Biota Environmental Sciences

Yarrie Southern Area Biological Survey







Prepared for BHP Western Australian Iron Ore

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Biota Environmental Sciences

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Yarrie Southern Area Biological Survey

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1.0 Executive Summary

BHP Western Australian Iron Ore commissioned Biota Environmental Sciences to complete a desktop study, a single-season detailed and targeted flora and vegetation survey and a basic and targeted vertebrate fauna survey of the Yarrie Southern Area (approximately 358.7 hectares) at its Yarrie mine in the Pilbara region of Western Australia. The aim of the study was to identify key biological values within the Survey Area, particularly communities or species listed under the Commonwealth *Environment Protection and Biodiversity Act 1999* or WA *Biodiversity Conservation Act 2016*, or listed under Western Australia's Department of Biodiversity, Conservation and Attractions policy. The results of this study may be used to inform any future environmental approvals and/or rehabilitation works in the area.

The field survey was undertaken between the 6th and 10th May 2024. Although the survey was conducted during the recommended post-wet season survey timing for the Pilbara, lower than usual rainfall was recorded prior to the survey and on-ground conditions were dry.

Approximately 12.4% of the survey area was cleared, consisting of the overburden storage area as well as minor tracks. A further 1.5% of the Survey Area consisted of rehabilitated vegetation on a previously cleared mine slope. Five intact vegetation associations were mapped for the remainder of the Survey Area: one from low undulating hills and stony plains, two from sandy loam sand plains and floodplains, and two from minor to medium-sized drainage lines. None of the vegetation associations comprised listed Threatened Ecological Communities or Priority Ecological Communities. Two presumably artificial water features occurred at the toe of the overburden storage area, within the medium drainage line vegetation association. These appeared to be predominantly seep-fed from the adjacent mining area. While most of the Survey Area (71.8%) was in Excellent condition, vegetation condition ranged from Excellent to Completely Degraded. Disturbance was due to weed invasion, impacts from cattle or other stock, and previous clearing or ground disturbance.

A total of 121 native vascular flora species from 69 genera and 33 families were recorded during the survey. Seven introduced flora species were also recorded, including **Calotropis procera* (Calotrope, or Rubber Bush), which is a Declared Pest for the whole of WA under the *Biosecurity and Agriculture Management Act 2007*. Calotrope was recorded from 10 locations in the Survey Area, from drainages and disturbed areas. No Threatened or Priority flora species were recorded during the survey. One Priority 3 annual flora species, *Euphorbia clementii,* was ranked as having a moderate likelihood of occurrence following the survey. Given the dry conditions leading up to the survey, the timing of the survey was considered unsuitable to detect this species. The remaining 14 Priority flora species returned from the desktop study were ranked as having a low likelihood of occurrence in the Survey Area.

The Survey Area contained six main fauna habitats: Stony Plain, Sand Plain, Minor Drainage Line, Artificial Wetland, Rehabilitation Area, and Cleared/ Disturbed areas. A total of 55 vertebrate species were recorded during the survey, comprising 17 mammals (including 11 bat species), 33 birds and five reptiles. Three of these species are listed as significant under State or Commonwealth legislation or Department of Biodiversity, Conservation and Attractions policy:

- Northern Quoll (*Dasyurus hallucatus*) – Endangered under the *Biodiversity Conservation Act 2016* and the *Environment Protection and Biodiversity Conservation Act 1999*, recorded through the observation of a single scat;
- Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia* Pilbara form) – Vulnerable under the *Biodiversity Conservation Act 2016* and the *Environment Protection and Biodiversity Conservation Act 1999,* recorded at three locations using ultrasonic audio recorders; and
- Western Pebble-mound Mouse (*Pseudomys chapmani*) – Department of Biodiversity, Conservation and Attractions Priority 4, recorded during the current survey from four inactive mounds.

A further six avifauna species listed as Marine species under the *Environment Protection and Biodiversity Conservation Act 1999* were also recorded during the current survey. The Pilbara Olive Python (*Liasis olivaceus barroni;* Vulnerable under the *Biodiversity Conservation Act 2016* and the *Environment Protection and Biodiversity Conservation Act 1999*) was recorded in the Survey Area in 2023 and therefore is known to occur. Five other significant fauna species remain likely to occur in the Survey Area, while seven have a moderate likelihood of occurrence.

Species considered likely to occur in the Survey Area were:

- Bilby, Dalgyte (*Macrotis lagotis*) – Vulnerable under the *Biodiversity Conservation Act 2016* and the *Environment Protection and Biodiversity Conservation Act 1999*;
- Ghost Bat (*Macroderma gigas*) – Vulnerable under the *Biodiversity Conservation Act 2016* and the *Environment Protection and Biodiversity Conservation Act 1999*;
- Pacific Swift (*Apus pacificus*) – Migratory under the *Biodiversity Conservation Act 2016* and the *Environment Protection and Biodiversity Conservation Act 1999*;
- Grey Falcon (*Falco hypoleucos*) – Vulnerable under the *Biodiversity Conservation Act 2016* and the *Environment Protection and Biodiversity Conservation Act 1999*; and
- Peregrine Falcon (*Falco peregrinus*) – Other Specially Protected Fauna under the *Biodiversity Conservation Act 2016*.

Species considered to have a moderate likelihood of occurrence in the Survey Area were:

- Brush-tailed Mulgara (*Dasycercus blythi*) – Department of Biodiversity, Conservation and Attractions Priority 4;
- Short-tailed Mouse (*Leggadina lakedownensis*) – Department of Biodiversity, Conservation and Attractions Priority 4;
- Common Sandpiper (*Actitis hypoleucos*) – Migratory under the *Biodiversity Conservation Act 2016* and the *Environment Protection and Biodiversity Conservation Act 1999*;
- Oriental Plover (*Charadrius veredus*) – Migratory under the *Biodiversity Conservation Act 2016* and the *Environment Protection and Biodiversity Conservation Act 1999*;
- Oriental Pratincole (*Glareola maldivarum*) – Migratory under the *Biodiversity Conservation Act 2016* and the *Environment Protection and Biodiversity Conservation Act 1999*;
- Barn Swallow (*Hirundo rustica*) – Migratory under the *Biodiversity Conservation Act 2016* and the *Environment Protection and Biodiversity Conservation Act 1999*; and
- Glossy Ibis (*Plegadis falcinellus*) – Migratory under the *Biodiversity Conservation Act 2016* and the *Environment Protection and Biodiversity Conservation Act 1999*.

2.0 Introduction

2.1 Project Background

Mining commenced at the BHP Western Australian Iron Ore (BHP WAIO) Yarrie mine in 1993, with iron ore extracted from open cut pits and transported by rail to Port Hedland. Production at Yarrie was suspended in 2014 and the mine is currently in a suspended operations status with some areas undergoing rehabilitation activities.

BHP WAIO required a biological survey (flora, vegetation and vertebrate fauna) to be undertaken for a component of the Yarrie mine, specifically the Yarrie Southern Area (hereafter referred to as the Survey Area). The Survey Area encompasses approximately 358.7 ha and is located approximately 180 km east of Port Hedland in the northeastern Pilbara region of Western Australia (WA). The location of the Survey Area is presented in Figure 2.1. Much of the Survey Area comprises predominantly undisturbed native vegetation, with cleared and highly modified areas associated with the Yarrie mining areas localised in the northwest of the Survey Area. A small area of mine site rehabilitation also occurs in the northwest of the Survey Area.

2.2 Objectives of the Study

BHP WAIO commissioned Biota to complete a desktop study, a single-season detailed and targeted flora and vegetation survey and a single-season basic and targeted vertebrate fauna survey of the Survey Area consistent with relevant Environmental Protection Authority (EPA) guidance and policy. The overall objective of the study was to identify key biological values within the Survey Area. The results of this biological survey may be used to inform any future environmental approvals and/or rehabilitation works in the area.

The key elements of the current scope comprised:

1. Desktop study of the locality (i.e. a broader 40 km area, hereafter referred to as the Study Area) to identify flora and fauna values that may be associated with the Survey Area.
2. A detailed and targeted flora and vegetation survey, consistent with relevant EPA guidance (EPA 2016a) to:
    - Describe, photograph and map the dominant vegetation types of the Survey Area;
    - Assess and map the condition of vegetation within the Survey Area;
    - Identify any vegetation of significance, including potential Threatened Ecological Communities (TECs) or Priority Ecological Communities (PECs);
    - Compile a non-exhaustive list of vascular flora species;
    - Record and map populations of significant flora species within the Survey Area; and
    - Record populations of weeds, with a particular focus on species listed as Declared Pests under the WA *Biosecurity and Agriculture Management Act 2007* (the BAM Act), or those listed as Weeds of National Significance (WoNS).
3. A basic fauna survey consistent with EPA guidance (EPA 2020) to gather information on general fauna assemblages, and to assess and map fauna habitats within the Survey Area, particularly with regard to their potential to support significant species.
4. A targeted vertebrate fauna survey of the Survey Area for significant species that may be present, including but not be limited to the Northern Quoll (*Dasyurus hallucatus*), Ghost Bat (*Macroderma gigas*), Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*), Night Parrot (*Pezoporus occidentalis*), and Pilbara Olive Python (*Liasis olivaceus barroni*).
5. Reporting of all data from the survey in a technical flora, vegetation and fauna report.

2.3 Relevant State and Commonwealth Policy

This report has been prepared with consideration of relevant State and Commonwealth policy documents including:

- *Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016a);
- *Environmental Factor Guideline: Flora and Vegetation* (EPA 2016b);
- *Technical Guidance – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment* (EPA 2020);
- *Environmental Factor Guideline: Terrestrial Fauna* (EPA 2016c);
- *Survey Guidelines for Australia's Threatened Birds* (DEWHA 2010a);
- *Survey Guidelines for Australia's Threatened Mammals* (DSEWPaC 2011a);
- *Survey Guidelines for Australia's Threatened Reptiles* (DSEWPaC 2011b);
- *Survey Guidelines for Australia's Threatened Bats* (DEWHA 2010b); and
- *Guidelines for determining the likely presence and habitat usage of Night Parrot (Pezoporus occidentalis) in Western Australia* (DBCA 2024).

