment of the Project Area against the “Ten Clearing Principles” should be undertaken to determine whether the Project is likely to be at variance to the Principles. The Ten Clearing Principles aim to ensure that potential

impacts resulting from removal of native vegetation can be assessed in an integrated way. An assessment of the Project Area against the Ten Clearing Principles was undertaken (Table 11). The assessment determined that clearing within the Project Area is unlikely to be at variance to any principles.

Table 11 Assessment of the Project Area against the ten clearing principles

Principle	Assessment	Outcome	Data sources
a) – Native vegetation should not be cleared if it comprises a high level of biological diversity.	The Project Area is situated within the Murchison IBRA bioregion and Western Murchison subregion. Four vegetation types (excluding Cleared/Degraded) were identified from the Project Area. The vegetation condition ranged from Good to Completely Degraded, Good accounted for 33% (3.86 ha) of the overall Project Area. The Project Area is located in a region where vegetation is largely intact and vegetation association 29 current extent remaining is greater than 99% of the pre-European extents in the local and broader region. The Project Area does not contain areas of native vegetation that are in better condition, or offer a higher floristic value than the surrounding environment. Desktop searches did not identify TECs or PECs within 10 km of the Project Area The field survey recorded 39 flora taxa representing 11 families. This total comprised 39 native flora and one introduced flora taxon. Desktop searches identified the presence/potential presence of two conservation significant flora taxa within 10 km of the Project Area. No EPBC Act or WC Act or DBCA listed flora taxa were recorded within the Project Area. A likelihood of occurrence assessment conducted post-field survey concluded that one taxon is possible to occur and the other considered unlikely to occur in the Project Area. Four fauna habitat types were recorded from the Project Area including highly disturbed area. The fauna survey recorded 21 vertebrate fauna species including 15 birds, four mammals and two reptiles. Desktop searches identified the presence/potential presence of 22 conservation significant fauna taxa within 10 km of the Project Area. No EPBC Act or WC Act or DBCA listed fauna were recorded within the Project Area. A likelihood of occurrence assessment conducted post-field survey concluded that one taxon is likely to occur and remainder are considered unlikely or highly unlikely to occur in the Project Area. No conservation significant fauna species were recorded.	Unlikely to be at variance to this Principle	Beard (1976) DEE (2017a) DBCA (2007–) WA Herbarium (1998–)
b) – Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of, a	Four broad fauna habitats were recorded within the Project Area, including: Low Open Woodland, Shrubland, Scattered Shrubs on Artificial Drainage Line and Highly Disturbed. All habitat types are well represented at a local and regional scale and overall the Survey Area retains relatively high local, and regional connectivity. The field surveys recorded 21 vertebrate fauna species, including 21 vertebrate fauna species including 15 birds, four mammals and two reptiles. No conservation significant fauna species were recorded.	Unlikely to be at variance to this Principle	DEE (2017a) DBCA (2007–) Beard (1976)

Principle	Assessment	Outcome	Data sources
significant habitat for fauna indigenous to WA	One conservation significant species were assessed as likely to occur within the survey area, including: • Rainbow Bee-eater (Merops ornatus) – Listed under the International Agreement by WC Act The habitats are considered suitable foraging habitat, however is unsuitable for breeding.		
(c) – Native vegetation should not be cleared if it includes, or is necessary for the continued existence of, rare flora.	Desktop searches did not identify the presence/potential presence of EPBC Act and/or WC Act listed flora taxa within 10 km of the Project Area.	Unlikely to be at variance to this Principle.	DEE (2017a) DBCA (2007–) WA Herbarium (1998–)
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.	There are no known TECs within 10 km of the Project Area.	Unlikely to be at variance to this Principle.	DEE (2017a) DBCA (2007–)
(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.	The vegetation within the survey area has been mapped as vegetation association 29; there is greater than 98% of the pre-European extent remaining at all levels (state, IBRA bioregion, IBRA subregion and LGA).	Unlikely to be at variance to this Principle	Beard (1976) Shepherd *et al.* (2002) GoWA (2016)
(f) – Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland.	No watercourses or drainage lines or wetlands were recorded within the Project Area.	Unlikely to be at variance to this Principle.	DEE (2017a) GoWA (2017)
(g) – Native vegetation should not be cleared if the clearing of the vegetation is likely to	The Project Area is located in the Yanganoo and Ero Land Systems. The Yanganoo is described as 'Wash plains and sandy banks on hardpan, with mulga shrublands and wanderrie grasses or spinifex.'	Unlikely to be at variance to this Principle.	DAFWA (2007) Hennig *et. al.* (1994)

Principle	Assessment	Outcome	Data sources
cause appreciable land degradation.	The Ero is described as 'Alluvial plains with halophytic shrublands'. Both land systems have a mildly to moderately acceptable to erosion where degraded. Given the size of the clearing area (7.28 ha) and that clearing will be temporary, it is unlikely to cause appreciable land degradation via wind erosion. The proposed clearing is not likely to cause appreciable land degradation via salinity or eutrophication. Given the size of the clearing area, it is unlikely the Project Area is a risk to water erosion.		GoWA (2017)
(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.	No reserves, conservation areas or other DBCA-managed estates are located within or in the vicinity of the Project Area. As discussed in Principle (e), the survey area is located within a region where more than 98% of the pre-European extent of vegetation association remains.	Unlikely to be at variance to this Principle.	DEE (2017a) DBCA (2007–)
(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.	No rivers or surface water bodies listed under the RIWI Act were identified within the Project Area. There are no natural drainage lines, lakes or wetlands in the Survey Area. The clearing is unlikely to disturb or interrupt any natural drainage and surface run-off patterns due to the sandy soils present in the area.	Unlikely to be at variance to this Principle.	GoWA (2017)
(j) – Native vegetation should not be cleared if clearing the vegetation is likely to cause, or exacerbate, the incidence of flooding	The soils of the Project Area are sandy and porous and the area is generally well-drained. No wetlands, watercourses or areas subject to inundation are located within the Project Area. It is unlikely that the removal of vegetation proposed for this project would cause or exacerbate the incidence or intensity of flooding in the local area. The Project Area is unlikely to be susceptible to waterlogging due to the highly porous nature of the soils in the area and clearing is unlikely to cause or exacerbate waterlogging.	Unlikely to be at variance to this Principle.	

6. Conclusions and recommendations

6.1 Conclusions

The Commonwealth Scientific and Industrial Research Organisation (CSIRO) are seeking to construct four new drains and extend the runways at the Boolardy Aerodrome on Boolardy Station, South Murchison, Western Australia (the Project Area). To facilitate these works, 7.28 hectares (ha) of vegetation clearing is required. The location of the Project Area is provided in Figure 1.

Butterfields (Aust) Services Pty Ltd (Butterfields) on behalf of the CSIRO commissioned GHD Pty Ltd (GHD) to undertake a single season vegetation, flora and fauna assessment of the Project Area. The purpose of this assessment was to delineate key flora, vegetation, fauna, soil, groundwater and surface water values within the Project Area

6.1.1 Key findings

Vegetation

- The current extents remaining of all vegetation associations are greater than 98 per cent (%) of their pre-European extents at all scales (e.g. State, IBRA Bioregion, IBRA Subregion and LGA).
- The desktop study revealed no DBCA-managed conservation areas located within 10 km of the Project Area.
- No Threatened Ecological Communities or Priority Ecological Communities were identified within 10 km of the Project Area.
- Four vegetation types (excluding Cleared/Degraded) were identified from the Project Area.
- The field survey recorded 39 flora taxa representing 11 families. This total comprised 39 native flora and one introduced flora taxon.
- Desktop searches identified the presence/potential presence of two conservation significant flora taxa within 10 km of the Project Area.
- No EPBC Act, WC Act or DBCA Priority-listed flora were recorded within the Project Area.
- A likelihood of occurrence assessment conducted post-field survey concluded that one taxon is possible to occur and the other considered unlikely to occur in the Project Area.
- Four fauna habitat types were recorded from the Project Area including highly disturbed area.
- The fauna survey recorded 21 vertebrate fauna species including 15 birds, four mammals and two reptiles
- No EPBC Act or WC Act or DBCA listed fauna were recorded within the Project Area
- A likelihood of occurrence assessment conducted post-field survey concluded that one taxon is likely (Rainbow Bee-eater) to occur and remainder are considered unlikely or highly unlikely to occur in the Project Area.

Ten Clearing Principles

The assessment determined that clearing within the Project Area is unlikely to be at variance to any principles.

6.2 Recommendations

GHD provides the following recommendations for Butterfields consideration:

- One directional clearing to allow fauna to move into adjacent habitat.
- Implement appropriate land management practices to minimise the risk of water and wind erosion during clearing activities.

7. References

AECOM Australia Pty Ltd (AECOM) 2014, *Square Kilometre (SKA) Ecological Assessment*, report for Department of Industry.

Bamford Consulting Ecologists (BCE) 2016, *Square Kilometre Array (SKA) Main Roads Upgrade Project Fauna Assessment*, report for Parsons Brinckerhoff (on behalf of Main Roads Western Australia).

Bamford Consulting Ecologists (BCE) 2017, *Square Kilometre Array (SKA) Main Roads Upgrade Project Fauna Assessment*, report for Aueron (on behalf of Main Roads Western Australia).

Beard, J.S. (1976). Vegetation Survey of Western Australia – 1:1,000,000 vegetation series, Sheet 6, Murchison [cartographic material]/ mapped by J.S. Beard. University of WA, Western Australia.

Bureau of Meteorology (BoM) 2017, *Climate Data Online*, retrieved Sep 2017, from http://www.bom.gov.au/climate/data/.

Christidis, L and Boles, WE 2008, *Systematics and Taxonomy of Australian Birds*, Melbourne, CSIRO Publishing.

Department of Biodiversity, Conservation and Attractions (DBCA) 2007–, *NatureMap: Mapping WA's Biodiversity*, retrieved Sep 2017, from http://naturemap.dpaw.wa.gov.au/default.aspx/.

Department of the Environment and Energy (DEE) 2017a, *Environmental Protection and Biodiversity Conservation Act 1999 Protected Matters Search Tool Results*, retrieved Sep 2017, from http://www.environment.gov.au/epbc/pmst/index.html.

Department of the Environment and Energy (DEE) 2017b, *Environment Protection and Biodiversity Act 1999 List of Threatened Flor*a, retrieved Sep 2017, from http://www.environment.gov.au/cgi-bin/sprat/public/publicthreatenedlist.pl?wanted=flora.

Department of the Environment and Energy (DotEE) 2017c, Interim Biogeographic Regionalisation of Australia, Version 7, retrieved Sep 2017, from http://www.environment.gov.au/land/nrs/science/ibra.

Desmond, A and Chant, A 2001, *Yalgoo (YAL)*, in Department of Conservation and Land Management (ed), A Biodiversity Audit of WA's 53 Biogeographical Subregions in 2002, pp 656.

Desmond, A, Cowan, M and Chant, A 2001, *Murchison 2 (MUR2 — Western Murchison subregion)*, in Department of Conservation and Land Management (ed), A Biodiversity Audit of WA's 53 Biogeographical Subregions in 2002, pp 480.

Environmental Protection Authority (EPA) 2016a, *Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment*, Environmental Protection Authority, WA.

Environmental Protection Authority (EPA) 2016b, *Technical Guidance – Terrestrial Vertebrate Fauna Surveys*, Environmental Protection Authority, WA.

Executive Steering Committee for Australian Vegetation Information (ESCAVI) 2003, *Australian Vegetation Attribute Manual: National Vegetation Information System, Version 6.0*, Canberra, Department of the Environment and Heritage.

Government of WA (GoWA) 2016, *2016 State-wide Vegetation Statistics incorporating the CAR Reserve Analysis (Full report)*, Current as of October 2016, Department of Biodiversity, Conservation and Attractions, Perth, Australia, retrieved Sep 2017, from https://catalogue.data.wa.gov.au/dataset/dbca-statewide-vegetation-statistics/resource/9de1e47c-2945-4aaa-b569-64d8c71d96c8.

Government of Western Australia (GoWA) 2017, data.wa.gov.au, retrieved Sep 2017, from https://data.wa.gov.au/.

Hennig, P., Curry, P., Blood, D. and Leighton, K (1994) *An Inventory and Condition Survey of the Murchison River Catchment, Western Australia.* Technical Bulletins 84, Department of Agriculture and Food, WA.

Morcombe, M 2004, *Field Guide to Australian Birds*, Queensland, Australia, Steve Parish Publishing Archer Field.

Morcombe, M and Stewart, D (2016) *The Morcombe & Stewart Guide to Birds of Australia.*

Phoenix Environmental Services (Phoenix) 2015, *Reconnaissance survey for the Shield-backed Trapdoor Spider (Idiosoma nigrum) for the Square Kilometre Array,* prepared for AECOM Pty Ltd.