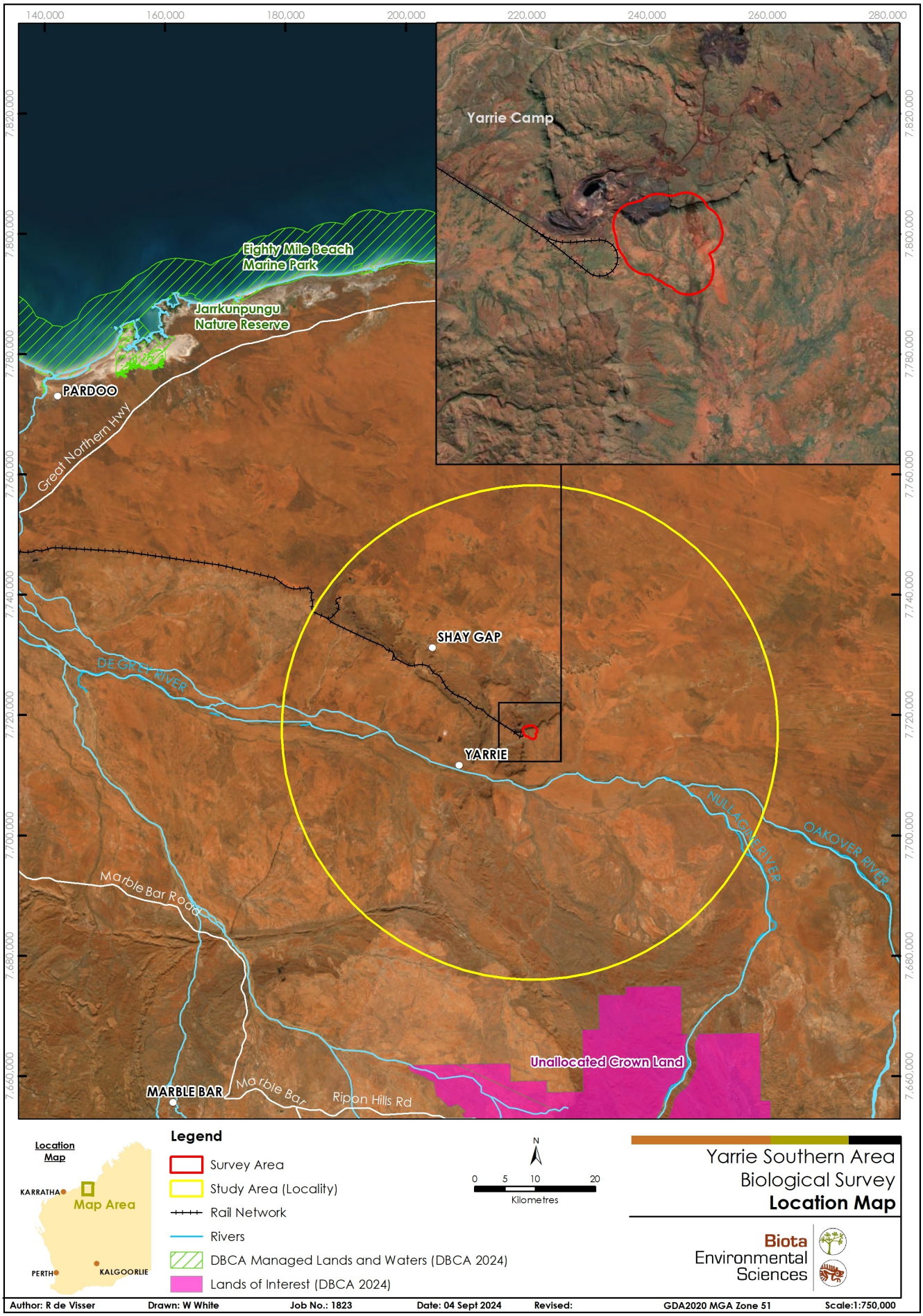


Figure 2.1: Location and extent of the Survey Area and Study Area.

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3.0 Methodology

3.1 Desktop Study

The aim of the initial desktop study was to compile and review information relevant to the Survey Area and locality, particularly to identify known features of significance (see Appendix 1 for definitions of significant species and communities). This enabled a preliminary assessment of potential key values relating to vegetation, flora and vertebrate fauna that may need to be considered during the field survey.

The desktop study incorporated the results of database searches (Section 3.1.1), as well as regional information and previous biological surveys completed in the locality (Section 3.1.2).

3.1.1 Database Searches

The following databases were searched to assist in the determination of vegetation, flora and fauna of significance relevant to the Survey Area:

1. The NatureMap database: this joint project of the DBCA and the WA Museum was the most comprehensive source of information regarding WA's flora and fauna before it was taken offline in December 2021. It comprised information from the DBCA Fauna Survey Returns database, the WA Threatened Flora and Fauna Databases, the WA Herbarium and WA Museum Specimen databases, and the BirdLife Australia Atlas. While NatureMap is no longer publicly available, data from a 40 km buffer of the Survey Area was provided upon request through DBCA; this did not include location information for individual records.
2. The Commonwealth EPBC Act Protected Matters Search Tool (PMST) was used to identify flora and fauna species and other matters of national environmental significance (MNES) that may occur in the locality. A search was completed for a buffer of 40 km radius around the Survey Area.
3. Atlas of Living Australia (ALA)[1] is a joint project between academic collecting institutions, private individual collectors, and community groups, hosted by the Commonwealth Scientific and Industrial Research Organisation (CSIRO). It contains occurrence records, environmental data and images, and provides the conservation status of species throughout Australia. The ALA search was completed for a 40 km radius around the Survey Area.
4. Specific searches of the DBCA Threatened and Priority Flora Database and Threatened and Priority Fauna Database were commissioned to identify the significant flora and fauna species known from within 40 km of the Survey Area.
5. The DBCA database of TECs, PECs and Environmentally Sensitive Areas (ESAs) was searched to identify significant communities known to occur within 40 km.
6. The Index of Biodiversity Surveys for Assessments (IBSA): this database consolidates data from land-based biodiversity surveys conducted to support EIA and compliance required under the *Environmental Protection Act 1986,* and provides a publicly available online platform for data sharing (where agreed by the proponent). IBSA was searched for previous surveys within a 40 km radius of the Survey Area.
7. eBird[2] is a citizen science database of bird records from around the globe, managed by Cornell University and moderated by local experts.
8. Biota's internal database of past surveys was also searched for relevant records.

Individual outputs from the various database searches can be provided on request. Results are summarised in Appendix 2 and discussed in Section 4.7.

[1] http://www.ala.org.au

[2] https://ebird.org/

3.1.2 Literature and Spatial Data Review

Published and unpublished reports relevant to the Survey Area were reviewed. Several regional-scale reports and data sets were examined, as well as bioregional data, land systems, soils and geology (see Sections 4.1 to 4.3).

Results and methodologies of the following 11 biological surveys in the locality were also reviewed as part of the desktop study (Section 4.7):

- Nimingarra, Shay Gap and Sunrise Hill Vertebrate Fauna Interim Summary Report (ENV Australia 2011);
- Callawa Level 2 Vertebrate Fauna Assessment (Eco Logical 2012);
- Callawa West Flora, Vegetation and Fauna Assessment (Onshore Environmental 2013a);
- Cundaline Northern Ridge Flora, Vegetation and Fauna Assessment (Onshore Environmental 2013b);
- Yarrie Level 2 Flora and Vegetation and Level 1 Fauna Survey (Astron 2013);
- Callawa West Vertebrate Fauna Survey (Biologic 2014a);
- Cattle Gorge Targeted Vertebrate Fauna Survey (Biologic 2014b);
- Yarrie 2022 Significant Species Monitoring (Biologic 2022a);
- Cattle Gorge and Callawa West 2020 Significant Species and Rehabilitation Monitoring (Biologic 2022b);
- Yarrie 2021 Significant Species Monitoring (Biologic 2023); and
- Yarrie Pilbara Olive Python Monitoring 2023 (Biota unpubl. data, 2023).

3.2 Assessment of Likelihood of Occurrence

Significant species identified in the desktop study were assessed for their likelihood of occurrence in the Survey Area, both prior to and following the survey. This assessment was based on the proximity of previous records to the Survey Area, knowledge of the habitat preferences of each taxon, an assessment of the habitats present within the Survey Area, and any records obtained during the field survey.

The guidelines used to assess likelihood of occurrence are outlined in Table 3.1, with the assessments for flora and fauna provided in Appendix 3 and Appendix 4 respectively. For the purposes of this report, the term "proximity" is defined as being within 20 km of the Survey Area, while the "locality" comprises the area up to 40 km from the Survey Area.

Table 3.1: Guidelines used to assess the likelihood of occurrence of significant flora and fauna.

Likelihood	Guideline
Recorded	1. The species was recorded during the field survey or has been previously recorded in the Survey Area.
Likely to occur or "High"	1. There are existing records of the species within 20 km of the Survey Area; and • the species is strongly linked to a specific habitat, which is present in the Survey Area; or • the species has more general habitat preferences, and suitable habitat is present.
May occur or "Moderate"	1. There are existing records of the species within 40 km of the Survey Area, however • the species is strongly linked to a specific habitat, of which only a small amount is present in the Survey Area; or • the species has more general habitat preferences, but only some suitable habitat is present in the Survey Area. 2. There is suitable habitat in the Survey Area, but the species is recorded infrequently in the locality.
Unlikely to occur or "Low"	1. The species is linked to a specific habitat, which is absent in the Survey Area; or 2. Suitable habitat is present, however there are no existing records of the species from within 40 km of the Survey Area despite reasonable previous search effort in suitable habitat; or 3. There is some suitable habitat in the Survey Area, however the species is very infrequently recorded in the locality or the only records are historical (>40 years ago).
Would not occur	1. The species is strongly linked to a specific habitat, which is absent from the Survey Area; and/or 2. The species' range is very restricted and does not include the Survey Area.

3.3 Field Survey

3.3.1 Survey Team, Timing and Conditions

The survey was conducted between the 6th and 10th May 2024, by Principal Botanist Chloe Flaherty and Senior Zoologist Joshua Keen (both of Biota). A summary of the field team members and their experience is provided in Table 3.2. The survey was completed under a DBCA 'Flora Taking (Biological Assessment) Licence' (FB62000167-2) and 'Authorisation to Take or Disturb Threatened Species License' (TFA 2324-0276). A Regulation 27 'Fauna taking (biological assessment)' licence (BA27001068) and Section 40 'Authorisation to take or disturb threatened species' (TFA 2324-0276) were also obtained, both held by Joshua Keen.

Table 3.2: Survey team, qualifications, and experience.

Name	Position at Biota	Survey Role	Qualification	Years of Experience
Joshua Keen	Senior Zoologist	Fauna (project manager, S26 supervisor and fauna field leader)	BSc. (Zool), Hons.	9
Chloe Flaherty	Principal Botanist	Flora (project manager and flora field leader)	BSc. (NRM), Hons.	14

Weather data were obtained from the Bureau of Meteorology weather stations at Yarrie (no. 4046; 13 km southwest of Survey Area) and at Marble Bar (no. 4106; 85 km southwest of Survey Area) for the year preceding the survey (Bureau of Meteorology 2024). Long-term data were obtained from these stations for comparison with the data preceding the survey (Figure 3.1).

Maximum and minimum temperatures were generally consistent with long-term trends, however mean maximum temperatures between August 2023 and February 2024 were slightly higher than the long-term medians for the same months.

Rainfall in the six months preceding the survey (136.7 mm) was lower than the long-term median for the same months (176.2 mm). In the months leading up to the survey, February 2024 was notably dry (4.0 mm), despite usually being the wettest month of the wet season (long-term median 65.9 mm). Just over half the long-term median rainfall was received in the three months preceding the survey (56.4 mm, compared to the long-term median for the same period of 99.8 mm) (Figure 3.1). The last rainfall event before the survey was on 10th April 2024; this was 25 days preceding the start of the survey, and only 1.2 mm was received. As a result of the low rainfall, on-ground conditions during the survey were dry, and few annual flora species were recorded.