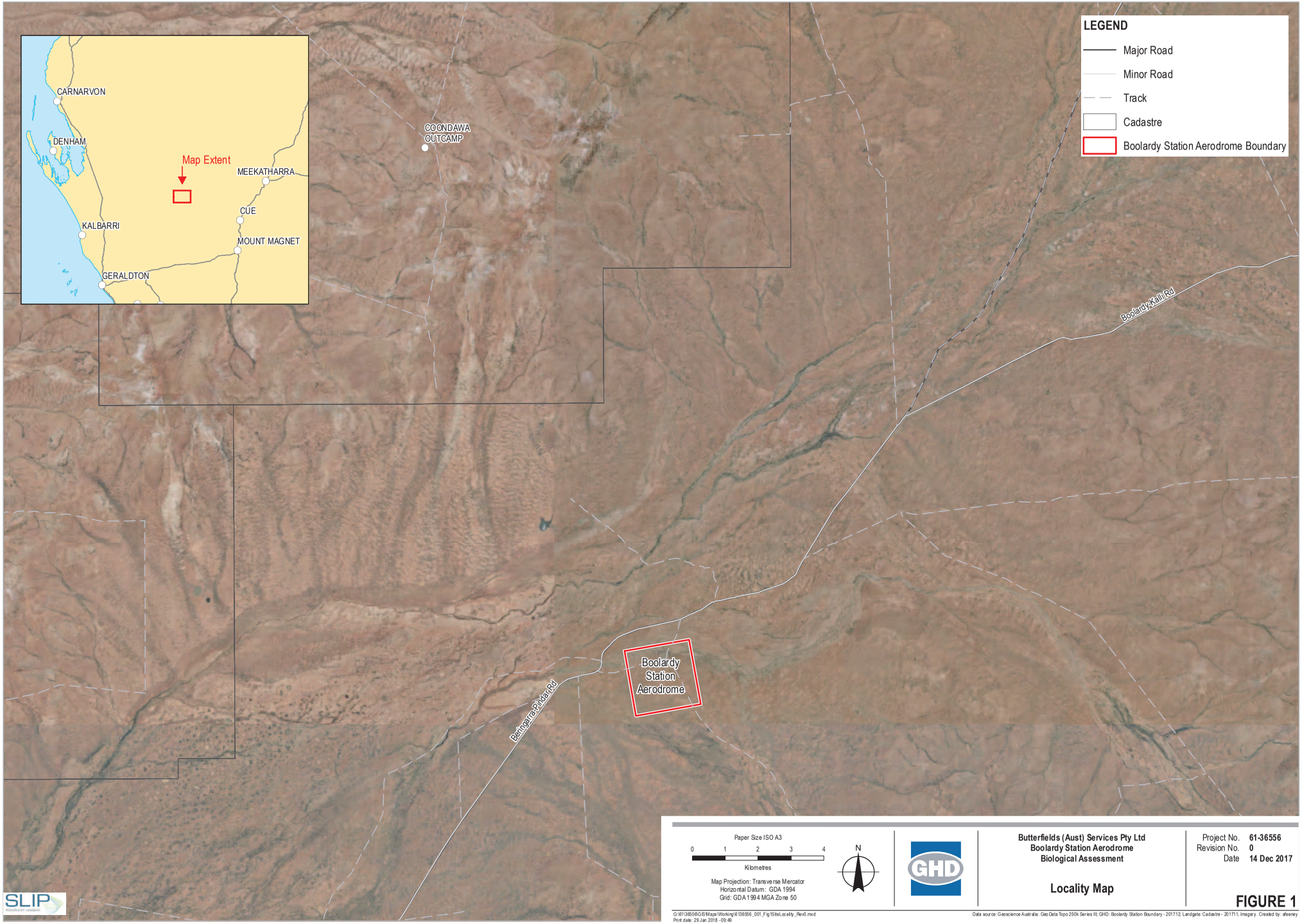
Shepherd, DP, Beeston, GR, and Hopkins, AJM 2002, *Native Vegetation in WA – Extent, Type and Status*, Resource Management Technical Report 249, Department of Agriculture and Food, WA.

Tille, P 2006, *Soil-landscapes of Western Australia's Rangelands and Arid Interior*, Resource Management Technical Report 313, Perth, Department of Agriculture and Food.

WA Herbarium 1998–, *FloraBase–the Western Australian Flora*, Department of Biodiversity, Conservation and Attractions, retrieved September 2017, from http://florabase.dpaw.wa.gov.au/.

Appendices

Appendix A - Figures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Minor Road
Track
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CARNARVON
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KALBARRI
MOUNT MAGNET
GERALDTON
COONDAWA
OUTCAMP
Boolardy-Kalli Rd
Boolardy Station Aerodrome
Beringarra-Pindar Rd
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Biological Assessment
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Revision No. 0
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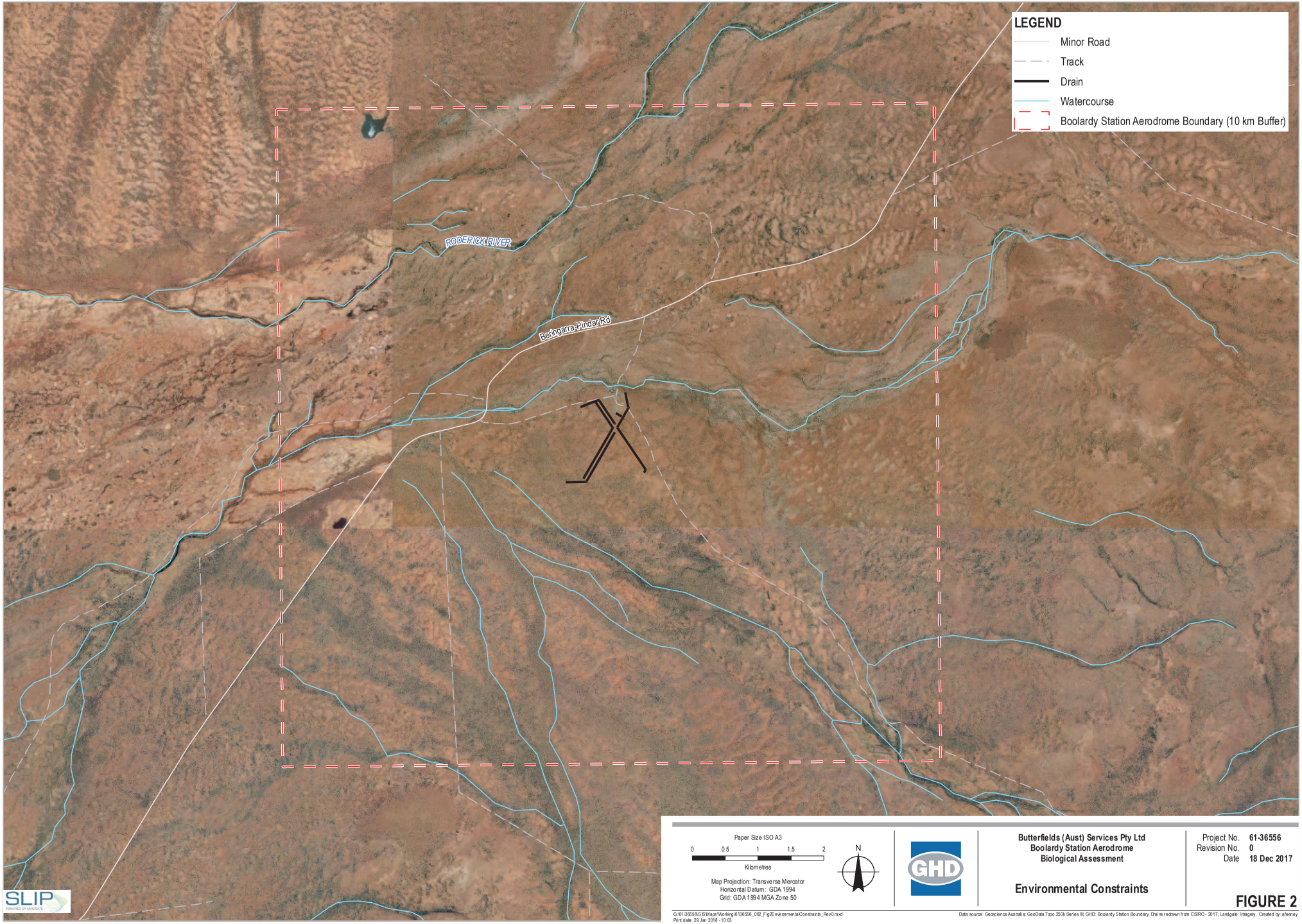

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Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

Butterfields (Aust) Services Pty Ltd
Boolardy Station Aerodrome
Biological Assessment

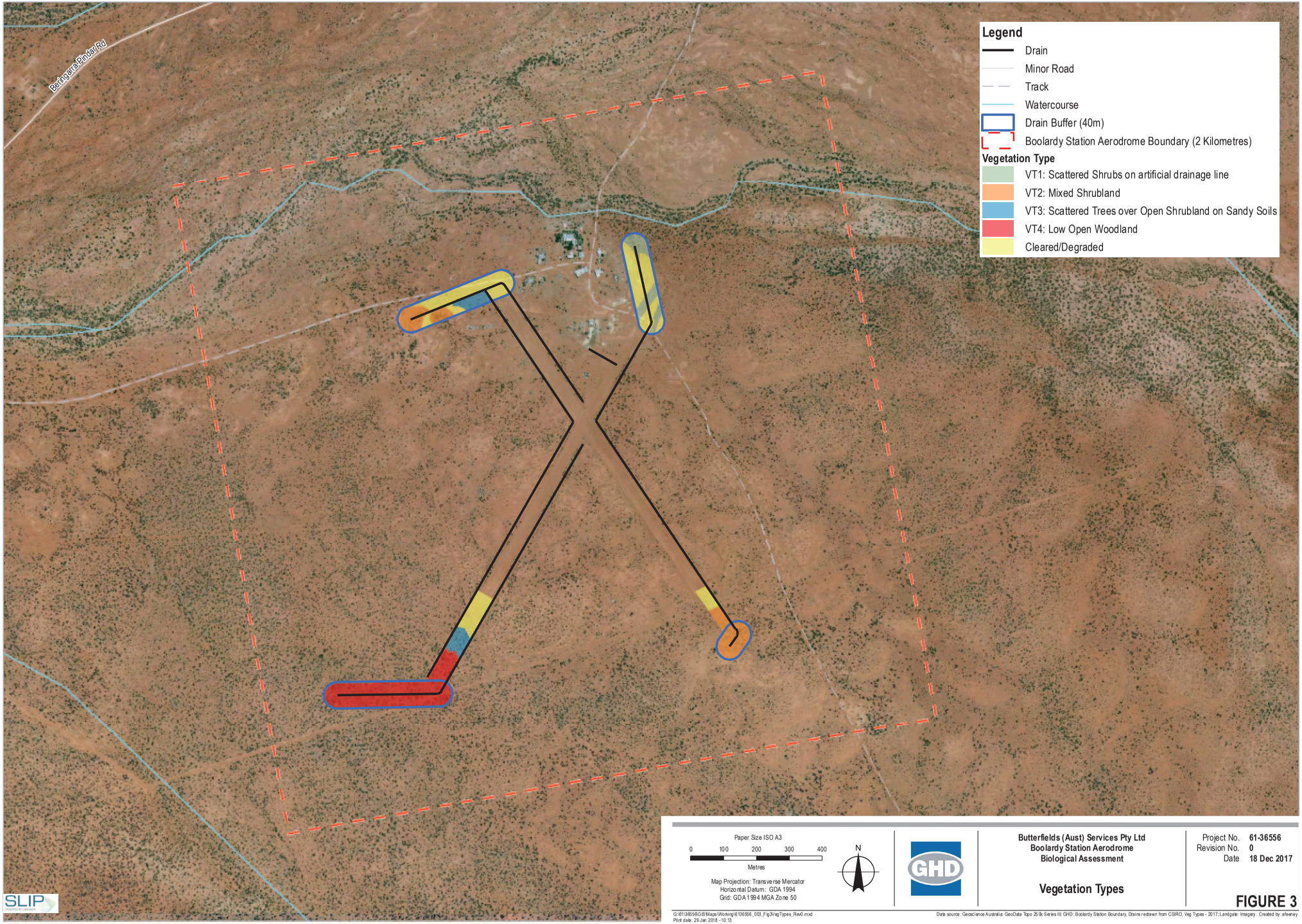
Environmental Constraints

Project No. **61-36556**
Revision No. **0**
Date **18 Dec 2017**

FIGURE 2

G:\61\36556\GIS\Maps\Working\6136556_002_Fig2EnvironmentalConstraints_Rev0.mxd
Print date: 29 Jan 2018 - 10:03

Data source: Geoscience Australia: GeoData Topo 250k Series III; GHD: Boolardy Station Boundary, Drains redrawn from CSIRO - 2017; Landgate: Imagery. Created by: afeeney



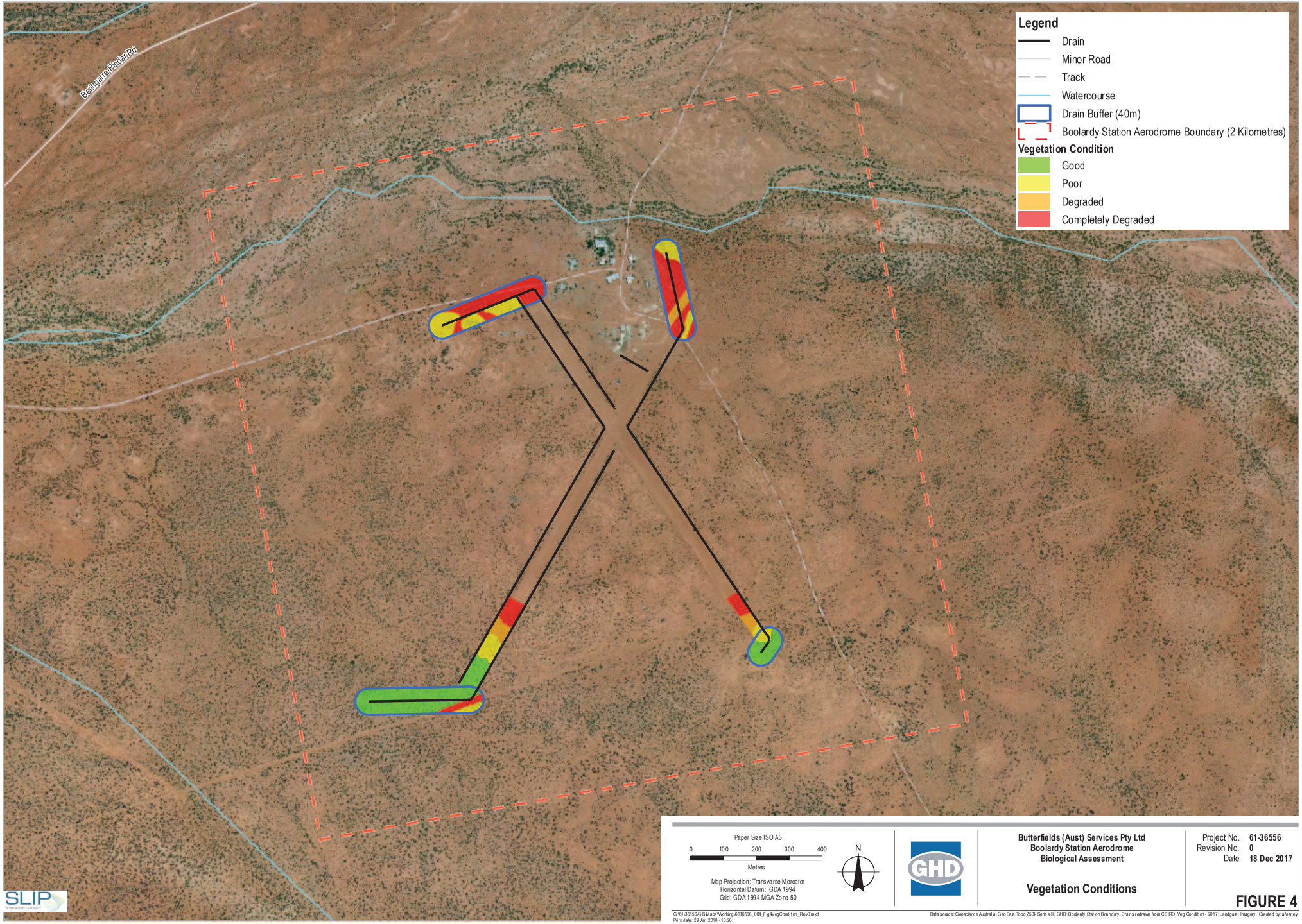
GHD

Butterfields (Aust) Services Pty Ltd
Boolardy Station Aerodrome
Biological Assessment

Vegetation Types

Project No. **61-36556**
Revision No. **0**
Date **18 Dec 2017**

FIGURE 3


Beringarra Pindar Rd
Legend
Drain
Minor Road
Track
Watercourse
Drain Buffer (40m)
Boolardy Station Aerodrome Boundary (2 Kilometres)
Vegetation Condition
Good
Poor
Degraded
Completely Degraded
SLIP
Paper Size ISO A3
0 100 200 300 400
Metres
Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50
N
GHD
Butterfields (Aust) Services Pty Ltd
Boolardy Station Aerodrome
Biological Assessment
Vegetation Conditions
Project No. 61-36556
Revision No. 0
Date 18 Dec 2017
FIGURE 4
G:\61\36556\GIS\Maps\Working\6136556_004_FigAVegCondition_Rev0.mxd
Print date: 29 Jan 2018 - 10:20
Data source: Geoscience Australia: Geo Data Topo 250k Series III; GHD: Boolardy Station Boundary, Drains redrawn from CSIRO, Veg Condition - 2017; Landgate: Imagery. Created by: afeeney

Appendix B - Relevant legislation, conservation codes and background information

Relevant legislation

Federal Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is the Federal Government's central piece of environmental legislation. It provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places, which are defined in the EPBC Act as Matters of National Environmental Significance (MNES).

The biological aspects listed as MNES include:

- Nationally threatened flora and fauna species and ecological communities
- Migratory species.

A person must not undertake an action that has, will have, or is likely to have a significant impact (direct or indirect) on MNES, without approval from the Federal Minister for the Environment.

The EPBC Act is administered by the Department of the Environment and Energy (DEE).

State Environmental Protection Act 1986

The *Environmental Protection Act 1986* (EP Act) is the primary legislative Act dealing with the protection of the environment in Western Australia. The Act allows the Environmental Protection Authority (EPA), to prevent, control and abate pollution and environmental harm, for the conservation, preservation, protection, enhancement and management of the environment and for matters incidental to or connected with the foregoing. Part IV of the EP Act is administered by the EPA and makes provisions for the EPA to undertake environmental impact assessment of significant proposals, strategic proposals and land use planning schemes.

The Department of Water and Environment Regulation (DWER) is responsible for administering the clearing provisions of the EP Act (Part V). Clearing of native vegetation in Western Australia requires a permit from the DWER, unless exemptions apply. Applications for clearing permits are assessed by the Department and decisions are made to grant or refuse the application in accordance with the Act. When making a decision the assessment considers clearing against the ten clearing principles as specified in Schedule 5 of the EP Act:

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

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

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

d. Native vegetation should not be cleared if it comprises the whole or part of native vegetation in an area that has been extensively cleared.

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.

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

g. 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.

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

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.

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

Exemptions for clearing include clearing that is a requirement of a written law or authorised under certain statutory processes (listed in Schedule 6 of the EP Act) and exemptions for prescribed low impact day-to-day activities (prescribed in the Environmental Protection (Clearing of Native Vegetation) Regulations 2004); these exemptions do not apply in environmentally sensitive areas (ESAs).

State Biodiversity and Conservation Act 2016

The Biodiversity Conservation Bill 2015 was introduced to State Parliament in November 2015, and passed in September 2016. The Bill became the *Biodiversity Conservation Act 2016* (BC Act) upon receiving Assent on 21 September 2016. The BC Act will eventually fully replace both the *Wildlife Conservation Act 1950* (WC Act) and the *Sandalwood Act 1929* (Sandalwood Act).

Several parts of the BC Act were proclaimed by the State Governor in the Government Gazette and came into effect on 3 December 2016. However, provisions that replace those existing under the WC Act and Sandalwood Act (including threatened species listings and controls over the taking and keeping of native species) and their associated Regulations cannot be brought into effect until the necessary Biodiversity Conservation Regulations have been made. It is hoped the new Regulations will be completed and ready to commence by late 2017.

State Wildlife Conservation Act 1950

The WC Act provides for the conservation and protection of wildlife. It is administered by the Department of Biodiversity, Conservation and Attractions (DBCA) and applies to both flora and fauna. Any person wanting to capture, collect, disturb or study fauna requires a permit to do so. A permit is required under the WC Act if removal of threatened species is required.

State Biosecurity and Agriculture Management Act 2007

The *Biosecurity and Agriculture Management Act 2007* (BAM Act) and associated regulations are administered by the Department of Primary Industries and Regional Development (DPIRD) and replace the repealed *Agriculture and Related Resources Protection Act 1976.* The main purposes of the BAM Act and its regulations are to:

- Prevent new animal and plant pests (vermin and weeds) and diseases from entering WA
- Manage the impact and spread of those pests already present in the state
- Safely manage the use of agricultural and veterinary chemicals
- Increased control over the sale of agricultural products that contain violative chemical residues

The Western Australian Organism List (WAOL) provides the status of organisms which have been categorised under the BAM Act. A Declared Pest is a prohibited organism or an organism for which a declaration under Section 22(2) of the Act is in force. Declared Pests may be assigned a control category including: C1 (exclusion), C2 (eradication) and C3 (management). The category may apply to the whole of the State, LGAs, districts, individual properties or even paddocks, and all landholders are obliged to comply with the specific category of control. Categories of control are defined below.

Table B1 Categories for Declared Pests under the BAM Act

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

Background information

Environmentally Sensitive Areas

Environmentally Sensitive Areas (ESAs) are declared by the Minister for Environment under Section 51B of the EP Act. The Table below outlines the aspects of areas declared as ESA in the Environmental Protection (Environmentally Sensitive Areas) Notice 2005.

Table B2 Aspects of ESAs

Aspects of Environmentally Sensitive Areas
A declared World Heritage property as defined in Section 13 of the EPBC Act.
An area that is included on the Register of the National Estate (RNE), because of its natural values, under the Australian Heritage Commission Act 1975 of the Commonwealth (the RNE was closed in 2007 and is no longer a statutory list – all references to the RNE were removed from the EPBC Act on 19 February 2012).
A defined wetland and the area within 50 m of the wetland. Defined wetlands include Ramsar wetlands, conservation category wetlands and nationally important wetlands.
The area covered by vegetation within 50 m of rare flora, to the extent to which the vegetation is continuous with the vegetation in which the rare flora is located.
The area covered by a Threatened Ecological Community.
A Bush Forever Site listed in “Bush Forever” Volumes 1 and 2 (2000), published by the Western Australia Planning Commission, except to the extent to which the site is approved to be developed by the Western Australia Planning Commission.
The areas covered by the Environmental Protection (Gnangara Mound Crown Land) Policy 1992.
The areas covered by the Environmental Protection (Western Swamp Tortoise Habitat) Policy 2002.
The areas covered by the lakes to which the Environmental Protection (Swan Coastal Plain Lakes) Policy 1992 (EPP Lakes) applies.
Protected wetlands as defined in the Environmental Protection (South West Agricultural Zone Wetlands) Policy 1998.

Reserves and conservation areas

Department of Biodiversity, Conservation and Attractions managed lands and waters

DBCA manages lands and waters throughout Western Australia to conserve ecosystems and species, and to provide for recreation and appreciation of the natural environment. DBCA managed lands and waters include national parks, conservation parks and reserves, marine

parks and reserves, regional parks, nature reserves, State forest and timber reserves. DBCA managed conservation estate, is vested with the Conservation Commission of Western Australia. Access to, or through, some areas of DBCA managed lands may require a permit or could be restricted due to management activities. Proposed land use changes and development proposals that abut DBCA managed lands will generally be referred to DBCA throughout the assessment process.

Wetlands

Wetlands include not only lakes with open water, but areas of seasonally, intermittently or permanently waterlogged soil.

Ramsar Listed Wetlands

The Convention of Wetlands of International Importance was signed in 1971 at the Iranian town of Ramsar. The Convention has since been referred to as the Ramsar Convention. Ramsar Listed wetlands are "sites containing representative, rare or unique wetlands, or wetlands that are important for conserving biological diversity … because of their ecological, botanical, zoological, limnological or hydrological importance" (DoEE 2017b). Once a Ramsar Listed Wetland is designated, the country agrees to manage its conservation and ensure its wise use. Under the Convention, wise use is broadly defined as "maintaining the ecological character of a wetland" (DoEE 2017b).

Nationally important wetlands

Wetlands of national significance are listed under the Directory of Important Wetlands in Australia. Nationally important wetlands are wetlands which meet at least one of the following criteria (DEE 2017a):

- It is a good example of a wetland type occurring within a biogeographic region in Australia
- It is a wetland which plays an important ecological or hydrological role in the natural functioning of a major wetland system/complex
- It is a wetland which is important as the habitat for animal taxa at a vulnerable stage in their life cycles, or provides a refuge when adverse conditions such as drought prevail
- The wetland supports one percent or more of the national populations of any native plant or animal taxa
- The wetland supports native plant or animal taxa or communities which are considered endangered or vulnerable at the national level
- The wetland is of outstanding historical or cultural significance

Vegetation extent and status

The National Objectives and Targets for Biodiversity Conservation 2001–2005 (Commonwealth of Australia 2001) recognise that the retention of 30 percent or more of the pre-clearing extent of each ecological community is necessary if Australia's biological diversity is to be protected. This is the threshold level below which species loss appears to accelerate exponentially and loss below this level should not be permitted. This level of recognition is in keeping with the targets recommended in the review of the National Strategy for the Conservation of Australia's Biological Diversity (ANZECC 2000).

The extent of remnant native vegetation in WA has been assessed by Shepherd et al. (2002) and the GoWA (2016), based on broadscale vegetation association mapping by Beard (various publications). The GoWA produces Statewide Vegetation Statistics Reports that are used for a

number of purposes including conservation planning, land use planning and when assessing development applications. The reports are updated at least every two years.

Vegetation condition

The vegetation condition can be assessed in accordance with the vegetation condition rating scale for the South West and Interzone, and the Eremaean and Northern Botanical Provinces (EPA 2016A). The scale recognises the intactness of vegetation and consists of six rating levels as outlined below.

Table B3 Vegetation condition rating scale for the South West and Interzone Botanical Provinces

Condition	South West and Interzone Botanical Provinces description
Pristine	Pristine or nearly so, no obvious signs of damage caused by human activities since European settlement.
Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species. Damage to trees caused by fire, the presence of non-aggressive weeds and occasional vehicle tracks.
Very Good	Vegetation structure altered, obvious signs of disturbance. Disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.
Good	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it. Disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.
Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. Disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds at high density, partial clearing, dieback and grazing.
Completely Degraded	The structure of vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often described as ‘parkland cleared’ with the flora comprising weed or crop species with isolated native trees or shrubs.

Table B4 Vegetation condition rating scale for the Eremaean and Northern Botanical Provinces

Condition	Eremaean and Northern Botanical Provinces description
Excellent	Pristine or nearly so, no obvious signs of damage caused by human activities since European settlement.
Very Good	Some relatively slight signs of damage caused by human activities since European settlement. For example, some signs of damage to tree trunks caused by repeated fire, the presence of some relatively non-aggressive weeds, or occasional vehicle tracks.
Good	More obvious signs of damage caused by human activity since European settlement, including some obvious impact on the vegetation structure such as that caused by low levels of grazing or slightly aggressive weeds
Poor	Still retains basic vegetation structure or ability to regenerate it after very obvious impacts of human activities since European settlement, such as grazing, partial clearing, frequent fires or aggressive weeds..
Degraded	Severely impacted by grazing, very frequent fires, clearing or a combination of these activities. Scope for some regeneration but not to a state approaching good condition without intensive management. Usually with a number of weed species present including very aggressive species.

Condition	Eremaean and Northern Botanical Provinces description
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.

Conservation codes

Species of significant flora, fauna and communities are protected under both Federal and State Acts. The Federal EPBC Act provides a legal framework to protect and manage nationally important flora and communities. The State WC Act is the primary wildlife conservation legislation in Western Australia. Information on the conservation codes is summarised in the following sections.

Ecological communities

Conservation significant communities

Ecological communities are defined as naturally occurring biological assemblages that occur in a particular type of habitat (English and Blyth 1997). Federally listed Threatened Ecological Communities (TECs) are protected under the EPBC Act. The DBCA also maintains a list of TECs for Western Australia; some of which are also protected under the EPBC Act. TECs are ecological communities that have been assessed and assigned to one of four categories related to the status of the threat to the community, i.e. Presumed Totally Destroyed, Critically Endangered, Endangered and Vulnerable.

Possible TECs that do not meet survey criteria are added to the DBCA Priority Ecological Community (PEC) List under Priorities 1, 2 and 3. These are ecological communities that are adequately known; are rare but not threatened, or meet criteria for Near Threatened. PECs that have been recently removed from the threatened list are placed in Priority 4. These ecological communities require regular monitoring. Conservation dependent ecological communities are placed in Priority 5. PECs are not listed under any formal Federal or State legislation, however, may be listed as TECs under the EPBC Act.

Table B5 Conservation codes and definitions for TECs listed under the EPBC Act or endorsed by the WA Minister for the Environment

Categories	Definition
Federal Government Conservation Categories (EPBC Act)	
Critically Endangered (CR)	An ecological community if, at that time, is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria (as outlined in Environment Protection and Biodiversity Conservation Regulations 2000)
Endangered (EN)	An ecological community if, at that time: is not critically endangered; and is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria (as outlined in Environment Protection and Biodiversity Conservation Regulations 2000)
Vulnerable (VU)	An ecological community if, at that time: is not critically endangered or endangered; and is facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria (as outlined in Environment Protection and Biodiversity Conservation Regulations 2000)
Western Australia Conservation Categories	
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

Categories	Definition
	that no occurrence of it is likely to recover its species composition and/or structure in the foreseeable future.
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.
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.
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.