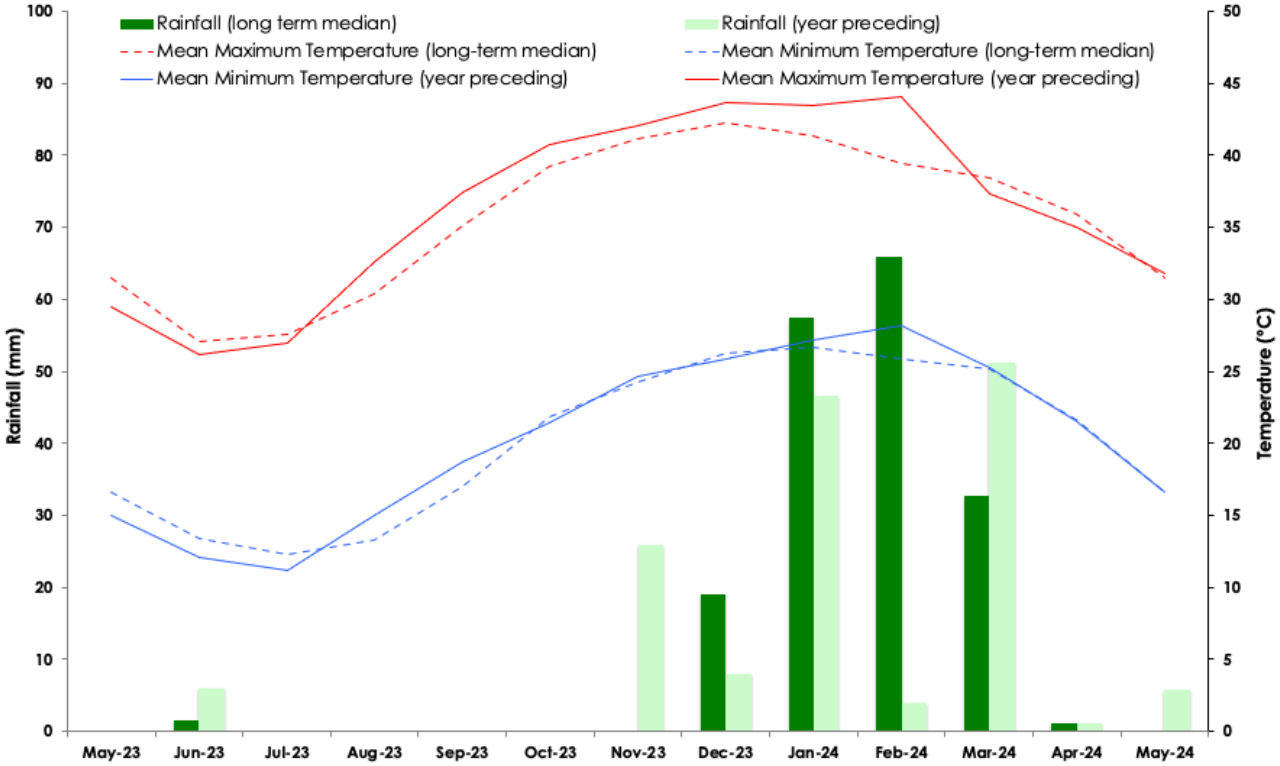


Figure 3.1: Climate and weather graph depicting long-term medians and 2023/2024 data.

All data from the Bureau of Meteorology. Rainfall data from Yarrie weather station (#4046) for1898-2024 (except Apr-May 2024 and Jul-Oct 2023, for which Marble Bar weather station (#4106) was used). Temperature data from Marble Bar (#4106) for 2001-2024.

3.3.2 Flora and Vegetation Survey

The methodology for the detailed and targeted flora and vegetation survey was consistent with relevant technical documents (see Section 2.3).

3.3.2.1 Floristic Data Collection: Assessment of Quadrats and Relevés

Indicative sites were selected prior to the field survey, based on the broad habitats and vegetation types apparent from aerial imagery. Once in the field, the actual locations of the sites were adjusted as necessary (e.g., to be placed in an area more representative of the broader vegetation type).

Sampling sites were established as either:

- Quadrats: bounded floristic sampling site. The standard for the Pilbara bioregion comprises a 50 m x 50 m square (or a modified shape with an equivalent area). Quadrats were measured out using an optical square and measuring tapes; or
- Relevés: unbounded floristic sampling sites with a similar search area to a quadrat. Relevés were used where the target vegetation area was too small or too narrow to effectively

establish a quadrat, or where the Survey Area boundary restricted the site to very narrow dimensions.

The following parameters were recorded for all quadrats and relevés:

1. Location coordinates (±1.5 m) were recorded using a hand-held Global Positioning System (GPS) unit; coordinates were recorded for all four corners of a quadrat. A central point was recorded as a minimum for a relevé, with a start and end point recorded for relevés that were undertaken in linear habitats;
2. Habitat: A description of the landform and habitat;
3. Soil: A broad description of the soil and any stony surface mantle;
4. Fire History: An estimate of time since last fire;
5. Disturbance Details: Vegetation condition was ranked according to the scale from BHP WAIO's Vegetation and Flora Survey Procedure (no. 0124627; BHP Iron Ore undated); this considers evidence of grazing, physical disturbance, weed invasion etc.;
6. Flora Species: The estimated percentage of foliar cover of each flora species present within the quadrat, or in the vicinity of the relevé (if not a linear site, then within a ~50 m radius of the centre point); and
7. Photograph: A representative digital photograph of the vegetation was taken, typically from the north or northwest corner of a quadrat or the central point of a relevé.

Ten quadrats and five relevés were completed in the Survey Area. Locations of the sampling sites are shown in Figure 3.2, while a summary of the raw data from the sites is provided in Appendix 5.

3.3.2.2 Vegetation Description and Mapping

The vegetation types for this study were described at the association level (level V as per the National Vegetation Information System; NVIS)[3].

Vegetation types and boundaries were subsequently verified using both the data collected in the field and digital imagery. The vegetation associations mapped for this assessment were given a unique code as per BHP WAIO's Vegetation and Flora Survey Procedure (no. 0124627; BHP Iron Ore undated).

Vegetation condition mapping was also prepared using the categories from BHP WAIO's Vegetation and Flora Survey Procedure (no. 0124627; BHP Iron Ore undated).

Vegetation maps were created and consolidated using Geographical Information System (GIS) software (QGIS and MapInfo Professional). All maps in this report were produced by Will White (Senior GIS Cartographer at Biota) or Melissa Robinson (Principal GIS Cartographer at Biota).

3.3.2.3 Searches for Significant Flora and Weeds

The desktop study identified a subset of the significant flora (i.e. Threatened and Priority listed species) known from the locality that were considered to have some potential to occur in the Survey Area (see Section 4.8.2 and Appendix 3). Targeted searches for these species were conducted on foot throughout the Survey Area in any areas of prospective habitat. Locations of introduced flora species (weeds) were also recorded during the foot traverses, along with an estimate of their population size. These searches focused on weeds of management concern; i.e. Declared Plants under the BAM Act and WoNS. Other weed species were recorded opportunistically, but no attempt was made to fully document their extent.

Survey effort is shown in Figure 3.2.

3.3.2.4 Opportunistic Records

Opportunistic records of flora species were also made for the Survey Area to supplement the species recorded at sites. These records were made during the foot traverses undertaken enroute to flora sampling sites, during vegetation mapping traverses, and during targeted flora traverses.

[3] http://www.environment.gov.au/land/publications/nvis-taxonomic-review/introduction#del

3.3.2.5 Flora Specimen Identification, Nomenclature, and Data Entry

Flora species were identified either in the field, or in the office following the field survey. If a species was common and well known to the survey botanist, the identification was confirmed and recorded in the field. If the species was difficult to determine without microscopic examination, belonged to a recognised species complex, or was poorly collected or otherwise unusual, a sample specimen was collected. Specimens were pressed in the field, and then dried for further study and confirmation.

Sample specimens were identified using flora keys, reference to appropriate publications, voucher reference collections and comparison to the collections held at the WA Herbarium. Principal Botanist Chloe Flaherty identified most specimens, which were then confirmed by Principal Botanist Michi Maier (of Biota). A small number of identifications were confirmed by consultant taxonomist Pierre-Louis de Kock (Principal of dK Botanical).

All data were entered into a Microsoft Access Vegetation Database structure held internally at Biota. The database structure employed by Biota was developed by Ted Griffin (private consultant) at the request of Malcolm Trudgen (M.E. Trudgen and Associates). Nomenclature and significance rankings used in this report are in accordance with the current listing of WA flora recognised by the WA Herbarium, as listed on Florabase[4] at the time of reporting.

3.3.2.6 Floristic Analysis

Hierarchical clustering analyses were conducted in PRIMER v7 (Clarke and Gorley 2015) to investigate the similarity of sampling sites based on their floristic composition. The 10 quadrats and five relevés sampled within the Survey Area were included in the input data set[5]. For this data set:

- Taxa that were only identified to genus level were excluded, as these could refer to multiple entities.
- Taxa were referred to a single entity where considered appropriate (e.g. *Bonamia pilbarensis* (Port Hedland form; densely indumented) was included under *Bonamia pilbarensis*).
- All singleton taxa (those occurring in only one site) were excluded, to reduce 'noise' in the data set.
- All weed species were omitted except for **Cenchrus* spp. as these taxa were dominant in some sampling sites.

The analysis was run using both percent cover (square-root transformed) and presence-absence data. The Bray-Curtis measure of similarity was used to produce a similarity matrix, and the group average method cluster analysis was used to determine floristic groups. Statistically different groups were identified through similarity profile analysis (SIMPROF). The similarity percentage test (SIMPER) was used to determine which species contributed most to the similarities between groups. Analyses were run using all species (perennial and annual).

Results of the analyses were investigated through outputs including dendrograms (tree diagrams) of site similarity, and Non-metric Multi-Dimensional Scaling plots (NMDS plots).

3.3.2.7 Species Accumulation Analysis

Plots of species accumulation curves can be used to assess sampling adequacy: when a survey has sampled an adequate proportion of the floristic assemblage, the curve should plateau and approach an asymptote. EstimateS (Colwell 2013) was used to calculate smoothed species accumulation curves based on 100 random permutations of the species data. Only quadrat and

4 http://florabase.dbca.wa.gov.au

5 The analysis was also re-run without quadrat YSA-01 (which was recovering from fire), however it was determined that the exclusion of this site from the analysis was not warranted, given that it was similar enough floristically that it formed a cluster with an unburnt site.

relevé data were used (opportunistic records were excluded), and the sampling sites were randomly assigned an order.

Species accumulation curves alone cannot be reliably used to extrapolate predicted species richness for future biological sampling. To estimate asymptotic richness (i.e. an extrapolation of species richness) for the incidence data (i.e. presence, rather than abundance data), the Chao 2 Mean and ICE Mean estimators were calculated using EstimateS.

3.3.3 Fauna Survey

The methodology for the basic and targeted vertebrate field survey was consistent with relevant technical documents (see Section 2.3). The following sections provide details for each survey technique.