Table B6 Conservation categories and definitions for PECS as listed by the DBCA

Category	Description
Priority 1	Poorly known ecological communities. Ecological communities that are known from very few occurrences with a very restricted distribution (generally ≤5 occurrences or a total area of ≤100 ha). Occurrences are believed to be under threat either due to limited extent, or being on lands under immediate threat (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) or for which current threats exist. May include communities with occurrences on protected lands. Communities may be included if they are comparatively well-known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range.
Priority 2	Poorly known ecological communities. Communities that are known from few occurrences with a restricted distribution (generally ≤10 occurrences or a total area of ≤200 ha). At least some occurrences are not believed to be under immediate threat of destruction or degradation. Communities may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under threat from known threatening processes.
Priority 3	Poorly known ecological communities. Communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation or: communities known from a few widespread occurrences, which are either large or with significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat, or; communities made up of large, and/or widespread occurrences, that may or may not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, and inappropriate fire regimes. Communities may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and/or are

Category	Description
	not well defined, and known threatening processes exist that could affect them.
Priority 4	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. Rare. Ecological communities known from few occurrences that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These communities are usually represented on conservation lands. Near Threatened. Ecological communities that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable. Ecological communities that have been removed from the list of threatened communities during the past five years.
Priority 5	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.

Other significant vegetation

Vegetation may be significant for a range of reasons other than a statutory listing. The EPA (2016a) states that significant vegetation may include vegetation that includes the following:

- Restricted distribution
- Degree of historical impact from threatening processes
- Local endemism in restricted habitats
- Novel combinations of taxa
- A role as a refuge
- A role as a key habitat for Threatened species or large population representing a significant proportion of the local to regional total population of a species
- Being representative of a vegetation unit in ‘pristine’ condition in a highly cleared landscape, recently discovered range extensions, or isolated outliers of the main range)
- Being poorly reserved

This may apply at a number of levels, so the unit may be significant when considered at the fine-scale (intra-locality), intermediate-scale (locality or inter-locality) or broad-scale (local to region).

Flora and fauna

Conservation significant flora and fauna

Species of significant flora are protected under both Federal and State legislation. Any activities that are deemed to have a significant impact on species that are recognised by the EPBC Act, and/or the WC Act can warrant referral to the DEE and/or the EPA.

The Federal conservation level of flora and fauna species and their significance status is assessed under the EPBC Act. The significance levels for fauna used in the EPBC Act are those recommended by the International Union for Conservation of Nature (IUCN).

The EPBC Act also protects land and migratory species that are listed under International Agreements. The list of migratory species established under section 209 of the EPBC Act comprises:

- Migratory species which are native to Australia and are included in the appendices to the Bonn Convention (Convention on the Conservation of Migratory Species of Wild Animals Appendices I and II)
- Migratory species included in annexes established under the Japan-Australia Migratory Bird Agreement (JAMBA) and the China–Australia Migratory Bird Agreement (CAMBA)
- Native, migratory species identified in a list established under, or an instrument made under, an international agreement approved by the Minister, such as the republic of Korea–Australia Migratory Bird Agreement (ROKAMBA)

The State conservation level of Threatened flora and fauna has been published as Specially Protected under the WC Act, and listed under Schedules 1 to 7 of the Wildlife Conservation (Specially Protected Fauna) Notice 2015 for Threatened Fauna and under Schedules 1 to 4 of the Wildlife Conservation (Rare Flora) Notice 2015 for Threatened (Declared Rare) Flora. The schedules align with the categories of the EPBC Act Threatened Fauna and Threatened Flora Lists. Threatened species are those are species which have been adequately searched for and are deemed to be, in the wild, either rare, under identifiable threat of extinction, or otherwise in need of special protection, and have been gazetted as such.

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 flora or fauna.

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.

For the purposes of this assessment, all species listed under the EPBC Act, WC Act and DBCA Priority species are considered conservation significant.

Table B7 Conservation categories and definitions for EPBC Act listed flora and fauna species

Conservation category	Definition
Extinct	There is no reasonable doubt that the last member of the species has died.
Extinct in the Wild	A species known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; or A species that 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	A species facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria (as outlined in Environment Protection and Biodiversity Conservation Regulations 2000).
Endangered	A species not critically endangered; and

Conservation category	Definition
	A species facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria.
Vulnerable	A species not critically endangered or endangered; and A species facing a high risk of extinction in the wild in the medium-term, as determined in accordance with the prescribed criteria.
Conservation Dependent	The species is the focus of a specific conservation program the cessation of which would result in the species becoming vulnerable, endangered or critically endangered; or The following subparagraphs are satisfied: the species is a species of fish; the species is the focus of a plan of management that Section 180 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; 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 B8 Conservation codes and descriptions for WC Act listed flora and fauna species

Conservation category	Schedule and definition
Threatened species (T)	Published as Specially Protected under the WC Act, and listed under Schedules 1 to 4 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora. Threatened fauna is that subset of 'Specially Protected Fauna' declared to be 'likely to become extinct' pursuant to section 14(4) of the WC Act. Threatened flora is flora that has been declared to be 'likely to become extinct or is rare, or otherwise in need of special protection', pursuant to section 23F(2) of the WC Act.
Critically Endangered (CR)	Schedule 1: Threatened species considered to be facing an extremely high risk of extinction in the wild.
Endangered (EN)	Schedule 2: Threatened species considered to be facing a very high risk of extinction in the wild.
Vulnerable (VU)	Schedule 3: Threatened species considered to be facing a high risk of extinction in the wild.
Presumed Extinct (EX)	Schedule 4: Species which have been adequately searched for and there is no reasonable doubt that the last individual has died.
International Agreement (IA)	Schedule 5: Migratory birds protected under an international agreement
Conservation Dependent (CD)	Schedule 6: Fauna of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as threatened.
Other Specially Protected (OS)	Schedule 7: Fauna otherwise in need of special protection to ensure their conservation.

Table B9 Conservation codes for DBCA listed Priority flora and fauna

Priority category	Definition
Priority 1	Poorly-known taxa Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.
Priority 2	Poorly-known taxa Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.
Priority 3	Poorly-known taxa Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.
Priority 4	Rare, Near Threatened and other taxa in need of monitoring Rare: Taxa 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 taxa are usually represented on conservation lands. Near Threatened. Taxa that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable. Taxa that have been removed from the list of threatened taxa during the past five years for reasons other than taxonomy.

Other significant flora

Flora species, subspecies, varieties, hybrids and ecotypes may be significant for a range of reasons, other than a statutory listing. The EPA (2016b) states that significant flora may include taxa that have:

- A keystone role in a particular habitat for threatened or Priority flora or fauna species, or large populations representing a considerable proportion of the local or regional total population of a species
- Relictual status, being representation of taxonomic or physiognomic groups that no longer occur widely in the broader landscape
- Anomalous features that indicate a potential new discovery
- Being representative of the range of a species (particularly, at the extremes of range, recently discovered range extensions, or isolated outliers of the main range)

- The presence of restricted subspecies, varieties, or naturally occurring hybrids
- Local endemism (a restricted distribution) or association with a restricted habitat type (e.g. surface water or groundwater dependent ecosystems)
- Being poorly reserved

Other significant fauna

Fauna species may be significant for a range of reasons other than those protected by international agreement or treaty, Specially Protected or Priority Fauna. Significant fauna may include short-range endemic species, species that have declining populations or declining distributions, species at the extremes of their range, or isolated outlying populations, or species which may be undescribed (EPA 2010).

Introduced plants (weeds)

Declared Pests

Information on species considered to be Declared Pests is provided under *State Biosecurity and Agriculture Management Act 2007*.

Weeds of National Significance

The spread of weeds across a range of land uses or ecosystems is important in the context of socio-economic and environmental values. The assessment of Weeds of National Significance (WoNS) is based on four major criteria:

- Invasiveness
- Impacts
- Potential for spread
- Socio-economic and environmental values

Australian state and territory governments have identified thirty-two Weeds of National Significance (WoNS); a list of 20 WoNS was endorsed in 1999 and a further 12 were added in 2012.

References

ANZECC 2000, Core Environmental Indicators for Reporting on the State of Environment, ANZECC State of the Environment Reporting Task Force.

Commonwealth of Australia 2001, National Targets and Objectives for Biodiversity Conservation 2001–2005, Canberra, AGPS.

DEE 2017a, Criteria for determining nationally important wetlands, retrieved 2017, from http://www.environment.gov.au/topics/water/water-our-environment/wetlands/australian-wetlands-database/directory-important.

DEE 2017b, The Ramsar Convention on Wetlands, retrieved 2017, from http://www.environment.gov.au/topics/water/water-our-environment/wetlands/ramsar-convention-wetlands.

English, V and Blyth, J 1997, Identifying and Conserving Threatened Ecological Communities in the South West Botanical Province, Perth, Department of Conservation and Land Management.

EPA 2010, Technical Guide – Terrestrial Fauna Surveys, EPA, Perth, WA.

EPA 2016a, Technical Guide – Flora and Vegetation Surveys for Environmental Impact Assessment, EPA, Perth, WA.

EPA 2016b, Environmental Factor Guideline - Flora and Vegetation, EPA, Perth, WA.

GoWA 2016, Statewide Vegetation Statistics incorporating the CAR Reserve Analysis (Full report), Current as of October 2016, Perth Western Australia, Department of Environment and Conservation, retrieved 2017, from https://www2.landgate.wa.gov.au/web/guest/downloader.

Shepherd, DP, Beeston, GR & Hopkins, AJM 2002, Native Vegetation in Western Australia – Extent, Type and Status, Resource Management Technical Report 249, Perth, Department of Agriculture.

Appendix C – Database Searches

EPBC Act PMST Report

NatureMap Report

Australian Government
Department of the Environment and Energy

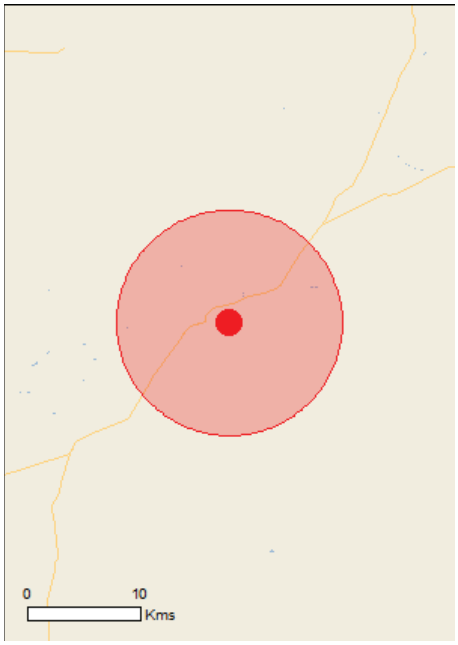
EPBC Act Protected Matters Report

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

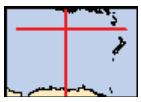
Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

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

Report created: 29/11/17 17:13:14



Coordinates
Buffer: 10.0Km



Summary

Matters of National Environmental Significance

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

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	4
Listed Migratory Species:	5

Other Matters Protected by the EPBC Act

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

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

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

Commonwealth Land:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	7
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Commonwealth Reserves Marine:	None

Extra Information

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

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

Details

Matters of National Environmental Significance

Listed Threatened Species		[Resource Information]
Name	Status	Type of Presence
Birds		
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Pezoporus occidentalis		
Night Parrot [59350]	Endangered	Species or species habitat may occur within area
Other		
Idiosoma nigrum		
Shield-backed Trapdoor Spider, Black Rugose Trapdoor Spider [66798]	Vulnerable	Species or species habitat likely to occur within area
Reptiles		
Egernia stokesii badia		
Western Spiny-tailed Skink, Baudin Island Spiny-tailed Skink [64483]	Endangered	Species or species habitat known to occur within area

Listed Migratory Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Migratory Terrestrial Species		
Motacilla cinerea		
Grey Wagtail [642]		Species or species habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata		
Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos		
Pectoral Sandpiper [858]		Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species [Resource Information]

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

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat likely to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area

Extra Information

Invasive Species [Resource Information]

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

Name	Status	Type of Presence
Birds		
Streptopelia senegalensis Laughing Turtle-dove, Laughing Dove [781]		Species or species habitat likely to occur within area
Mammals		
Capra hircus Goat [2]		Species or species habitat likely to occur within area

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

Caveat

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

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

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

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

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

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

- migratory and
- marine

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

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

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

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

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

Coordinates

-26.98842 116.53638

Acknowledgements

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

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

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

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

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NatureMap
Mapping Western Australia's biodiversity

Boolardy Aerodrome

Created By Guest user on 29/11/2017

Current Names Only Yes
Core Datasets Only Yes
Method 'By Circle'
Centre 116° 32' 11" E,26° 59' 20" S
Buffer 10km
Group By Family

Family	Species	Records
Acanthizidae	4	4
Accipitridae	4	6
Aegothelidae	1	2
Agamidae	2	2
Amaranthaceae	5	12
Anatidae	1	1
Apocynaceae	1	1
Ardeidae	2	3
Artamidae	1	1
Asteraceae	9	11
Boraginaceae	1	1
Burhinidae	1	1
Cacatuidae	1	3
Campephagidae	1	3
Casuariidae	1	3
Charadriidae	3	4
Chenopodiaceae	14	28
Cinclosomatidae	1	1
Columbidae	3	9
Convolvulaceae	1	1
Corvidae	2	3
Cracticidae	3	7
Cupressaceae	1	1
Cyperaceae	2	2
Dicaeidae	1	1
Dicruridae	2	6
Estrildidae	1	3
Euphorbiaceae	1	1
Fabaceae	40	101
Falconidae	1	2
Gentianaceae	1	1
Goodeniaceae	5	7
Gyrostemonaceae	1	1
Haloragaceae	1	1
Hirundinidae	2	6
Lamiaceae	2	5
Loranthaceae	1	1
Maluridae	2	2
Malvaceae	2	2
Meliphagidae	3	5
Meropidae	1	1
Myrtaceae	4	4
Pachycephalidae	3	7
Petroicidae	1	2
Phalacrocoracidae	1	1
Physciaceae	2	2
Pittosporaceae	1	1
Poaceae	18	31
Polygalaceae	1	1
Pomatostomidae	1	3
Proteaceae	4	4
Psittacidae	6	10
Ptilonorhynchidae	1	2
Rubiaceae	1	2
Rutaceae	1	1
Scincidae	2	2
Scrophulariaceae	14	35
Solanaceae	1	2
Teloschistaceae	1	1
Threskiornithidae	1	2
Thymelaeaceae	2	3
Vespertilionidae	1	1
Zygophyllaceae	4	5
TOTAL	**203**	**378**