3.3.3.1 Fauna Habitat Assessment and Targeted Searches

A preliminary review of the fauna habitats present in the Survey Area was conducted by examination of aerial photography and thematic layers including land systems (Section 4.2), geology and soils (Section 4.3), and Beard's vegetation mapping (Section 4.4). Ground-truthing of preliminary fauna habitat mapping was conducted in the field while driving and traversing on foot through the Survey Area.

Habitat descriptions comprised soil type, landform, any notable microhabitats present, any disturbance (e.g. fire, weeds, grazing, evidence of introduced fauna), broad vegetation characteristics and representative photographs. These descriptions were recorded at each flora relevé, as well as at motion camera, acoustic, and ultrasonic recorder locations. This information was then used to develop the fauna habitat profiles.

Targeted searches were undertaken for significant fauna species assessed during the desktop study as potentially occurring in the Survey Area; specifically, the Bilby (*Macrotis lagotis*), Northern Quoll (*Dasyurus hallucatus*), Pilbara Olive Python (*Liasis olivaceus barroni*), Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia* Pilbara form), and Ghost Bat (*Macroderma gigas*). The Night Parrot (*Pezoporus occidentalis*) was considered unlikely to occur, but survey effort was undertaken for the species as a precautionary approach.

Opportunistic observations of any potential significant species were also recorded (in the form of individuals, tracks, scats, diggings or remains).

3.3.3.2 Motion Cameras

Motion cameras with scent lures were deployed at five locations within the Survey Area, primarily targeting Northern Quolls (*Dasyurus hallucatus*) in and around the higher, rocky spinifex grassland areas and along drainage lines (travel/foraging routes). The total survey effort amounted to 16 camera-nights. Motion camera survey locations and effort are summarised in Table 3.3 and mapped in Figure 3.2, with site pictures provided in Plate 3.1 to Plate 3.5.

Table 3.3: Motion camera locations and effort.

Site Name	Latitude	Longitude	Landform	Date Deployed	Date Collected	Effort (nights)
YSA-01MC	-20.6203	120.3127	Hillslope	6/5/2024	10/5/2024	4
YSA-02MC	-20.6188	120.3167	Minor drainage line	6/5/2024	10/5/2024	4
YSA-03MC	-20.6306	120.325	Stony plain	7/5/2024	10/5/2024	3
YSA-04MC	-20.6301	120.3226	Minor drainage line	7/5/2024	10/5/2024	3
YSA-05MC	-20.6275	120.3199	Minor drainage line	8/5/2024	10/5/2024	2
					Total	**16**



Plate 3.1: Motion camera site YSA-01MC.



Plate 3.2: Motion camera site YSA-02MC.



Plate 3.3: Motion camera site YSA-03MC.



Plate 3.4: Motion camera site YSA-04MC.



Plate 3.5: Motion camera site YSA-05MC.

3.3.3.3 Ultrasonic Sound Recorders

SongMeter4Bat (Wildlife Acoustics) automated ultrasonic sound recorders were deployed at four locations within the Survey Area to target significant bat species, particularly the Ghost Bat and Pilbara Leaf-nosed Bat. Ultrasonic sound recorder locations and effort are summarised in Table 3.4 and mapped in Figure 3.2, with site pictures provided in Plate 3.6 to Plate 3.9.

Table 3.4: Ultrasonic bat recorder locations and effort.

Site Name	Latitude	Longitude	Landform	Date Deployed	Date Collected	Effort (nights)
YSA-01BAT	-20.6207	120.3131	Minor drainage line	6/5/2024	8/5/2024	2
YSA-02BAT	-20.6190	120.3166	Minor drainage line	6/5/2024	8/5/2024	2
YSA-03BAT	-20.6275	120.3198	Minor drainage line	8/5/2024	10/5/2024	2
YSA-04BAT	-20.6335	120.3236	Minor drainage line	8/5/2024	10/5/2024	2
					Total	**8**



Plate 3.6: Bat recorder site YSA-01BAT.



Plate 3.7: Bat recorder site YSA-02BAT.



Plate 3.8: Bat recorder site YSA-03BAT.



Plate 3.9: Bat recorder site YSA-04BAT.

3.3.3.4 Acoustic Sound Recorder

Song Meter SM4 and SongMeter Mini Bat (Wildlife Acoustics) automated acoustic sound recorders were deployed at four locations within the Survey Area to target Night Parrot (*Pezoporus occidentalis*). These devices were programmed to record continuously during two periods: the first period commenced two hours prior to sunrise and concluded 30 minutes post-sunrise, while the second period began 30 minutes preceding sunset and extended for two hours thereafter. Current Night Parrot survey guidelines recommend ARUs be set to record from 25 minutes after

sunset continuously until 25 minutes before sunrise (DBCA 2024). However, the approach used in the present study has been adapted to enhance the likelihood of detecting the Night Parrot while minimizing false positives in the subsequent analysis. Audible-range sound recorder locations and effort are summarised in Table 3.5 and mapped in Figure 3.2. Night Parrots are known to roost within areas containing large spinifex hummocks (DBCA 2024), therefore deployment of the recorders targeted the largest *Triodia* hummocks within the Survey Area. Site pictures are provided in Plate 3.10 to Plate 3.13. The survey guidelines for Night Parrot prescribe a minimum of six nights of continuous acoustic recording (DBCA 2024), however due to the relatively low quality habitat for the species present within the Survey Area, fewer nights of acoustic recording were conducted and therefore not considered a notable constraint.

Audio files were analysed by John Graff (Senior Zoologist at Biota) using Kaleidoscope Pro software (version 5.5.2). The spectrogram recogniser was developed using the calls of Night Parrots recorded in Western Australian (available at https://nightparrot.com.au/index.php/resources/night-parrot-calls). Potential matches were then assessed by inspecting the spectra and listening to the recordings. Incidental bird calls from other species recorded are presented in Section 6.3 in the list of opportunistic species detected during the survey.

Table 3.5: Audible-range recorder unit locations and effort.

Site Name	Latitude	Longitude	Landform	Date Deployed	Date Collected	Effort (nights)
YSA-01NP	-20.6211	120.3137	Sand Plain	6/5/2024	10/5/2024	4
YSA-02NP	-20.6213	120.3201	Stony Plain	6/5/2024	10/5/2024	4
YSA-03NP	-20.6306	120.3251	Stony Plain	7/5/2024	10/5/2024	3
YSA-04NP	-20.6294	120.3191	Stony Plain	7/5/2024	10/5/2024	3
					Total	**14**



Plate 3.10: Audible-range recorder YSA-01NP.



Plate 3.11: Audible-range recorder YSA-02NP.



Plate 3.12: Audible-range recorder YSA-03NP.



Plate 3.13: Audible-range recorder YSA-04NP.

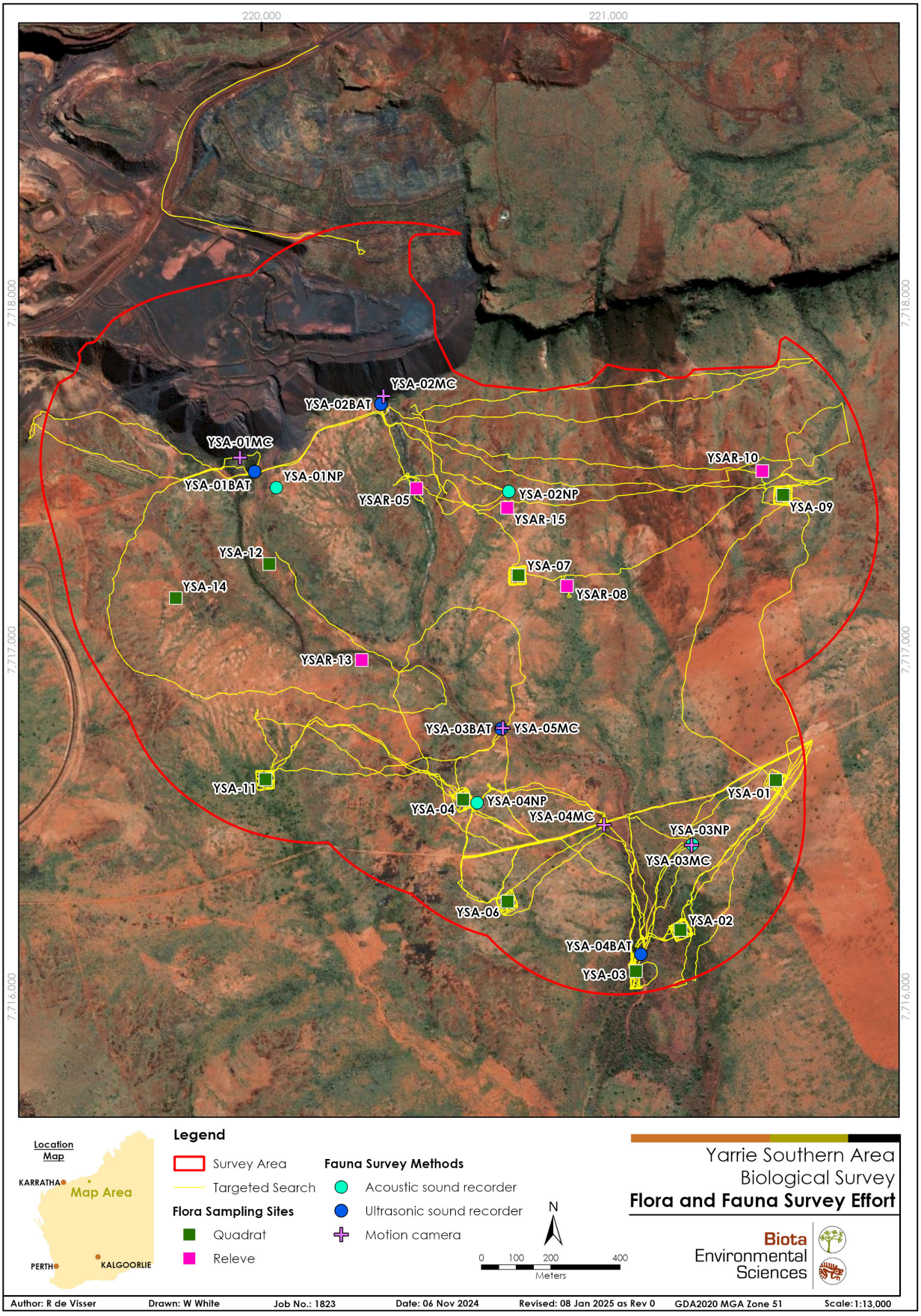


Figure 3.2: Vegetation, flora and fauna survey effort.

3.4 Limitations of the Study

The field survey provided an adequate representation of the vegetation, flora, and fauna values of the Survey Area. However, there are limitations to this study that must be considered when reviewing the results detailed in this report. As per the relevant EPA Technical Guidance Statements (EPA 2016a, 2020), potential constraints and consequent limitations of this study are summarised in Table 3.6.

Table 3.6: Assessment of potential limitations for this study.