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
Acanthizidae					
1.	24260	*Acanthiza apicalis (Broad-tailed Thornbill, Inland Thornbill)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
2.	24261	*Acanthiza chrysorrhoa (Yellow-rumped Thornbill)*			
3.	24265	*Acanthiza uropygialis (Chestnut-rumped Thornbill)*			
4.	25528	*Aphelocephala leucopsis (Southern Whiteface)*			
Accipitridae					
5.	25535	*Accipiter cirrocephalus (Collared Sparrowhawk)*			
6.	24285	*Aquila audax (Wedge-tailed Eagle)*			
7.		*Elanus axillaris*			
8.	24295	*Haliastur sphenurus (Whistling Kite)*			
Aegothelidae					
9.	25544	*Aegotheles cristatus (Australian Owlet-nightjar)*			
Agamidae					
10.	24886	*Ctenophorus reticulatus (Western Netted Dragon)*			
11.	24889	*Ctenophorus scutulatus (Lozenge-marked Dragon)*			
Amaranthaceae					
12.	2717	*Ptilotus divaricatus (Climbing Mulla Mulla)*			
13.	2741	*Ptilotus macrocephalus (Featherheads)*			
14.	2746	*Ptilotus nobilis (Tall Mulla Mulla)*			
15.	41001	*Ptilotus nobilis subsp. nobilis (Yellow Tails)*			
16.	2747	*Ptilotus obovatus (Cotton Bush)*			
Anatidae					
17.	24321	*Chenonetta jubata (Australian Wood Duck, Wood Duck)*			
Apocynaceae					
18.	12949	*Marsdenia australis*			
Ardeidae					
19.	24341	*Ardea pacifica (White-necked Heron)*			
20.		*Egretta novaehollandiae*			
Artamidae					
21.	25566	*Artamus cinereus (Black-faced Woodswallow)*			
Asteraceae					
22.	19901	*Actinobole oldfieldianum*			
23.	7830	*Angianthus microcephalus (Small-headed Angianthus)*		P2	
24.	7836	*Angianthus tomentosus (Camel-grass)*			
25.	8116	*Myriocephalus guerinae*			
26.	13242	*Rhodanthe chlorocephala subsp. splendida*			
27.	13293	*Rhodanthe haigii*			
28.	13246	*Rhodanthe humboldtiana*			
29.	8200	*Schoenia cassiniana (Schoenia)*			
30.	8213	*Senecio magnificus (Showy Groundsel)*			
Boraginaceae					
31.	6723	*Omphalolappula concava (Burr Stickseed)*			
Burhinidae					
32.	24359	*Burhinus grallarius (Bush Stone-curlew)*			
Cacatuidae					
33.		*Eolophus roseicapillus*			
Campephagidae					
34.	25568	*Coracina novaehollandiae (Black-faced Cuckoo-shrike)*			
Casuariidae					
35.	24470	*Dromaius novaehollandiae (Emu)*			
Charadriidae					
36.	24377	*Charadrius ruficapillus (Red-capped Plover)*			
37.	47937	*Elseyornis melanops (Black-fronted Dotterel)*			
38.	24386	*Vanellus tricolor (Banded Lapwing)*			
Chenopodiaceae					
39.	2450	*Atriplex amnicola (Swamp Saltbush)*			
40.	2459	*Atriplex holocarpa (Pop Saltbush)*			
41.	2476	*Atriplex semilunaris (Annual Saltbush)*			
42.	2489	*Chenopodium gaudichaudianum (Cottony Saltbush)*			
43.	2499	*Dissocarpus paradoxus (Curious Saltbush)*			
44.	2536	*Maireana atkinsiana (Bronze Bluebush)*			
45.	2538	*Maireana carnosa (Cottony Bluebush)*			
46.	2539	*Maireana convexa (Mulga Bluebush)*			
47.	2548	*Maireana lobiflora*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
48.	2556	*Maireana planifolia (Low Bluebush)*			
49.	30434	*Salsola australis*			
50.	2604	*Sclerolaena costata*			
51.	8877	*Sclerolaena gardneri*			
52.	2628	*Sclerolaena recurvicuspis*			
Cinclosomatidae					
53.	24390	*Psophodes occidentalis (Western Wedgebill, Chiming Wedgebill)*			
Columbidae					
54.	24401	*Geopelia cuneata (Diamond Dove)*			
55.	24407	*Ocyphaps lophotes (Crested Pigeon)*			
56.	24409	*Phaps chalcoptera (Common Bronzewing)*			
Convolvulaceae					
57.	11021	*Cuscuta planiflora*	Y		
Corvidae					
58.	24416	*Corvus bennetti (Little Crow)*			
59.	25593	*Corvus orru (Torresian Crow)*			
Cracticidae					
60.	24420	*Cracticus nigrogularis (Pied Butcherbird)*			
61.	25595	*Cracticus tibicen (Australian Magpie)*			
62.	25596	*Cracticus torquatus (Grey Butcherbird)*			
Cupressaceae					
63.	8466	*Callitris columellaris (White Cypress Pine)*			
Cyperaceae					
64.	750	*Bulbostylis barbata*			
65.	782	*Cyperus concinnus*			
Dicaeidae					
66.	25607	*Dicaeum hirundinaceum (Mistletoebird)*			
Dicruridae					
67.	24443	*Grallina cyanoleuca (Magpie-lark)*			
68.	25614	*Rhipidura leucophrys (Willie Wagtail)*			
Estrilidae					
69.	30870	*Taeniopygia guttata (Zebra Finch)*			
Euphorbiaceae					
70.	42869	*Euphorbia porcata*			
Fabaceae					
71.	37260	*Acacia aptaneura*			
72.	3248	*Acacia burkittii (Sandhill Wattle)*			
73.	3273	*Acacia craspedocarpa (Hop Mulga)*			
74.	15280	*Acacia cuthbertsonii subsp. cuthbertsonii*			
75.	3321	*Acacia eremaea*			
76.	36781	*Acacia fuscaneura*			
77.	3355	*Acacia grasbyi (Miniritchie)*			
78.	3399	*Acacia kempeana (Witchetty Bush, Ilykuwara)*			
79.	37240	*Acacia macraneura*			
80.	3480	*Acacia palustris*			
81.	3500	*Acacia pruinocarpa (Gidgee)*			
82.	36800	*Acacia pteraneura*			
83.	3510	*Acacia ramulosa (Horse Mulga)*			
84.	19483	*Acacia ramulosa var. linophylla*			
85.	19499	*Acacia ramulosa var. ramulosa*			
86.	3519	*Acacia rhodophloia*			
87.	13078	*Acacia sclerosperma subsp. sclerosperma*			
88.	3577	*Acacia tetragonophylla (Kurara, Wakalpuka)*			
89.	3586	*Acacia tysonii*			
90.	13114	*Chorizema racemosum*			
91.	3907	*Gastrolobium laytonii (Breelya, Prilya)*			
92.	3938	*Glycine canescens (Silky Glycine)*			
93.	4061	*Lotus cruentus (Redflower Lotus)*			
94.	39782	*Muelleranthus obovatus*			
95.	4111	*Muelleranthus trifoliolatus*			
96.	17645	*Senna artemisioides*			
97.	12276	*Senna artemisioides subsp. filifolia*			
98.	12279	*Senna artemisioides subsp. helmsii*			
99.	17558	*Senna artemisioides subsp. x artemisioides*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
100.	12283	*Senna artemisioides subsp. x sturtii*			
101.	12305	*Senna glutinosa subsp. chatelainiana*			
102.	14578	*Senna sp. Billabong (J.D. Alonzo 721)*			
103.	14577	*Senna sp. Meekatharra (E. Bailey 1-26)*			
104.	12355	*Swainsona affinis*			
105.	4226	*Swainsona elegans*			
106.	12356	*Swainsona formosa*			
107.	4229	*Swainsona gracilis*			
108.	13586	*Swainsona paucifoliolata*			
109.	4242	*Swainsona pterostylis*			
110.	4316	*Trigonella suavissima (Sweet Fenugreek)*			
Falconidae					
111.	25622	*Falco cenchroides (Australian Kestrel, Nankeen Kestrel)*			
Gentianaceae					
112.	41660	*Schenkia australis*			
Goodeniaceae					
113.	7477	*Dampiera stenostachya (Narrow-spiked Dampiera)*			
114.	7486	*Dampiera wellsiana (Wells' Dampiera)*			
115.	7583	*Lechenaultia macrantha (Wreath Leschenaultia)*			
116.	7644	*Scaevola spinescens (Currant Bush, Maroon)*			
117.	7648	*Scaevola tomentosa (Raggedleaf Fanflower)*			
Gyrostemonaceae					
118.	2778	*Codonocarpus cotinifolius (Native Poplar, Kundurangu)*			
Haloragaceae					
119.	6143	*Glischrocaryon aureum (Common Popflower)*			
Hirundinidae					
120.	24491	*Hirundo neoxena (Welcome Swallow)*			
121.	48061	*Petrochelidon nigricans (Tree Martin)*			
Lamiaceae					
122.	41025	*Dasymalla terminalis (Native Foxglove)*			
123.	6827	*Spartothamnella teucriiflora*			
Loranthaceae					
124.	12051	*Lysiana exocarpi subsp. exocarpi (Harlequin Mistletoe)*			
Maluridae					
125.	25651	*Malurus lamberti (Variegated Fairy-wren)*			
126.	24544	*Malurus lamberti subsp. assimilis (Variegated Fairy-wren)*			
Malvaceae					
127.	46824	*Seringia velutina (Velvet firebush)*			
128.	5103	*Thomasia tremandroides*			
Meliphagidae					
129.	24559	*Acanthagenys rufogularis (Spiny-cheeked Honeyeater)*			
130.	25661	*Lichmera indistincta (Brown Honeyeater)*			
131.	24583	*Manorina flavigula (Yellow-throated Miner)*			
Meropidae					
132.	24598	*Merops ornatus (Rainbow Bee-eater)*		IA	
Myrtaceae					
133.	35640	*Chamelaucium pauciflorum subsp. Perenjori (B.J. Conn 2181)*			
134.	5895	*Melaleuca conothamnoides*			
135.	6003	*Micromyrtus sulphurea*			
136.	6054	*Thryptomene decussata*			
Pachycephalidae					
137.	25675	*Colluricincla harmonica (Grey Shrike-thrush)*			
138.	24618	*Oreoica gutturalis (Crested Bellbird)*			
139.	25680	*Pachycephala rufiventris (Rufous Whistler)*			
Petroicidae					
140.	24659	*Petroica goodenovii (Red-capped Robin)*			
Phalacrocoracidae					
141.	24667	*Phalacrocorax sulcirostris (Little Black Cormorant)*			
Physciaceae					
142.	41284	*Hyperphyscia syncolla*			
143.	27972	*Physcia jackii*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
Pittosporaceae					
144.	19744	*Pittosporum angustifolium*			
Poaceae					
145.	12063	*Aristida holathera var. holathera*			
146.	290	*Dactyloctenium radulans (Button Grass)*			
147.	310	*Digitaria brownii (Cotton Panic Grass)*			
148.	357	*Enneapogon caerulescens (Limestone Grass)*			
149.	378	*Eragrostis dielsii (Mallee Lovegrass)*			
150.	388	*Eragrostis leptocarpa (Drooping Lovegrass)*			
151.	411	*Eriachne helmsii (Buck Wanderrie Grass)*			
152.	16486	*Eriachne pulchella subsp. pulchella*			
153.	426	*Eriochloa pseudoacrotricha (Perennial Cupgrass)*			
154.	11011	*Eulalia aurea*			
155.	490	*Monachather paradoxus*			
156.	11232	*Paractaenum novae-hollandiae subsp. novae-hollandiae*			
157.	518	*Paspalidium clementii (Clements Paspalidium)*			
158.	606	*Setaria dielsii (Diels' Pigeon Grass)*			
159.	613	*Setaria verticillata (Whorled Pigeon Grass)*	Y		
160.	673	*Themeda triandra*			
161.	678	*Tragus australianus (Small Burrgrass)*			
162.	717	*Urochloa piligera*			
Polygalaceae					
163.	4553	*Comesperma drummondii (Drummond's Milkwort)*			
Pomatostomidae					
164.	25706	*Pomatostomus temporalis (Grey-crowned Babbler)*			
Proteaceae					
165.	13453	*Grevillea didymobotrya subsp. didymobotrya*			
166.	13430	*Grevillea hakeoides subsp. stenophylla*			
167.	16797	*Grevillea levis*			
168.	19137	*Hakea lorea subsp. lorea*			
Psittacidae					
169.		*Barnardius zonarius*			
170.	24722	*Cacatua leadbeateri (Major Mitchell's Cockatoo)*			
171.	25716	*Cacatua sanguinea (Little Corella)*			
172.	24736	*Melopsittacus undulatus (Budgerigar)*			
173.		*Neopsephotus bourkii*			
174.	24742	*Nymphicus hollandicus (Cockatiel)*			
Ptilonorhynchidae					
175.		*Ptilonorhynchus guttatus*			
Rubiaceae					
176.	18210	*Psydrax rigidula*			
Rutaceae					
177.	18508	*Philotheca sericea*			
Scincidae					
178.	25045	*Ctenotus helenae*			
179.	25107	*Egernia stokesii subsp. badia (Western Spiny-tailed Skink (interior WA & Shark Bay), Gidgee Skink)*		T	
Scrophulariaceae					
180.	17157	*Eremophila compacta subsp. compacta*			
181.	17155	*Eremophila compacta subsp. fecunda*			
182.	15052	*Eremophila forrestii subsp. forrestii*			
183.	17152	*Eremophila forrestii subsp. hastieana (Grey Poverty Bush)*			
184.	7209	*Eremophila fraseri (Burra)*			
185.	29532	*Eremophila galeata*			
186.	7219	*Eremophila granitica (Thin-leaved Poverty Bush)*			
187.	15158	*Eremophila mackinlayi subsp. spathulata*			
188.	16363	*Eremophila maculata subsp. brevifolia (Native Fuchsia)*			
189.	7250	*Eremophila pantonii*			
190.	15058	*Eremophila platycalyx subsp. platycalyx*			
191.	15170	*Eremophila pterocarpa subsp. pterocarpa*			
192.	17165	*Eremophila simulans subsp. megacalyx*		P3	
193.	7270	*Eremophila spathulata (Spoon-leaved Eremophila)*			
Solanaceae					
194.	7018	*Solanum lasiophyllum (Flannel Bush, Mindjulu)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
Teloschistaceae					
195.		*Caloplaca sp.*			
Threskiornithidae					
196.	24845	*Threskiornis spinicollis (Straw-necked Ibis)*			
Thymelaeaceae					
197.	5245	*Pimelea forrestiana*			
198.	11185	*Pimelea microcephala subsp. microcephala*			
Vespertilionidae					
199.	24205	*Vespadelus finlaysoni (Finlayson's Cave Bat)*			
Zygophyllaceae					
200.	4374	*Tribulus astrocarpus*			
201.	4383	*Tribulus terrestris (Caltrop)*	Y		
202.	4386	*Zygophyllum aurantiacum (Shrubby Twinleaf)*			
203.	4390	*Zygophyllum fruticulosum (Shrubby Twinleaf)*			