Potential Limitation	Assessment
1. Availability of contextual information at a regional and local scale	Numerous biological surveys have been completed near the Survey Area, including several in the last 10 years. Databases of information relating to significant species and communities were also searched. Contextual information was not a limiting factor for this study.
2. Competency/ experience of the team carrying out the survey, including experience in the bioregion surveyed	Both field team members were suitably qualified to fulfill their role in the survey. Senior Zoologist Joshua Keen has nine years of zoological surveying experience, including six years of experience in the Pilbara bioregion. Principal Botanist Chloe Flaherty has 14 years of experience conducting botanical surveys in the Pilbara bioregion. Numerous plant specimens were collected, and these were confirmed by Principal botanists Michi Maier (Biota), who has over 30 years of experience, and specialist taxonomist Pierre-Louis de Kock (dK Botanical), who has 15 years of experience. There were no limitations due to experience of personnel.
3. Proportion of flora recorded and/or collected, any identification issues	All vascular flora encountered in the Survey Area were recorded. The dry survey conditions meant fewer than expected annual species were recorded. Although dry, most (94%) of the flora specimens collected during the field survey were of sufficient quality to be fully determined to the lowest relevant taxonomic level. Fungi and non-vascular flora (algae, mosses and liverworts) were not systematically surveyed, which is consistent with the accepted level of effort for a survey of this type and scale. The proportion of flora recorded was considered to be a minor limitation.
4. Appropriate area fully surveyed (effort and extent)	The scope of the study was to complete a detailed and targeted flora survey, and a basic and targeted fauna survey (terms as described in EPA 2016a, 2020). A considerable portion of the Survey Area was traversed on foot, with traverses intersecting all native vegetation types and habitats present. The minimum replication of three sites per vegetation type was reached for all vegetation types except for SA Aanc Te Ch Ast, which was restricted to a small area in the Survey Area (9.5 ha, 2.6% of the Survey Area). The Survey Area is considered to have been adequately assessed; however, the number of nights that acoustic recorders were deployed fell below the recommended guidance for Night Parrot surveys (DBCA 2024). Additionally, the audio recording schedule differed from the recommended approach to enhance the likelihood of detecting the Night Parrot while minimizing false positives in the subsequent analysis. This is not regarded as a significant constraint, as a pre-survey desktop assessment determined the likelihood of Night Parrot occurrence to be low. Additionally, the on-ground habitat assessment during the survey confirmed the habitat as low-quality for the species, further supporting this conclusion.
5. Access restrictions within the Survey Area	All vegetated parts of the Survey Area were accessible and there were no access restrictions. Access was not a limitation.

Potential Limitation	Assessment
6. Survey timing, rainfall, season of survey	The survey was completed in May 2024, which is within the recommended timing for primary surveys in the Pilbara. However, lower than usual rainfall in the months preceding the survey may have impacted the presence of some annual or cryptic perennial species. The drier conditions may have impacted the detectability of one of the nine significant flora species identified in the desktop study as having potential to occur in the Survey Area, *Euphorbia clementii* (P3) (see Section 5.2). Rainfall prior to the survey is therefore considered a minor limitation for the study.
7. Disturbance that may have affected the results of survey such as fire, flood or clearing	Approximately 12.4% of the Survey Area, predominantly in the northwest corner, has been cleared as part of the Yarrie mine. In addition, 1.5% of the Survey Area comprised rehabilitated vegetation on the former mine slope. Some sections in the east of the Survey Area were also subject to a recent fire. However, there was sufficient intact vegetation throughout the remainder of the Survey Area to define the intact vegetation types adequately. Disturbance to vegetation is not considered to be a limitation.

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4.0 Desktop Study

4.1 IBRA Bioregion and Subregion

The Interim Biogeographic Regionalisation for Australia (IBRA) recognises 89 bioregions and 419 biological subregions for Australia (DCCEEW 2024a). The Survey Area lies within the Pilbara bioregion, which is a major centre for biodiversity within Western Australia, and within the Chichester subregion. The Chichester subregion (PIL1) is 9,044,560 ha and is described as:

> "*Undulating Archaean granite and basalt plains include significant areas of basaltic ranges. Plains support a shrub steppe characterised by Acacia inaequilatera over Triodia wiseana (formerly Triodia pungens) hummock grasslands, while Eucalyptus leucophloia tree steppes occur on ranges. The climate is semi-desert-tropical and received 300 mm of rainfall annually. Drainage occurs to the north via numerous rivers (e.g. De Grey, Oakover, Nullagine, Shaw, Yale, Sherlock)*" (Kendrick and McKenzie 2003).

4.2 Land Systems

Land systems are composed of repeating patterns of topography, soils and vegetation, which are described as a series of land units (Christian and Stewart 1953). A total of 105 land systems were identified and mapped in the Pilbara bioregion by the then Department of Agriculture. Land systems mapping covering the Survey Area was prepared by van Vreeswyk et al. (2004).

The Survey Area intersects four land systems, with the Boolgeeda land system covering over half (Table 4.1, Figure 4.1). The extent of each land system in the Survey Area is minimal, representing <0.1% of their respective extents within the Pilbara.

Table 4.1: Land systems intersected by the Survey Area.

Land System	Description	Extent of Land System in the Pilbara Bioregion (ha)	Extent in the Survey Area		Extent in Survey Area as a Proportion of the Pilbara Bioregion (%)
			Area (ha)	Proportion (%)	
Boolgeeda (RGEBGD)	Stony lower slopes and plains below hill systems supporting hard and soft spinifex grasslands or mulga shrublands.	961,636.9	199.9	55.7	0.02
Macroy (RGEMAC)	Stony plains and occasional tor fields based on granite supporting hard and soft spinifex grasslands.	1,331,609.9	129.7	36.2	0.003
Capricorn (RGECPN)	Hills and ridges of sandstone and dolomite supporting low shrublands or shrubby spinifex grasslands.	698,525.6	16.9	4.7	0.002
Mallina (RGEMAL)	Sandy surfaced alluvial plains supporting soft spinifex (and occasionally hard spinifex) grasslands.	335,753.2	12.2	3.4	0.003

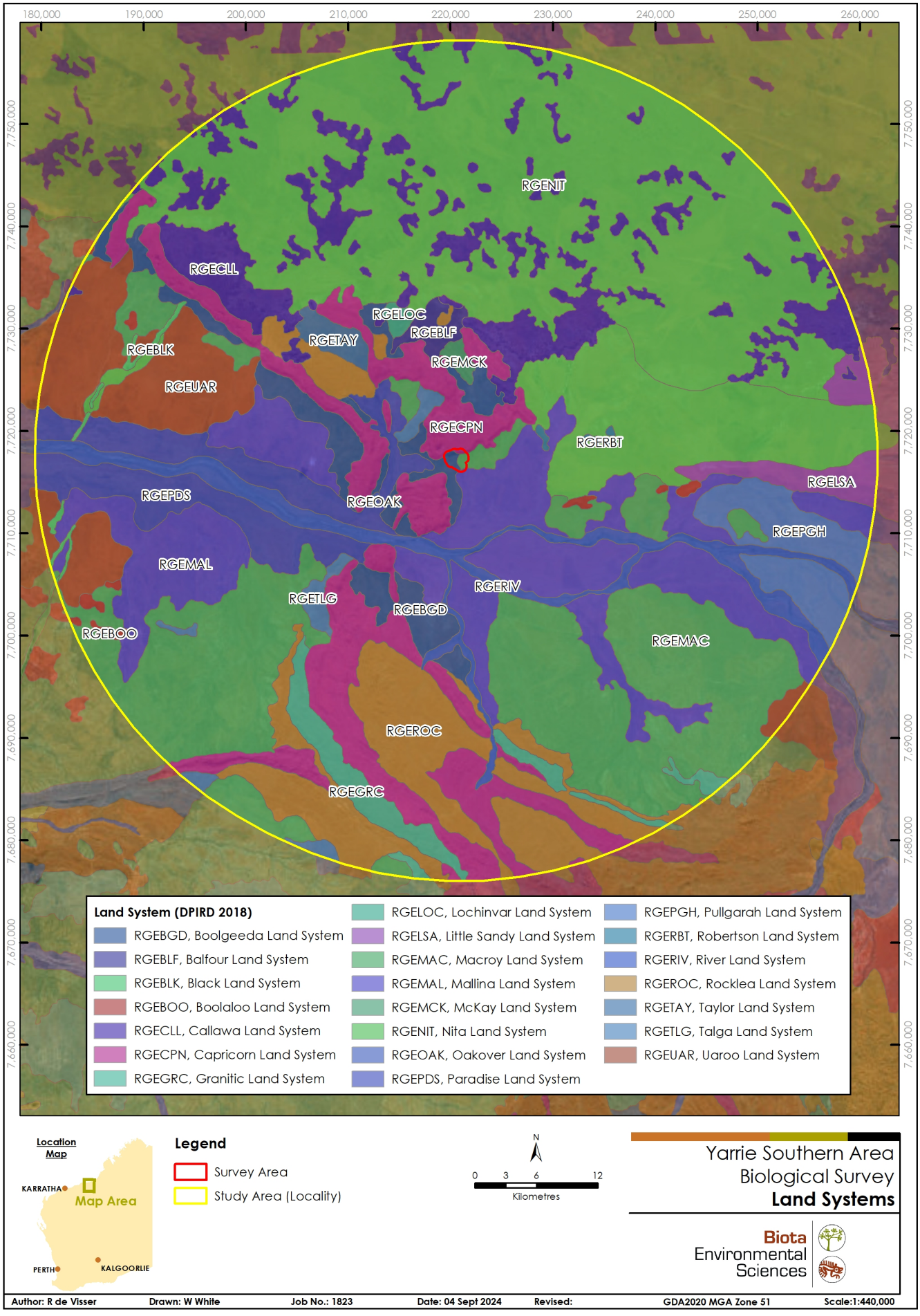


Figure 4.1: **Land systems of the Survey Area and surrounds.**
Digital dataset used from DPIRD (2018a).

4.3 Geology and Soils

Surface geology mapping has been compiled for the locality area at a scale of 1:1,000,000 based on geological maps published by Geoscience Australia (2008) and the Geological Survey of Western Australia (2011). The Survey Area is underlain by three soil units, primarily by the Agu (Emu Pool Supersuite) unit (Table 4.2, Figure 4.2).

Table 4.2: Geological units occurring in the Survey Area.

Map Symbol (Unit Name)	Description	Extent within Survey Area	
		Area (ha)	Proportion (%)
Agu (Emu Pool Supersuite)	Undivided and un-named intrusions in the Emu Pool Supersuite; Monzogranite, horneblende-biotite monzogranite, syenogranite, tonalite, granodiorite, mafic tornalite, quartz diorite.	297.7	83.0
Acg (Gorge Creek Group)	Chert, ferruginous chert, banded iron formation, jaspilite, minor siltstone, shale, sandstone, pebbly sandstone, quartzite, polymictic conglomerate, felsic volcaniclastic rock, basalt, ultramafic schist, mafic schist.	52.0	14.5
Qrc (Colluvium)	Colluvium, sheetwash, talus; gravel piedmonts and aprons over and around bedrock; clay-silt-sand with sheet and nodular kankar; alluvial and aeolian sand-silt-gravel in depressions and broad valleys in Canning Basin; local calcrete, reworked laterite	9.0	2.5

Soil landscapes comprising a number of soil units were mapped by Northcote et al. (1960) to provide consistent descriptions of Australia's soils. The Survey Area intersects two soil units. The primary unit, My54, consists of undulating plains with scattered rock outcrops and covers over 90% of the Survey Area (Table 4.3; Figure 4.3).

Table 4.3: Soil units occurring in the Survey Area.

Map Symbol / Unit Name	Description	Extent within Survey Area	
		Area (ha)	Proportion (%)
My54	Broad very gently undulating plains with scattered rock outcrops occurring as mesas: chief soils are neutral and acid red earths (Gn2.12, Gn2.11) with some hard red soils (Dr) occurring on pediments of unit Oc61.	326.1	90.9
Fa30	Ranges on metamorphosed sandstones, dolomites, jaspilites, and lavas with extensive rock exposures; soils are shallow and stony: chief soils are shallow stony earthy loams (Um5.51) together with some (Uc5.11) soils.	32.6	9.1

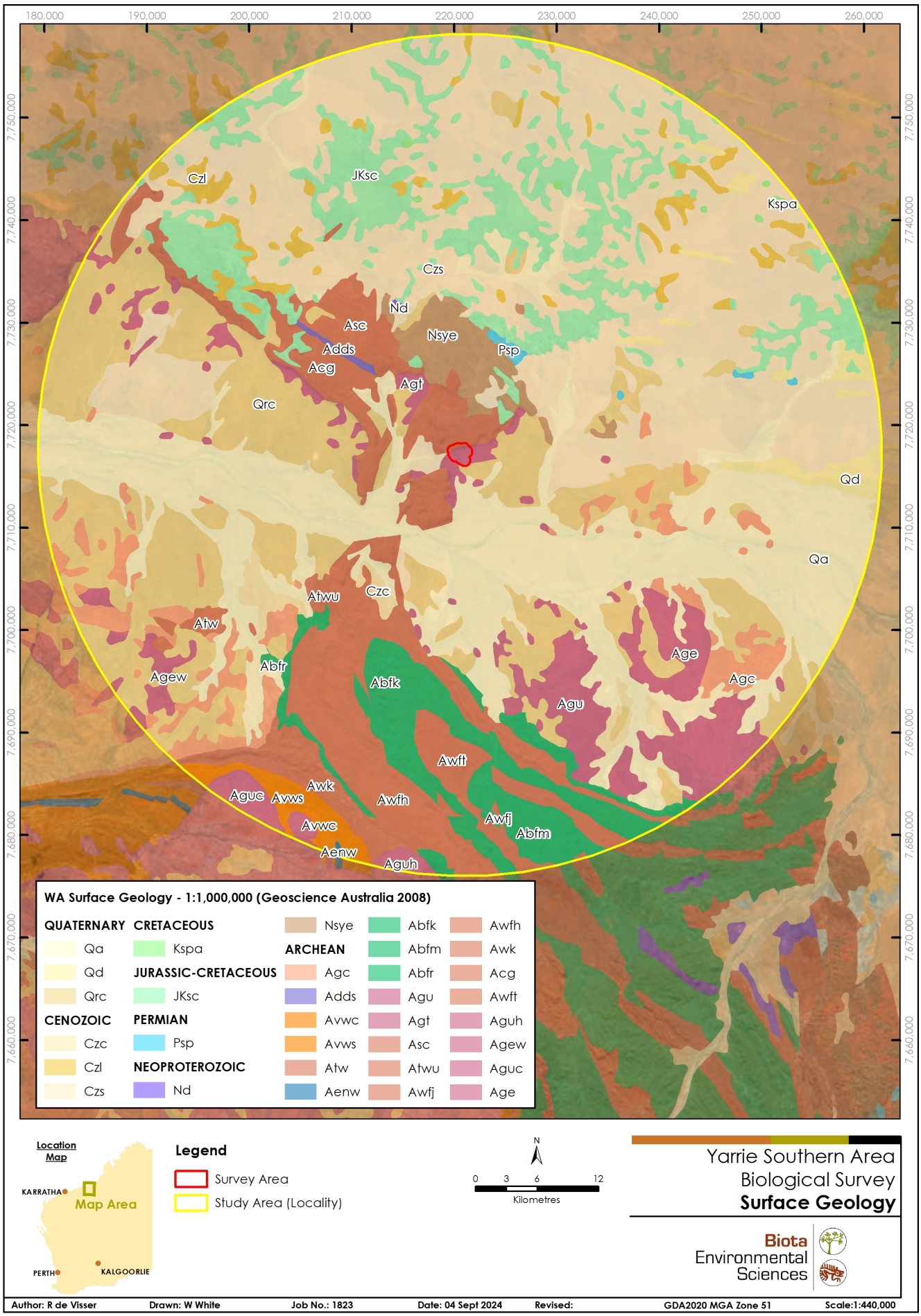


Figure 4.2: Geology of the Survey Area and surrounds.

Digital dataset used from Geoscience Australia (2008).

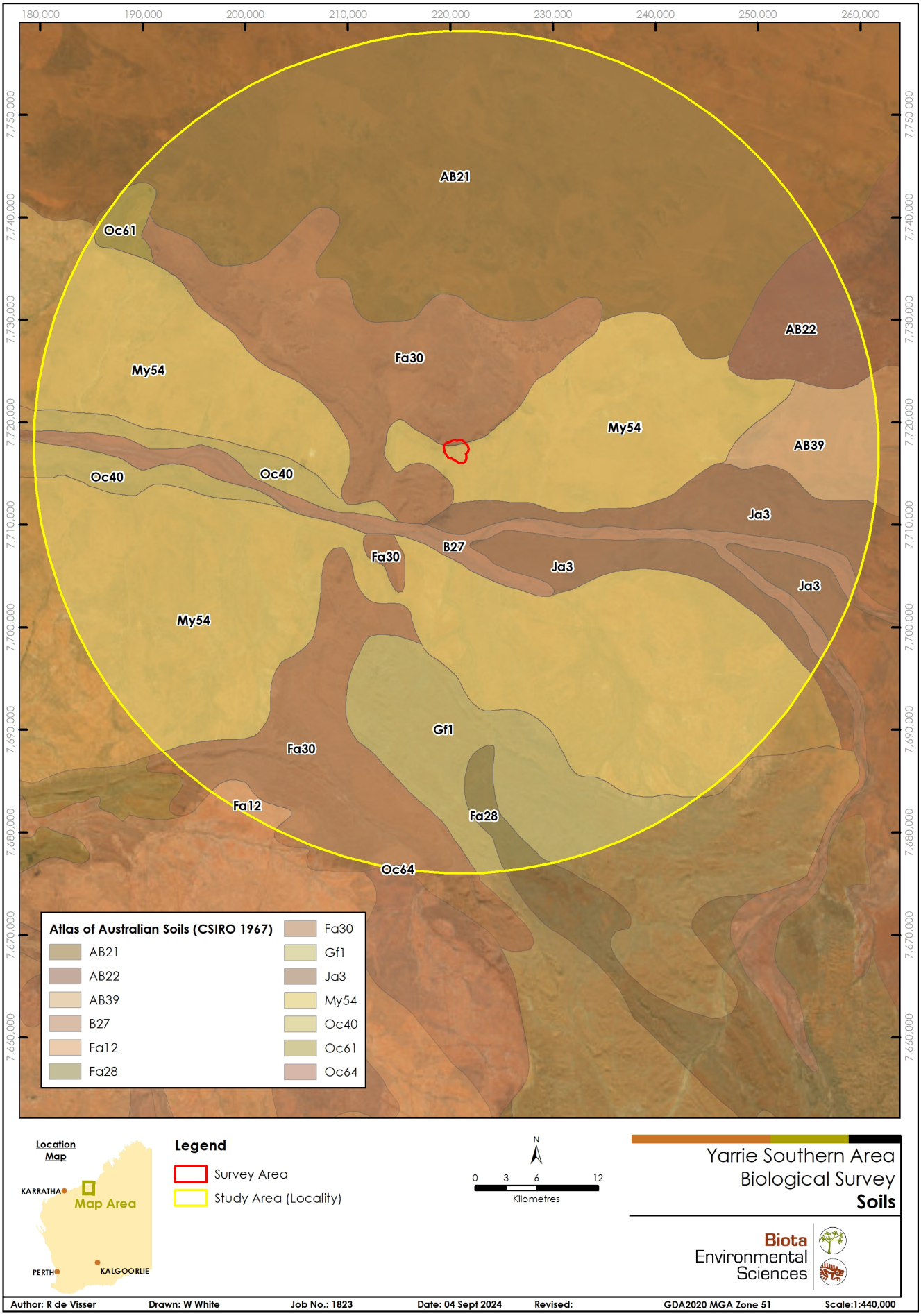


Figure 4.3: Soils of the Survey Area and surrounds.

Digital dataset from CSIRO (1967).

4.4 Beard's Vegetation

Beard (1975) mapped the vegetation units of the Pilbara broadly at a scale of 1:1,000,000. The Survey Area occurs in the Eremaean botanical province and intersects one mapping unit as defined by Beard (1975) within the Abydos Plain Chichester physiographic region (Table 4.4; Figure 4.4):

- Chichester 93: Hummock grasslands, shrub steppe; kanji over soft spinifex.

From 2007 to 2018, the DBCA and Department of Water and Environmental Regulation (DWER) published regular updates regarding the current and pre-European extents of each of Beard's vegetation units in WA. Based on the most recent data from 2018, the extent of the unit 93 in the Chichester subregion of the Pilbara bioregion remained above 99% of its pre-European extent at that time (Table 4.4). The extent within the Survey Area represents 0.01% of the overall extent within the Pilbara.

Table 4.4: Extent of Beard's vegetation association in the Survey Area.