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 D – Flora data

Flora species list

Quadrat data

Flora likelihood of occurrence assessment guidelines

Flora likelihood of occurrence assessment

Recorded Flora from Project Area

Family	Genus	Species	Status
Amaranthaceae	*Ptilotus*	*nobilis*	
Amaranthaceae	*Ptilotus*	*obovatus*	
Amaranthaceae	*Ptilotus*	*polystachyus*	
Chenopodiaceae	*Atriplex*	*codonocarpa*	
Chenopodiaceae	*Atriplex*	*semularis*	
Chenopodiaceae	*Chenopodium*	*gaudichaudianum*	
Chenopodiaceae	*Enchylaena*	*tomentosa*	
Chenopodiaceae	*Mairaena*	*triptera*	
Chenopodiaceae	*Rhagodia*	*?eremaea*	
Chenopodiaceae	*Salsola*	*australis*	
Chenopodiaceae	*Scaevola*	*spinescens*	
Chenopodiaceae	*Sclerolaena*	*cuneata*	
Chenopodiaceae	*Sclorolaena*	*eurtioides*	
Fabaceae	*Acacia*	*aptaneura*	
Fabaceae	*Acacia*	*craspedocarpa*	
Fabaceae	*Acacia*	*fuscaneura*	
Fabaceae	*Acacia*	*incurveneura*	
Fabaceae	*Acacia*	*miiritchie*	
Fabaceae	*Acacia*	*pteraneura*	
Fabaceae	*Acacia*	*sychronicia*	
Fabaceae	*Acacia*	*tetragonophylla*	
Fabaceae	*Senna*	*artemisioides* subsp. *helmsii*	
Fabaceae	*Senna*	*artemisoides* subsp. x *sturtii*	
Fabaceae	*Senna*	sp. Meekatharra (E. Bailey 1-26)	
Lamiaceae	*Spartothamnella*	*teucriiflora*	
Montiaceae	*Calandrina*	*remota*	
Poaceae	*Aristia*	*contorta*	
Poaceae	*Cenchrus*	*ciliaris*	*
Poaceae	*Eragrostis*	*eriopoda*	
Portulacaceae	*Portulaca*	*oleracea*	
Proteaceae	*Hakea*	*preissii*	
Scrophulariaceae	*Eremophila*	*forrestii* subsp. *forrestii*	
Scrophulariaceae	*Eremophila*	*fraseri*	
Scrophulariaceae	*Eremophila*	*georgei*	
Scrophulariaceae	*Eremophila*	*spathufolia*	
Solanaceae	*Sasola*	*australis*	
Solanaceae	*Sclorolaena*	*cuneata*	
Solanaceae	*Solanum*	*lasiophyllum*	
Zygophyllaceae	*Tribulus*	*astrocarpa*	

Vegetation Site Sheet: habitat information					Date:	25/11/2017	Site#:	Q1
Survey:	Boolardy Station Aerodrome							
Observers:	C Rigby S Petts							
Location:	15/33 extension							
MGA Zone:	50	**Easting:**	454479.358	7014053.98	**Northing:**	Q001		
Site Type:	Quadrat	**Dimensions:**	20 x 20m	**Camera:**	**303**	**From:**	NE	
Site Disturbance	**Frequency**		**Water or Wind Erosion Evidence**			**Field Vegetation Type**		
Clearing	Disturbs <10yr		No			Mixed shrubland		
Animal	Few recent 1-10yr					M+^Acacia pteraneura, Eremophila fraseri, E. forrestii subsp. forrestii, E. spathufolia\^shrubs\4\r;G+^Ptilotus obovatus, Rhagodia ?eremaea, Maireana triptera, Sclerolaena triptera, S. eurtioides, Salsola australis, Aristida contorta, Eragrostis eriopoda\^grass,forb\8\i		
Mining/Infrastructure	Few recent 1-10yr		**Climate**		**Vegetation Condition**		**Litter**	
			Dry, plants not stress		Poor			
			Site Drainage				**Leaf Litter:**	
			Poor Drain				Sparse	
			Fire Frequency		**Fire Intensity**		**Wood Litter:**	
			Old >5yr		Not applicable		Moderate	

Surface Components		Cover (if needed)		Soil		Landform		
Loose Soil	Sandy loam	60		Major Component		**Plain**		
Humus/Litter				Loam				
Cracked Clay								
Fine Rocks (2-6mm)				Minor		**Slope**		
Medium gravel/pebbles (6-20mm)				Sandy		Negligible		
Coarse gravel/pebbles (20-60mm)				Clayey				
Cobbly Cobbles (60-200mm)				Soil Colour		**Slope Aspect**		
Stony/stones (200-600mm)				Brown				
Surface Plates/boulders (>600mm)								
Growth Form Table								
Tree >10m		Tree 2-10m		Tree <2m			Tree Mallee	
Palm		Shrub >2m	M1	Shrub 1-2m	M2		Shrub >1m	
Cycads		Tussock Grass	G1	Hummock Grass			Sedge	
Vine		Herbs		Other	G2		Mallee Shrub	
Heath Shrub		Samphire Shrub		Chenopod	G2		Rush	
Grass Tree		Other						

Stratum	U1	U2	U3	M1	M2	M3	G1	G2
%Cover				2-10%	2-10%	2-10%	10-30%	2-10%
Ht range (m)				2.1-2.3	1.2-1.7	0.5-1.0	0.3-1.0	0.2
Av ht (m)				2.2	1.4	0.5	0.3	0.2

Collection Number	Family	Genus	Species	Status	Stratum	Height (m)	Cover (%)	Photo
	Scrophulariaceae	Eremophila	fraseri		M1	2.4	2-10%	
	Fabaceae	Acacia	pteraneura		M1	2.6	2-10%	
	Scrophulariaceae	Eremophila	forrestii subsp. forrestii		M2	1.65	10-30%	
	Scrophulariaceae	Eremophila	spathufolia		M3	0.8	2-10%	
	Poaceae	Eragrostis	eriopoda		G1	0.2-0.4	10-30%	
	Poaceae	Aristida	contorta		G1	0.1-0.2	2-10%	
	Chenopodiaceae	Maireana	triptera		G2	0.1-0.2	2-10%	
	Chenopodiaceae	Sclerolaena	cuneata		G2	0.1-0.3	2-10%	
	Chenopodiaceae	Salsola	australis		M3	0..4	2-10%	
	Chenopodiaceae	Rhagodia	?eremaea		M3	0.5	<2% Few than 10	
	Amaranthaceae	Ptilotus	obovatus		G2	0.1	<2% Numerous	
	Chenopodiaceae	Sclerolaena	eurtioides		G2	0.2	<2% Few than 10	

Incidentals

Collection Number	Family	Genus	Species	Status	Photo	WP	Count	Notes
	Fabaceae	Senna	artemisioides subsp. x sturtii					
	Amaranthaceae	Ptilotus	obovatus					
	Amaranthaceae	Ptilotus	nobilis					
	Fabaceae	Acacia	tetragonophylla					
	Chenopodiaceae	Enchylaena	tomentosa					
	Fabaceae	Senna	artemisioides subsp. helmsii					
	Lamiaceae	Spartothamnella	teucriflora					
	Zygophyllaceae	Tribulus	astrocarpa					
	Chenopodiaceae	Chenopodium	gaudichaudianum					

Vegetation Site Sheet: habitat information					Date:	25/11/2017	Site#:	Q002
Survey:	Boolardy Station Aerodrome Biological Assessment							
Observers:	S. Petts & C. Rigby							
Location:	18 Runway 03/21 Extension							
MGA Zone:	50	**Easting:**	453558.846		**Northing:**	7013964.452		
Site Type:	Quadrat	**Dimensions:**	20x20	**Camera:**	**p312**	**From:**	NE	
Site Disturbance	**Frequency**		**Water or Wind Erosion Evidence**			**Field Vegetation Type**		
Clearing	Disturbs <10yr		No			Low Open Woodland over low to tall shrubland		
Animal	Few recent 1-10yr					U+^Acacia fuscaneura, A. incurveneura\^trees\2\;M^A. tetragonophylla, A. grasbyi, Eremophila spathufolia, E. forrestii, Senna sp. Meekatharra (xxxxxx), S. artemisoides subsp. x sturtii/^shrubs/7/i: G^Aristida contorta, Ptilotus polystachyus, Solanum lasiophyllum, Sclorolaena cuneata\^Grass forb\4\c		
Flood	Disturbs <10yr		**Climate**		**Vegetation Condition**		**Litter**	
			Dry, plants not stress		Good			
			Site Drainage		Poor		**Leaf Litter:**	
			Poor Drain				Sparse	
			Fire Frequency		**Fire Intensity**		**Wood Litter:**	
			Old >5yr		Not applicable		Sparse	

Surface Components		Cover (if needed)		Soil		Landform		
Loose Soil	sandy loam			Major Component		**Plain**		
Humus/Litter				Loam				
Cracked Clay								
Fine Rocks (2-6mm)				Minor		**Slope**		
Medium gravel/pebbles (6-20mm)				Sandy		Negligible		
Coarse gravel/pebbles (20-60mm)				Clayey				
Cobbly Cobbles (60-200mm)				Soil Colour		**Slope Aspect**		
Stony/stones (200-600mm)				Brown				
Surface Plates/boulders (>600mm)								
Growth Form Table								
Tree >10m		Tree 2-10m	U1	Tree <2m			Tree Mallee	
Palm		Shrub >2m	M1	Shrub 1-2m		M3	Shrub >1m	
Cycads		Tussock Grass	G1	Hummock Grass			Sedge	
Vine		Herbs	G2	Other			Mallee Shrub	
Heath Shrub		Samphire Shrub		Chenopod		M3	Rush	
Grass Tree		Other						
Stratum	**U1**	**U2**	**U3**	**M1**	**M2**	**M3**	**G1**	**G2**
%Cover	10-30%			2-10%	2-10%	2-10%	30-70%	<2% Few than 10
Ht range (m)	4-5			2-3	1.4-1.8	0.5-0.8	0.1-0.4	0.1
Av ht (m)	4			2	1.6	0.5	0.2	0.1

Collection Number	Family	Genus	Species	Status	Stratum	Height (m)	Cover (%)	Photo
	Fabaceae	Acacia	fuscaneura		U1	4.5	10-30%	
	Fabaceae	Acacia	incurveneura		U1	5.6	2-10%	
	Fabaceae	Acacia	pteraneura		M1	2.3	2-10%	
	Fabaceae	Acacia	tetragonophylla		M1	3	2-10%	
	Fabaceae	Acacia	tetragonophylla		M2	1.5	2-10%	
Ref 5	Fabaceae	Senna	artemisoides subsp. x sturtii		M2	1.2	2-10%	
	Fabaceae	Senna	sp. Meekatharra (E. Bailey 1-26)		M3			
	Scrophulariaceae	Eremophila	spathufolia		M3	0.8	2-10%	
	Scrophulariaceae	Eremophila	forrestii subsp. forrestii		M3	0.5	2-10%	
	Fabaceae	Acacia	miiritchie		M1	2.2	2-10%	
	Poaceae	Aristia	contorta		G1	0.1-0.4	30-70%	
	Solanaceae	Solanum	lasiophylla		M3	0.2	<2% Few than 10	
	Chenopodiaceae	Sclorolaena	cuneata		M3	0.2	<2% Few than 10	
	Amaranthaceae	Ptilotus	polystachyus		G2	0.2	<2% Few than 10	

Incidentals

Collection Number	Family	Genus	Species	Status	Photo	WP	Count	Notes
	Scrophulariaceae	Eremopila	fraseri					
	Montiaceae	Calandrina	remota					
	Fabaceae	Senna	artemisoides subsp. helmsii					
	Fabaceae	Acacia	sychronicia					
	Fabaceae	Acacia	craspedocarpa					
	Portulacaceae	Portulaca	oleracea					

Vegetation Site Sheet: habitat information					Date:	25/11/2017	Site#:	Q003
Survey:	Boolardy Station Aerodrome							
Observers:								
Location:								
MGA Zone:	50	Easting:	453666.711		Northing:	7014086.69		
Site Type:	Quadrat	Dimensions:	20x20	Camera:	p317	From:	NE	
Site Disturbance	Frequency		Water or Wind Erosion Evidence			Field Vegetation Type		
Clearing	Few recent 1-10yr		No			Scattered Trees over Open Shrubland		
Animal	Few recent 1-10yr					U+^Acacia pteraneura\trees\1\M+^Acacia tetragonophylla, A. synchronicia, Eremophila spathufolia, E. georgei\^shrubs\4\i;G^Aristida contorta, Solanum lasiophyllum, Sclerolaena cuneata, Ptilotus polystachyus, Ptilotus obovatus, Sasola australis, Maireana triptera, Atriplex codonocarpus\^grass, chenopod\8\i		
Flood	Disturbs <10yr		Climate		Vegetation Condition		Litter	
			Dry, plants not stress		Poor			
			Site Drainage				Leaf Litter:	
			Poor Drain				Sparse	
			Fire Frequency		Fire Intensity		Wood Litter:	
			Old >5yr		Not applicable		Sparse	

Surface Components		Cover (if needed)		Soil		Landform		
Loose Soil	sandy loam			Major Component				
Humus/Litter								
Cracked Clay								
Fine Rocks (2-6mm)				Minor		Slope		
Medium gravel/pebbles (6-20mm)								
Coarse gravel/pebbles (20-60mm)								
Cobbly Cobbles (60-200mm)				Soil Colour		Slope Aspect		
Stony/stones (200-600mm)								
Surface Plates/boulders (>600mm)								
Growth Form Table								
Tree >10m		Tree 2-10m	U1	Tree <2m			Tree Mallee	
Palm		Shrub >2m	M1	Shrub 1-2m		M3	Shrub >1m	
Cycads		Tussock Grass	G1	Hummock Grass			Sedge	
Vine		Herbs	G2	Other			Mallee Shrub	
Heath Shrub		Samphire Shrub		Chenopod		M3	Rush	
Grass Tree		Other						
Stratum	U1	U2	U3	M1	M2	M3	G1	G2
%Cover				2-10%	2-10%	2-10%	30-70%	<2% Few than 10
Ht range (m)				2-3	1.4-1.8	0.5-0.8	0.1-0.4	0.1
Av ht (m)	4							