Beard's Vegetation Mapping Unit	Extent (ha)		Percent Remaining	Extent within the Survey Area (ha) (% of 2018 Mapped Extent)
	Pre-European	In 2018		
Chichester 93	2,940,348.04	2,936,731.54	99.88%	358.7 (0.01%)

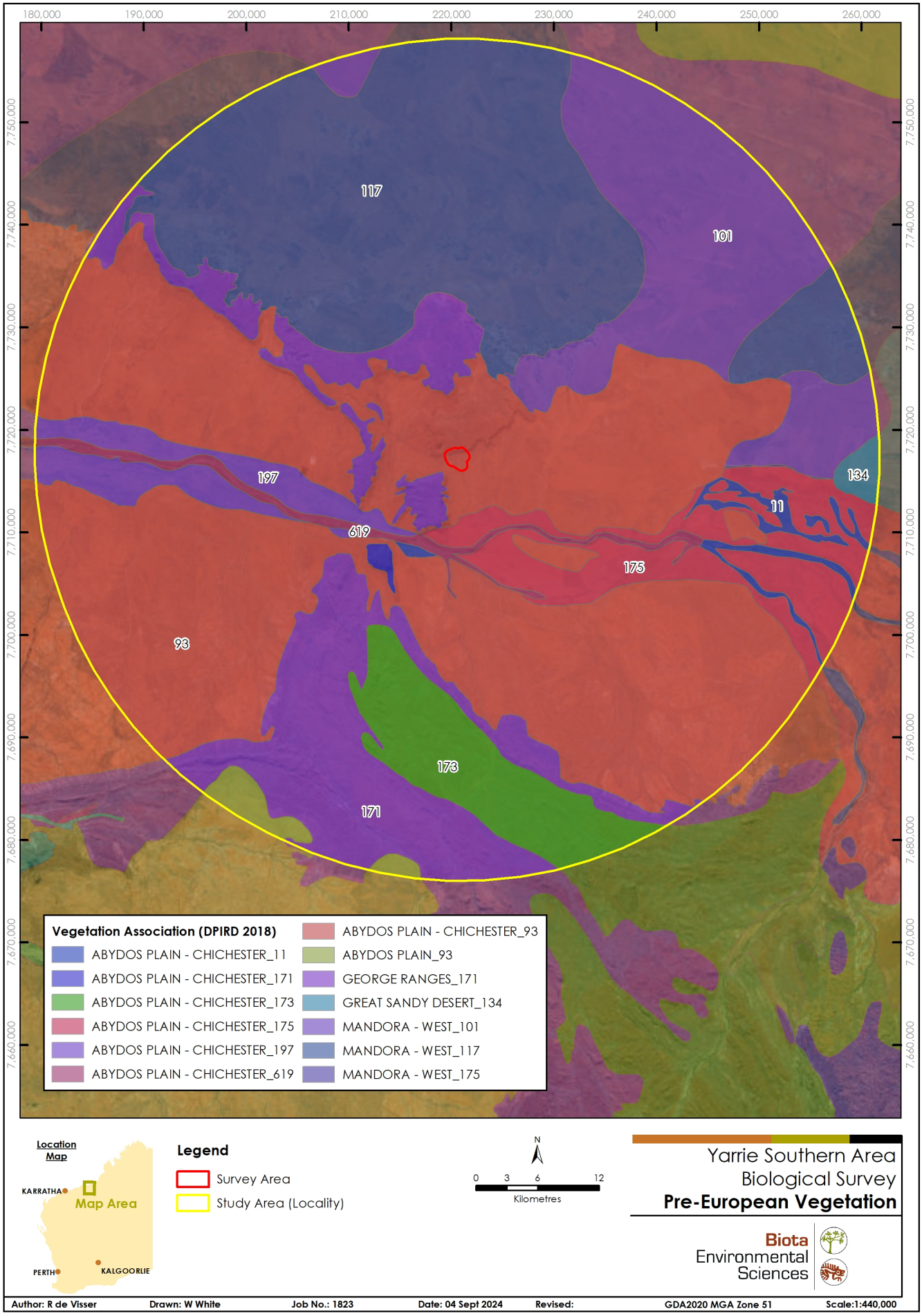


Figure 4.4: Beard's vegetation mapping units of the Survey Area and surrounds.
Digital dataset used from DPIRD (2018b).

4.5 Surface Hydrology

Surface water in the Survey Area generally flows in a north to south direction. Drainage from the large mesa range and the steep slopes of the Yarrie mine to the north of the Survey Area feeds into numerous minor drainage lines, and three tributaries of a moderate-sized, shallowly incised drainages. While most of the drainage lines are ephemeral, two small presumably artificial water features with surface water occur at the toe of the Overburden Storage Area (OSA) (see Section 5.1.5).

4.6 Conservation Reserves and Protected Areas in the Locality

There are no gazetted conservation reserves or protected areas within 40 km of the Survey Area. However, there is an area of unallocated crown land (ex-Meentheena Station) in proximity to the south of the 40 km buffer that is considered 'Lands of Interest' to DBCA (Figure 2.1). 'Lands of Interest' represent areas to which DBCA is recognised as the manager, but which is not vested under any Act that is administered by DBCA.

4.7 Previous Biological Surveys

A summary of previous studies and surveys completed in the locality, including some intersecting the Survey Area, is presented in Table 4.5.

Table 4.5: Relevant biological surveys conducted previously in the locality of the Survey Area.

Report/Survey	Survey Size and Location	Type of Survey/Study[6]	Survey Timing	Survey Limitations	No. Native Species Recorded	Threatened and Priority Species/Communities
Biological Surveys						
Callawa West Flora, Vegetation and Fauna Assessment (Onshore Environmental 2013a)	• ~660 ha. • Located ~4 km west.	Level 1 fauna; Level 2 flora and vegetation	October and November 2012	Not optimal collecting conditions for flora.	Fauna species: • 39 birds; • 2 mammals; • 3 reptiles. Flora species: 146 species from 80 genera and 33 families.	No significant vertebrate fauna species recorded. No TECs or PECs No Threatened or Priority flora species recorded. Two flora species of interest: *Stemodia* sp. Shay Gap (B. Cook 7) and *Sida macropoda,* but both no longer considered taxonomically significant.
Cundaline Northern Ridge Flora, Vegetation and Fauna Assessment (Onshore Environmental 2013b)	• ~600 ha. • Located ~15 km northwest.	Level 1 fauna; Level 2 flora and vegetation	July 2013	None listed.	Fauna species: • 38 birds; • 2 mammals; • 3 reptiles. Flora species: 157 flora species from 85 genera and 38 families.	No significant vertebrate fauna species recorded. No TECs or PECs No Threatened or Priority flora species recorded. Two flora species of interest: *Stemodia* sp. Shay Gap (B. Cook 7) and *Sida macropoda,* but both no longer considered taxonomically significant.
Yarrie Level 2 Flora and Vegetation and Level 1 Fauna Survey (Astron 2013)	• ~2,100 ha. • Located throughout the hilltops to the east of Yarrie camp.	Level 1 fauna; Level 2 flora and vegetation	October / November 2013	Not optimal collecting conditions for flora.	Fauna species: • 1 amphibian; • 40 birds; • 5 mammals; • 11 reptiles. Flora species: 168 flora species from 85 genera and 36 families.	Two significant vertebrate fauna species recorded: • Northern Quoll (EN); • Western Pebble-mound Mouse (P4). No TECs or PECs No Threatened or Priority flora species recorded.
Fauna Surveys						
Callawa Level 2 Vertebrate Fauna Assessment (Eco Logical 2012)	• ~1,200 ha. • Survey areas largely overlapping, extending ~3 km west	Single-phase Level 2 to supplement previous Level 2 fauna survey	June 2005 and May 2012	Some inaccessible areas.	Fauna species: • 1 amphibian; • 69 birds; • 19 mammals; • 36 reptiles.	Two significant vertebrate fauna species recorded: • Northern Quoll (EN); • Western Pebble-mound Mouse (inactive mounds only) (P4).

6 Corresponding survey definitions as per EPA (2016a, 2020), Level 1 approximately equivalent to Basic/Reconnaissance; Level 2 approximately equivalent to Detailed.

Report/Survey	Survey Size and Location	Type of Survey/Study[6]	Survey Timing	Survey Limitations	No. Native Species Recorded	Threatened and Priority Species/Communities
Callawa West Vertebrate Fauna Survey (Biologic 2014a)	• ~660 ha. • Located ~4 km west.	Single-phase Level 2 fauna	September 2013	None listed.	Fauna species: • 36 birds; • 16 mammals; • 11 reptiles.	Five significant vertebrate fauna species recorded: • Northern Quoll (EN); • Ghost Bat (VU); • Bilby (VU); • Western Pebble-mound Mouse (P4); • Pilbara Leaf-nosed Bat (VU).
Cattle Gorge Targeted Vertebrate Fauna Survey (Biologic 2014b)	• ~536 ha. • Located ~10 km northwest	Targeted fauna	July 2013	No nocturnal survey.	Fauna species: • 33 birds; • 11 mammals; • 7 reptiles.	Three significant vertebrate fauna species recorded: • Pilbara Olive Python (VU); • Northern Quoll (EN); • Pilbara Leaf-nosed Bat (VU).
Nimingarra, Shay Gap and Sunrise Hill Vertebrate Fauna Interim Summary Report (ENV Australia 2011)	• Survey area size not listed. • Located ~18-40 km northwest	First phase of a Level 2 fauna survey	Survey dates not listed, ~June 2011	None listed in Interim Report (full report unavailable).	Fauna species: • 7 amphibians; • 16 mammals; • 42 birds; • 42 reptiles.	Three significant vertebrate fauna species recorded: • Ghost Bat (VU); • Northern Quoll (EN); • Pilbara Leaf-nosed Bat (VU).
Yarrie 2022 Significant Species Monitoring (Biologic 2022a) **and** Cattle Gorge and Callawa West 2020 Significant Species and Rehabilitation Monitoring (Biologic 2022b) **and** Yarrie 2021 Significant Species Monitoring (Biologic 2023)	• ~16,700 ha. • Located immediately adjacent to Survey Area with some overlap, extending ~9 km north, 7 km south, and 11 km west.	Multi-phase Targeted and Detailed fauna	May 2020; May 2021; June 2021; February 2022; March 2022; May 2022	Some issues with collar retrieval and data analysis (not affecting species list).	Fauna species: • 50 birds; • 19 mammals; • 27 reptiles.	Five significant vertebrate fauna species recorded: • Ghost Bat (VU); • Northern Quoll (EN); • Bilby (VU); • Pilbara Leaf-nosed Bat (VU); • Pilbara Olive Python (VU).
Yarrie Pilbara Olive Python Monitoring 2023 (Biota unpubl. data 2023)	• ~23,300 ha. • Located immediately adjacent to Survey Area with some overlap, extending ~8 km south and 40 km northwest	Multi-phase Targeted Pilbara Olive Python	March/April 2023; October / November 2023; December 2023; January 2024	Some inaccessible sites.	Fauna species: • One reptile.	One significant vertebrate fauna species recorded: • Pilbara Olive Python (VU).

NB. Taxa have been reviewed and updated for current nomenclature and significance status; species included as significant in past reports that are no longer listed have been excluded.

4.8 Factors of Environmental Significance

4.8.1 Significant Vegetation in the Locality

No TECs or PECs occur in the locality, with the closest being the Priority 3 Gregory Land System PEC, located approximately 46 km northwest of the Survey Area.

4.8.2 Significant Flora in the Locality

No significant flora species have been recorded previously in the Survey Area. No Threatened flora are known to occur in the locality, however a total of 15 Priority flora species, consisting of six Priority 1 species, one Priority 2 species and eight Priority 3 species, were returned from the desktop study as having been recorded. The full list of significant flora is provided in Appendix 3, and Figure 4.5 shows the location of all Priority flora in the locality returned by the DBCA database search.

An assessment of the likelihood that each of these species would occur within the Survey Area was completed during the desktop study, based on the habitats and vegetation types that appeared to be present on aerial imagery, as well as the currency of records (see Appendix 3).

Of the 15 significant species, one species was assigned a ranking of 'likely to occur' and eight species were assigned a ranking of 'may occur' prior to the field survey (see Table 4.6).

Table 4.6: Significant flora species from the locality that have potential to occur in the Survey Area.