Collection Number	Family	Genus	Species	Status	Stratum	Height (m)	Cover (%)	Photo
	Fabaceae	Acacia	pteraneura		U1	3.5	2-10%	
	Fabaceae	Acacia	tetragonophylla		M1	3	2-10%	
	Fabaceae	Acacia	tetragonophylla		M2	1.5	2-10%	
	Fabaceae	Acacia	sychronicia		M2	1.2	2-10%	
	Scrophulariaceae	Eremophila	spathufolia		M3	0.8	2-10%	
	Scrophulariaceae	Eremophila	georgei		M2	0.9-1.2	2-10%	
	Poaceae	Aristida	contorta		G1	0.1-0.4	<2% Few than 10	
	Solanaceae	Solanum	lasiophylla		G2	0.2	<2% Few than 10	
	Solanaceae	Sclerolaena	cuneata		G2	0.2	<2% Few than 10	
	Amaranthaceae	Ptilotus	polystachyus		G2	0.2	<2% Few than 10	
	Amaranthaceae	Ptilotus	obovatus		M3	0.5	2-10%	
	Solanaceae	Sasola	australis		G2	0.3-0.5	2-10%	
	Chenopodiaceae	Maireana	triptera		G2	0.2	2-10%	
	Chenopodiaceae	Atriplex	codonocarpa		G2	0.2	<2% Few than 10	

Vegetation Site Sheet: habitat information					Date:	25/11/2017	Site#:	Q4
Survey:	Boolardy Station Aerodrome							
Observers:								
Location:	loation new drain 03/21							
MGA Zone:		**Easting:**	454256.977		**Northing:**	7015098.646		
Site Type:	Quadrat	**Dimensions:**	20x20	**Camera:**	**321**	**From:**	NE	
Site Disturbance	**Frequency**		**Water or Wind Erosion Evidence**			**Field Vegetation Type**		
Mining/Infrastructure	Disturbs >10yr		No			Scattered Shrubs on artificial drainage line		
Clearing	Disturbs >10yr					M+^Acacia tetragonophila, Scaevola spiniscens, Eremophila georgei, Senna artemisoides subsp. x sturtii, S. sp. Meekatharra\^shrubs\5\;G+^Maireana triptera, Sclerolaena cuneata, Aristida contorta, Ptilotus obovatus\^grass, chenopod\4\i		
Flood	Disturbs <10yr		**Climate**		**Vegetation Condition**		**Litter**	
Exotic Weeds	Current Disturbance		Dry, plants not stress		Good			
			Site Drainage				**Leaf Litter:**	
			Good Drain				Sparse	
			Fire Frequency		**Fire Intensity**		**Wood Litter:**	
			Old >5yr				Sparse	

Surface Components		Cover (if needed)		Soil		Landform		
Loose Soil	Sandy loam	50		Major Component		**Plain**		
Humus/Litter				Loam				
Cracked Clay								
Fine Rocks (2-6mm)				Minor		**Slope**		
Medium gravel/pebbles (6-20mm)				Sandy		Negligible		
Coarse gravel/pebbles (20-60mm)								
Cobbly Cobbles (60-200mm)				Soil Colour		**Slope Aspect**		
Stony/stones (200-600mm)				Brown				
Surface Plates/boulders (>600mm)								
Growth Form Table								
Tree >10m		Tree 2-10m		Tree <2m			Tree Mallee	
Palm		Shrub >2m	M1	Shrub 1-2m		M2	Shrub >1m	M3
Cycads		Tussock Grass	G1	Hummock Grass			Sedge	
Vine		Herbs		Other			Mallee Shrub	
Heath Shrub		Samphire Shrub		Chenopod		M3	Rush	
Grass Tree		Other						
Stratum	**U1**	**U2**	**U3**	**M1**	**M2**	**M3**	**G1**	**G2**
%Cover				10-30%	2-10%	2-10%	30-70%	2-10%
Ht range (m)				3	1.2-2	0.3-1	0.10.4	0.1
Av ht (m)								

Collection Number	Family	Genus	Species	Status	Stratum	Height (m)	Cover (%)	Photo
	Fabaceae	Acacia	tetragonophylla		M1	3	10-30%	
	Fabaceae	Acacia	tetragonophylla		M2	1.7	2-10%	
Ref 6	Chenopodiaceae	Scaevola	spinescens		M1	2	2-10%	323
	Fabaceae	Senna	artemisoides subsp. x sturtii		M3	1	2-10%	
	Scrophulariaceae	Eemophila	georgei		M3	1	2-10%	
	Fabaceae	Senna	artemisoides		M3	0.8	2-10%	
	Fabaceae	Senna	sp. Meekatharra (E. Bailey 1-26)		M3	0.7	2-10%	
	Solanaceae	Sasola	austallis		G2	0.2-0.5	10-30%	
	Chenopodiaceae	Mairaena	triptera		G2	0.1-0.3	2-10%	
	Chenopodiaceae	Sclorolaena	eurtioides		G2	0.10.2	2-10%	
	Chenopodiaceae	Atriplex	semularis		M3	0.2-0.3	2-10%	
	Poaceae	Aristida	contorta		G2	0.1-0.3	2-10%	
	Poaceae	Cenchrus	ciliaris		G1	0.2-0.4	30-70%	
	Chenopodiaceae	Sclerolaena	cuneata		G2	0.4		
	Amaranthaceae	Ptilotus	obovatus		G2	0.3	2-10%	325-326

Incidentals

Collection Number	Family	Genus	Species	Status	Photo	WP	Count	Notes
	Chenopodiaceae	Atriplex	codocarpa					
	Chenopodiaceae	Maireana	triptera					
	Fabaceae	Senna	artemisioides subsp. helmsii					
	Fabaceae	Acacia	sychronicia					
	Fabaceae	Acacia	tetragonophylla					
	Fabaceae	Acacia	aptaneura					
	Amaranthaceae	Ptilotus	obovatus					
	Poaceae	Aristida	contorta					
	Solanaceae	Solanum	lasiophyllum					

Flora likelihood of occurrence assessment guidelines

Likelihood of occurrence	Guideline
Known	Species recorded within 10 km of the Project Area from field survey results.
Likely	Species previously recorded within 2 km and large areas of suitable habitat occur within 10 km of the Project Area.
Possible	Species previously recorded within 2 km and areas of suitable habitat occur/may occur within 10 km of the Project Area.
Unlikely	Species previously recorded within 2 km, but suitable habitat does not occur within 10 km of the Project Area.
Highly unlikely	Species not previously recorded within 2 km, suitable habitat does not occur within 10 km of the Project Area and/or the Project Area is outside the natural distribution of the species.
Other considerations	Intensity of survey, availability of access, growth form type, recorded flowering times, cryptic nature of species

Source information - desktop searches

DBCA – DBCA (2007–) records of threatened flora, database search within the Survey Area (accessed September 2017)

NM – DBCA *NatureMap* (accessed September 2017)

PMST – DotEE Protected Matters Search Tool (PMST) to identify flora listed under the EPBC Act potentially occurring within 10 km of the Survey Area (accessed September 2017)

Definitions

Term	Description
Project Area	the area subject to the current survey
locality	the area within an approximate 10 km radius of the survey area

Table 12 Likelihood occurrence assessment for conservation significant flora

Family	Taxon	Status		Description and closest record information (if available) (WA Herbarium 1998–, DBCA 2017)	Likelihood of occurrence	Source
		WC Act/ DBCA	EPBC Act			
Asteraceae	*Angianthus microcephalus*	P2		Decumbent or ascending annual, herb, 0.06-0.1(-0.21) m high. Fl. yellow, Sep to Dec. Sandy or clayey soils. Salt swamps & pans.	Unlikely – Project Area does not support suitable habitat.	NM
Scrophylariaceae	*Eremophila simulans* subsp. *megacalyx*	P3		Shrub, 0.9-2 m high. Fl. violet, Aug to Sep. The species is know from the Nicholson Range where it grows abundantly on plains with sandy surfaces in *Acacia* woodland.	Possible – Not recorded however the Project Area supports suitable habitat.	NM

Appendix E – Fauna data

Fauna species list

Fauna likelihood of occurrence guidelines

Fauna likelihood of occurrence assessment

Record fauna from Project Area

Type	Family	Genus	Species	Common Name	Status
Bird	Acanthizidae	*Smicrornis*	*brevirostris*	Weebill	
Bird	Acanthizidae	*Acanthiza*	*inornata*	Western Thornbill	
Bird	Accipitridae	*Haliastur*	*sphenurus*	Whistling Kite	
Bird	Cacatuidae	*Cacatua*	*roseicapilla*	Galah	
Bird	Cacatuidae	*Nymphicus*	*hollandicus*	Cockatiels	
Bird	Columbidae	*Geopelia*	*striata* subsp. *placida*	Peaceful Dove	
Bird	Columbidae	*Ocyphaps*	*lophotes*	Crested Pigeon	
Bird	Cracticidae	*Cracticus*	*nigrogularis*	Pie Butcherbird	
Bird	Estrildidae	*Taeniopygia*	*guttata*	Zebra finch	
Bird	Meliphagidae	*Manorina*	*flavigula*	Yellow-throated Miner	
Bird	Meliphagidae	*Lichmera*	*indistincta*	Brown Honey-eater	
Bird	Meliphagidae	*Gavicalis*	*virescens*	Singing Honeyeater	
Bird	Pomatostomidae	*Pomatostomus*	*temporalis*	Grey-crowed Babbler	
Bird	Psittacidae	*Melopsittacus*	*undulatus*	Budgergar	
Bird	Psittacidae	*Platycercus*	*zonarius*	Australian Ringnecks	
Mammal	Bovidae	*Bos*	*taurus*	European Cattle	*
Mammal	Canidae	*Canis*	*lupus*	Dingo	*
Mammal	Leporidae	*Oryctolagus*	*cuniculus*	Rabbit	
Mammal	Macropodidae	*Macropus*	*robustus*	Euro	
Reptile	Agamidae	*Ctenophorus*	*nuchalis*	Central Netted Dragon	
Reptile	Varanidae	*Varanus*	*gouldii*	Gould's Goanna	

Parameters of fauna likelihood of occurrence assessment

Assessment outcome	Description
Present	Species recorded during the field survey or from recent, reliable records from within or close proximity to the survey area.
Likely	Species are **likely** to occur in the survey area where there is suitable habitat within the Project Area and there are recent records of occurrence of the species in close proximity to the Project Area. OR Species known distribution overlaps with the survey area and there is suitable habitat within the Project Area.
Unlikely	Species assessed as **unlikely** include those species previously recorded within 10 km of the survey area however: • There is limited (i.e. the type, quality and quantity of the habitat is generally poor or restricted) habitat in the Project Area. • The suitable habitat within the Project Area is isolated from other areas of suitable habitat and the species has no capacity to migrate into the survey area. OR Those species that have a known distribution overlapping with the Project Area however: • There is limited habitat in the survey area (i.e. the type, quality and quantity of the habitat is generally poor or restricted). • The suitable habitat within the survey area is isolated from other areas of suitable habitat and the species has no capacity to migrate into the Project Area.
Highly unlikely	Species that are considered **highly unlikely** to occur in the survey area include: • Those species that have no suitable habitat within the Project Area. • Those species that have become locally extinct, or are not known to have ever been present in the region of the Project Area.

Source information - desktop searches

NM – DBCA *NatureMap* (accessed September 2017)

PMST – DotEE Protected Matters Search Tool (PMST) to identify fauna listed under the EPBC Act potentially occurring within 10 km of the Project Area (accessed September 2017)

DBCA – DBCA (2007–) records of threatened fauna from a database search within the Midwest DBCA region (accessed September 2017)

Definitions

Term	Description
Project Area	the area subject to the current survey
locality	the area within an approximate 10 km radius of the Project Area

Likelihood of occurrence assessment for conservation significant fauna

Species Name	Status		Desktop search				Description and habitat requirements	Likelihood of occurrence
	EPBC Act	WC Act	NM	PMST	DBCA	Other		
Birds								
Ardea alba (Great Egret)	Ma	IA		X	X		The eastern Great Egret has been reported in a wide range of wetland habitats, including swamps and marshes; margins of rivers and lakes; damp or flooded grasslands, pastures or agricultural lands; reservoirs; sewage treatment ponds; drainage channels; salt pans and salt lakes; salt marshes; estuarine mudflats, tidal streams; mangrove swamps; coastal lagoons; and offshore reefs. Minor breeding sites are widely scattered across the species' distribution. Non-breeding birds have been recorded across much of Australia, but avoid the driest regions of the western and central deserts (DotE 2016).	**Unlikely - Irregular Visitor** **Habitat** - There is no suitable habitat within the Project Area
Ardea ibis (Cattle Egret)	Ma	IA		X	X		The Cattle Egret occurs in tropical and temperate grasslands, wooded lands and terrestrial wetlands. It has occasionally been seen in arid and semi-arid regions. This inland spread is believed to be due to the construction of artificial waterways. High numbers have been observed in moist, low-lying poorly drained pastures with an abundance of high grass; it avoids low grass pastures. It has been recorded on earthen dam walls and ploughed fields. It is commonly associated with the habitats of farm animals, particularly cattle, but also pigs, sheep, horses and deer. The Cattle Egret is known to follow earth-moving machinery and has been located at rubbish tips. It uses predominately shallow, open and fresh wetlands including meadows and swamps with low emergent vegetation and abundant aquatic flora. They have sometimes been observed in swamps with tall emergent vegetation. In Western Australia and the Northern Territory, the Cattle Egret is located from Wyndham to Arnhem Land (DotE 2016).	**Unlikely - Irregular Visitor** **Habitat** - There is no suitable habitat within the Project Area **Records –** Nearest record 41 km south-west of Project Area.

Species Name	Status		Desktop search				Description and habitat requirements	Likelihood of occurrence
	EPBC Act	WC Act	NM	PMST	DBCA	Other		
Calidris acuminata (Sharp-Tailed Sandpiper)	MM	IA		X	X		In Australasia, the Sharp-tailed Sandpiper prefers muddy edges of shallow fresh or brackish wetlands, with inundated or emergent sedges, grass, saltmarsh or other low vegetation. This includes lagoons, swamps, lakes and pools near the coast, and dams, waterholes, soaks, bore drains and bore swamps, saltpans and hypersaline saltlakes inland. They also occur in saltworks and sewage farms. They use flooded paddocks, sedgelands and other ephemeral wetlands, but leave when they dry. They use intertidal mudflats in sheltered bays, inlets, estuaries or seashores, and also swamps and creeks lined with mangroves. Sometimes they occur on rocky shores. They are widespread from Cape Arid to Carnarvon, around coastal and subcoastal plains of Pilbara Region to south-west and east Kimberley Division. Inland records indicate the species is widespread and scattered from Newman, east to Lake Cohen, south to Boulder and west to Meekatharra (DotE 2016).	**Unlikely - Irregular Visitor** **Habitat** - There is no suitable habitat within the Survey Areas. **Records –** Nearest record 93 km south of Survey Area 1.
Calidris subminuta (Long-Toed Stint)	MM	IA			X		In Australia, the Long-toed Stint occurs in a variety of terrestrial wetlands. They prefer shallow freshwater or brackish wetlands including lakes, swamps, river floodplains, streams, lagoons and sewage ponds. The species is also fond of areas of muddy shoreline, growths of short grass, weeds, sedges, low or floating aquatic vegetation, reeds, rushes and occasionally stunted samphire. It has been observed at open, less vegetated shores of larger lakes and ponds and is common on muddy fringes of drying ephemeral lakes and swamps, and frequents permanent wetlands such as reservoirs and artificial lakes. The species has occasionally been recorded in the Gascoyne Region, around Lake Wooleen, Meeberrie Station and McNeill Claypan. Inland records include Lake Brown, Hannan Lake, Lake Biolet, Newman Sewage Farm and Lake Gregory (DotE 2016).	**Unlikely - Irregular Visitor** **Habitat** - There is no suitable habitat within the Project Area. **Records-** 76 km west of the Project Area.
Thinornis rubricollis (Hooded Plover)		P4		X	X		The Hooded Plover can be found on inland and coastal salt lakes as well as coastal beaches, with a preference for wide sandy beaches with large amounts of seaweed and backed by extensive open dunes. After breeding, many migrate to larger salt lakes like Lake Clifton south of Mandurah, or Lake Gore and Warden in the Esperance region. Their distribution extends from Horrocks to Eyre on the Nullarbor, with their largest numbers on the Esperance lakes, as well as inland on some of the smaller ephemeral salt lakes, particularly in the Salmon Gum woodlands north of Esperance and those north west of Hyden and between Hyden and Norseman (Morcombe 2004; Nevill 2013).	**Highly unlikely** **Habitat –** there is no suitable habitat. **Records –** Nearest record 176 km east of the Project Area.

Species Name	Status		Desktop search				Description and habitat requirements	Likelihood of occurrence
	EPBC Act	WC Act	NM	PMST	DBCA	Other		
Elanus scriptus (Letter-Winged Kite)		P4			X		The Letter-Winged Kite inhabits open or sparsely wooded country and rests in *Eucalyptus coolabah* during the day. They nest in the cooler months when the rats often reach their peak, with nesting peaking in July. The nest is an open platform of sticks from herbage and shrubs. The Letter-Winged Kite occurs in the eastern arid zone of Australia but occasionally irrupts to all parts of the continent. Population cycles appear to be linked to those of the principal prey, the plague rat *Rattus villossimus*, which has population explosions following high rainfall (IUCN Redlist 2016).	**Unlikely – irregular visitor** **Habitat** – there is no suitable habitat. **Records** - Nearest record 204 km south-west of the Project Area.
Falco hypoleucos (Grey Falcon)		Vu			X		The Grey Falcon inhabits lightly timbered country, especially stony, inland plains and Acacia scrub, gibber deserts, sandridges, pastoral lands, and timbered watercourses, but seldom in driest deserts. Its distribution is centred on inland drainage systems. It also hunts in treeless areas and frequents tussock grassland and open woodland, especially in winter (Morcombe 2004; Pizzey & Knight 2012). It can mostly be seen on the northwest coast from Shark Bay to east Kimberley, and in the Pibara and desert regions (Nevill 2013; Pizzey & Knight 2012).	**Unlikely - Irregular Visitor** **Habitat** - The Grey Falcon may utilise the survey areas for dispersal and hunting. Low Open Woodland habitat type recorded from the Project Area. **Records** – Nearest record 70 km north-west of the Project Area.
Falco peregrinus (Peregrine Falcon)		OS			X	X	The Peregrine Falcon is found on and near cliffs, gorges, timbered watercourses, riverine environments, wetlands, plains, open woodlands, and pylons and spires of buildings, though less frequently in desert regions (Morcombe 2004; Pizzey & Knight 2012). They are not common but can be found almost anywhere throughout WA and in the southwest, including particularly at Fitzgerald River, Stirling Range, Porongurup National Parks, Kondinin, and Peak Charles, with many more locations north of Perth (Nevill 2013).	**Unlikely** **Habitat** - This species occupies a diverse range of habitats particularly open plains, it is likely to occur within the survey area. However, there are no breeding opportunities present within the Project Area. **Records –** The nearest record is 20 km north of the Project Area.

Species Name	Status		Desktop search				Description and habitat requirements	Likelihood of occurrence
	EPBC Act	WC Act	NM	PMST	DBCA	Other		
Leipoa ocellata (Malleefowl)	Vu	Vu	X	X	X	X	The Malleefowl generally occurs in semi-arid areas of WA, in shrublands and low woodlands that are dominated by mallee vegetation, as well as native pine *Callitris* woodlands, *Acacia* shrublands, paperbark, skheoak, Broombush *Melaleuca uncinata* vegetation, eucalypt woodlands, or coastal heathlands. Mostly they are found where there are sandy or gravel soils. The nest is a large mound of sand or soil and organic matter (Jones & Goth 2008; Morcombe 2004; Nevill 2013). In WA they are found from the southwest Nullarbor to Albany, north, and then west from Moore River up to Shark Bay, past Cue, across to Wiluna and east to the northern Victoria Desert south of the Blackstone Ranges (Nevill 2013; Pizzey & Knight 2012).	**Unlikely** **Habitat** – There is no suitable habitat for this species within the Project Area. **Records –** there are scattered historical records nearby the Project Area.
Merops ornatus (Rainbow Bee-eater)	Ma	IA		X	X	X	The Rainbow Bee-eater is found throughout the state except in desert regions, particularly in open forests and woodlands, with sandy, loamy soil, but also sandridges, sandpits, riverbanks, mangroves, rainforest shrublands, and in various cleared or semi-cleared habitats, including farmland and areas of human habitation. They also inhabit sand dune systems in coastal areas and at inland sites that are in close proximity to water (Morcombe 2004; Pizzey & Knight 2012). They dig out nests in open areas where there is relatively soft but firm sands, either on flat ground or in the side of a sandy bank (Nevill 2013).	**Likely – Irregular visitor** **Habitat –** There is suitable foraging habitat within all survey areas. However, there is no suitable breeding habitat with the Project Area. **Records –** There records within 19 km of the Project Area.
Motacilla cinerea (Grey Wagtail)	MM	IA		X			The Grey Wagtail is an opportunistic migrant to Australia. The species typically migrates to Indonesia occasionally landing in Australia. Most records for the species are from Northern Australia and South Australia (Morcombe 2004). The non-breeding habitat only of the Grey Wagtail has a strong association with water, particularly rocky substrates along water courses but also lakes and marshes (DotE 2016). It can be found mainly in banks and rocks in fast-running freshwater habitats: rivers, creeks, streams, and around waterfalls, both in forest and open country; but occurs almost anywhere during migration (Johnstone & Storr 2004).	**Highly Unlikely -** Geographically restricted to Northern Australia in particular the Kimberley Region.
Motacilla flava (Yellow Wagtail)	MM	IA		X			The Yellow Wagtail occupies a range of damp or wet habitats with low vegetation, from damp meadows, marshes, waterside pastures, sewage farms and bogs to damp steppe and grassy tundra (IUCN Redlist 2016). In Australia, the Yellow Wagtail is a very uncommon except in the Broome region. They can often be found in nothern towns wherever there are well watered grass areas (DotEE 2017).	**Highly Unlikely -** Geographically restricted to Northern Australia in particular the Pilbara Region.

Species Name	Status		Desktop search				Description and habitat requirements	Likelihood of occurrence
	EPBC Act	WC Act	NM	PMST	DBCA	Other		
Pezoporus occidentalis (Night Parrot)	En	Cr		X			The Night Parrot is a highly elusive nocturnal ground dwelling parrot found in arid and semi-arid areas that are characterised by having dense, low vegetation. Based on accepted records, the habitat of the Night Parrot consists of *Triodia* grasslands in stony or sandy environments and of samphire and chenopod shrublands, including genera such as *Atriplex*, *Bassia* and *Maireana*, on floodplains and claypans and on the margins of saltlakes, creeks or other sources of water (Parker 1980). It has also been observed to enter dense *Muehlenbecki* growth when flushed from a more typical habitat (DotEE 2017).	**Highly Unlikely -** Locally extinct.
Plegadis falcinellus (Glossy Ibis)	MM	IA			X		The Glossy Ibis' preferred habitat for foraging and breeding are shallow, grassy, fresh water marshes at the edges of lakes and rivers, lagoons, flood-plains, wet meadows, swamps, reservoirs, sewage ponds, and cultivated areas under irrigation. The species is occasionally found in coastal locations such as estuaries, deltas, saltmarshes and coastal lagoons, and in wooded swamps, artificial wetlands (such as irrigated fields), and in mangroves. It may retreat to permanent wetlands and/or coastal areas (including tidal wetlands) during drought. Within Australia, the Glossy Ibis is generally located east of the Kimberley in WA and Eyre Peninsula in SA. The species is also known to be patchily distributed in the rest of WA (DotE 2016).	**Unlikely – irregular visitor** **Habitat** – there is no suitable habitat. **Records –** The nearest record is 45 km south of the Project Area.
Mammals								
Dasyurus geoffroii (Chuditch, Western Quoll)	Vu	Vu		X	X		The Chuditch inhabits eucalypt forest (especially Jarrah, *E. marginata*), dry woodland, mallee shrublands, heaths, and desert, particularly in the south coast of WA. They also occur at lower densities in drier woodland and mallee shrubland in the goldfields and wheatbelt, as well as in Kalbarri National Park (translocated). Chuditch require adequate numbers of suitable den and refuge sites (horizontal hollow logs or earth burrows) to survive (DEC 2012). In Jarrah forest, Chuditch populations occur in both moist, densely vegetated, steeply sloping forest and drier, open, gently sloping forest (Van Dyck & Strahan 2008). The species can travel large distances, and for this reason requires habitats that are of a suitable size and not excessively fragmented (DEC 2012).	**Highly Unlikely** **Records –** The nearest record is 200 km west of the Project Area.

Species Name	Status		Desktop search				Description and habitat requirements	Likelihood of occurrence
	EPBC Act	WC Act	NM	PMST	DBCA	Other		
Petrogale lateralis subsp. *lateralis* (Black-Flanked Rock-Wallaby, Warru)	Vu	En			X		Current known Black-flanked Rock-wallaby populations remain restricted to suitable habitat in the Little Sandy Desert, Cape and Calvert Ranges, with seven populations in the Wheatbelt region, Barrow and Salisbury Islands, and Ningaloo Station. Populations have been re-established via translocation to a number of sites in the Avon Valley and Cape le Grand National Parks and Paruna Sanctuary. The habitat varies between colonies but always involves grassland feeding habitat for feeding in close proximity to cliff, rock-pile, talus or escarpment refuge habitat. Rock cliffs or other steep substrates with adequate shelter and refuge are essential for breeding (Van Dyck & Strahan 2008).	**Unlikely** **Habitat –** There is no suitable habitat within the survey areas. **Record –** There is a historical record 62 km south-east from Survey Area 2.
Sminthopsis longicaudata (Long-Tailed Dunnart)		P4			X	X	The Long-tailed Dunnart occurs throughout the Gibson Desert, Murchison, southern Canarvon Basin and the Pilbara. Its habitat includes rugged, rocky areas with hummock grasses, shrubs and tall open shrublands and woodlands (Van Dyck & Strahan 2008).	**Unlikely** **Habitat –** There is no suitable habitat within the survey areas. **Record –** There is a historical record 45 km south of the Project Area.
Reptiles								
Cyclodomorphus branchialis (Gilled Slender Bluetongue)		Vu			X	X	The Gilled Slender Blue-tongue occurs across the southern and western area of the Murchison bioregion with the species distribution fragmented due to the lack of suitable habitat. This species is a nocturnal ground-dwelling skink which shelters in spinifex, leaf litter and fall timber. Fauna survey conducted at Blue Hills have found the species to occur on the ridges of the BIFs and it was not found in the surrounding area (DBCA, 2007).	**Unlikely** **Habitat –** There is limited suitable habitat within the Project Area. This Survey Area lacks suitable leaf and wood litter cover. **Record –** There nearest record in 188 km south of the Project Area.

Species Name	Status		Desktop search				Description and habitat requirements	Likelihood of occurrence
	EPBC Act	WC Act	NM	PMST	DBCA	Other		
Egernia stokesii subsp. *badia* (Western Spiny-Tailed Skink, black form)	En	Vu		X	X	X	The Western Spiny-tailed Skink (black form) was originally known from a limited number of sites on Austin Downs Station, east of Cue (e.g. Walga, Wurrah and Woolgerong Rocks). They were restricted to massive granite exposures ('whalebacks') with a variable cover of loose boulders and pockets of soil and low shrubland vegetation. These outcrops are separated by open low woodland and shrubland. The skinks live in narrow crevices and boulders and are observed most readily when they bask close to their refugia. Hollow logs are used as refuge sites in woodland habitat. Preferred refuges consist of piles of several, overlapping, hollow logs providing a combination of basking and shelter sites. An increasing number of skinks are being located in altered habitat under piles of wood, scrap metal or under buildings on private property (DotE 2016). Surveys between 2006 and 2009 identified over 70 new locations in the Murchison region (ecologia Environment 2010).	**Unlikely** **Habitat –** There is no suitable habitat within the Survey Areas. **Record –** the nearest recorded in 23 km south of the Project Area.
Invertebrates								
Idiosoma nigrum (Shield-backed Trapdoor Spider)	Vu	Vu		X	X	X	The Shield-backed Trapdoor Spider is endemic to semi-arid south-west Western Australia. It occurs in a number of severely fragmented populations in the central and northern Wheatbelt (e.g. Minnivale and East Yorkrakine). Further north, the species occurs in more arid areas in the Midwest (e.g. large isolated ranges at Jack Hills, Weld Range and Blue Hills) and coastal areas of the Midwest (e.g. Zuytdorp Station north of the Murchison River and Nanga Station south of Shark Bay). The arid Midwest populations are naturally fragmented or isolated because they persist only on ranges, but the Wheatbelt and coastal Midwest populations are all severely fragmented as a result of land clearing (DotEE 2017).	**Unlikely – not recorded** **Habitat –** There is no suitable habitat within the Project Area. **Record –** There are records on Boolardy Station.

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