Likely to Occur / 'High' Likelihood of Occurrence		May Occur / 'Moderate' Likelihood of Occurrence	
Species	**Status**	**Species**	**Status**
Euphorbia clementii	Priority 3	*Acacia cyperophylla* var. *omearana*	Priority 1
		Eremophila maculata subsp. *filifolia*	Priority 1
		Hibiscus krichauffianus	Priority 1
		Goodenia hartiana	Priority 2
		Croton aridus	Priority 3
		Gymnanthera cunninghamii	Priority 3
		Indigofera ammobia	Priority 3
		Rothia indica subsp. *australis*	Priority 3

4.8.3 Significant Vertebrate Fauna in the Locality

A total of 35 vertebrate fauna species listed as significant under State or Commonwealth legislation were identified from the locality during the desktop study (Appendix 4). Note this includes all species returned from the EPBC PMST, including those based solely on habitat occurring (i.e. without records). This total comprised eight mammals, 24 bird species and three reptile species.

Locations for those species which have previously been recorded within 40 km of the Survey Area are presented in Figure 4.6. This figure includes DBCA, ALA and eBird records of significant species, in addition to Pilbara Olive Python records from previous surveys to supplement the database searches (Biota in prep.). Note some database records (primarily from ALA) are generalised up to 10 km. Species only identified from the EPBC Act search are not included on Figure 4.6 as there are no associated spatial records.

A number of species have been recorded in proximity to the Survey Area, bolstered by annual monitoring efforts targeting MNES vertebrate fauna. There were, however, no previous records of significant vertebrate fauna from within the Survey Area itself.

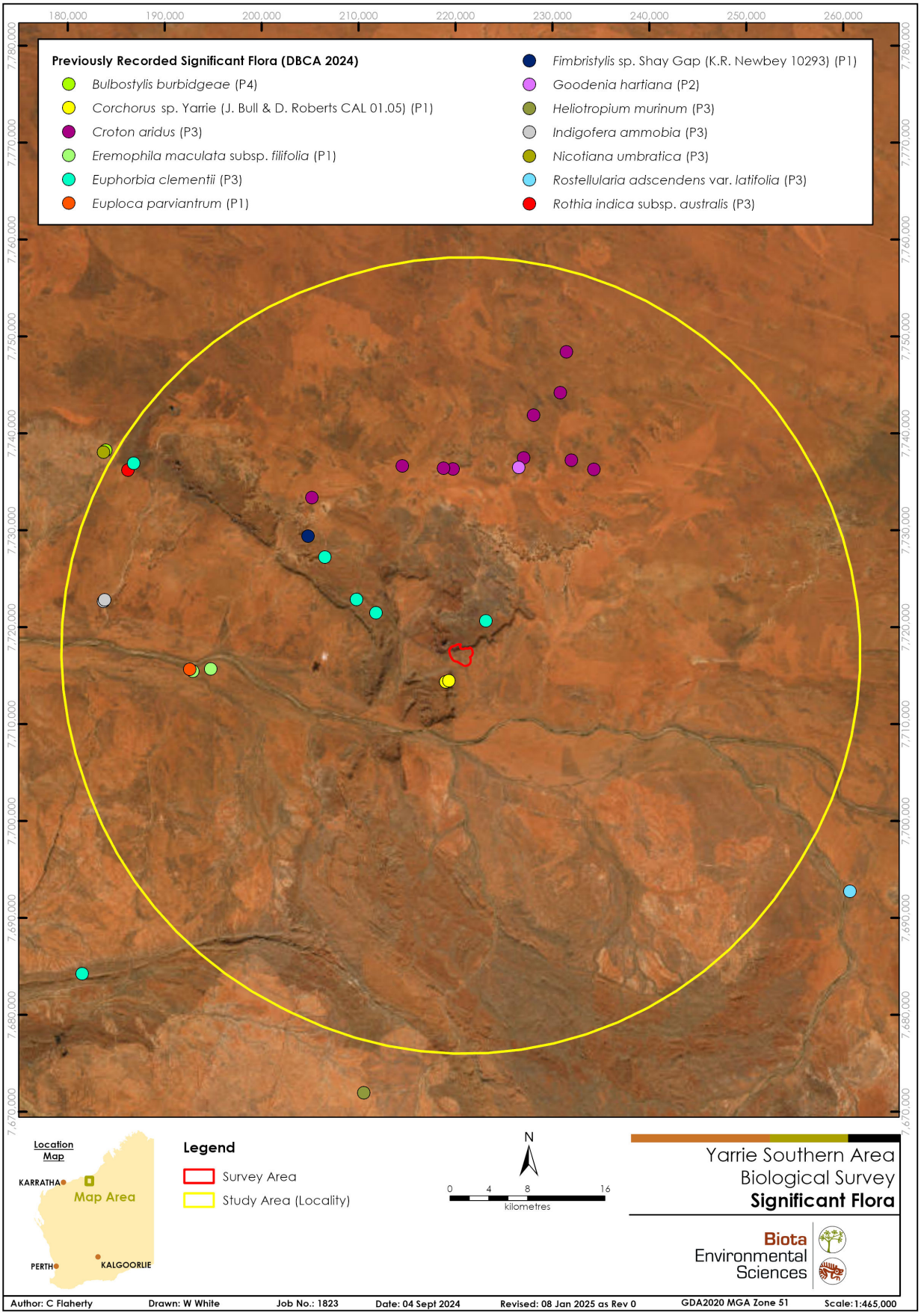


Figure 4.5: Previous significant flora records in the vicinity of the Survey Area.

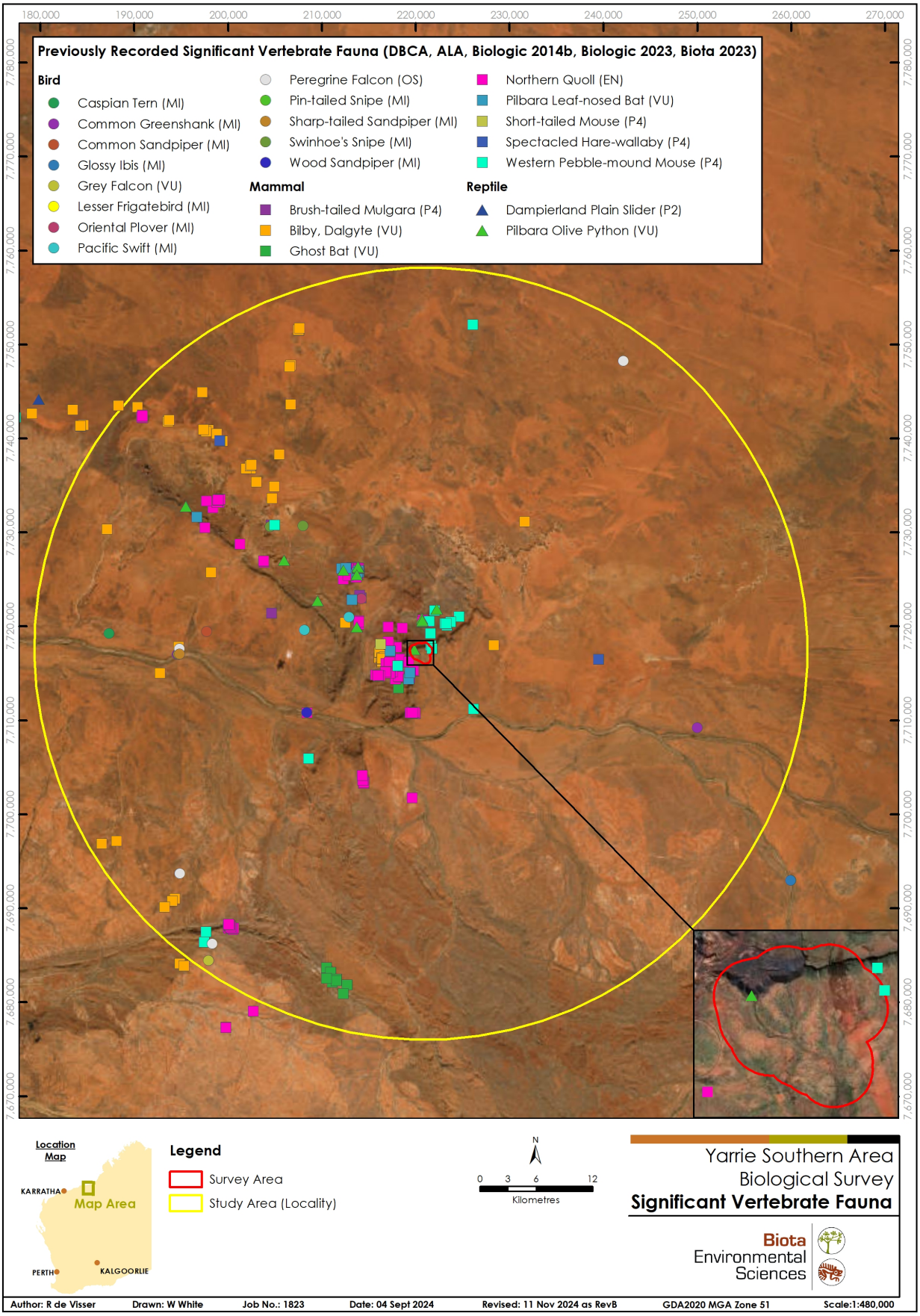


Figure 4.6: Previous significant vertebrate fauna records in the locality of the Survey Area.

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5.0 Flora and Vegetation Results

5.1 Vegetation

5.1.1 Broad Floristic Formations

A total of five broad floristic formations were described form the Survey Area based on the dominant growth form and genus for the dominant stratum:

- *Triodia* hummock grassland;
- *Acacia* low open heath;
- *Acacia* open scrub;
- *Corymbia* low woodland; and
- *Triodia* open hummock grassland.

The dominant broad floristic formation (based on extent in the Survey Area) was *Triodia* hummock grassland (206.7 ha; 57.7% of the Survey Area), which occurred broadly over the plains and undulating low stony hills of the Survey Area. Each broad floristic formation supported one vegetation association (see Section 5.1.2 below).

5.1.2 Overview of Vegetation Associations

Remnant native vegetation accounted for 86.1% of the Survey Area and consisted of five intact vegetation associations (described to Level V according to the NVIS; see Section 3.3.2.2).

The remaining 13.9% of the Survey Area consisted of two modified units:

- Cleared land (C): areas (44.4 ha) devoid of native vegetation including tracks, and an overburden storage area slope in the northwest of the Survey Area; and
- Rehabilitation (R): a small area (5.5 ha) of rehabilitated mine slope which consisted of mixed *Acacia* spp. over *Triodia epactia*.

The extents of the vegetation associations within the Survey Area are shown in Table 5.1 and Figure 5.1, with descriptions of the vegetation associations provided in Section 5.1.3.

Table 5.1: Extent and description of the vegetation associations and other mapping units mapped in the Survey Area.

Vegetation Code	Broad Floristic Formation	Description	Overall Extent in the Survey Area	
			Area (ha)	Proportion (%)
Remnant Native Vegetation Associations				
SP TeTw Ch Ai	*Triodia* hummock grassland	Hummock grassland of *Triodia epactia, T. wiseana* with scattered low trees of *Corymbia hamersleyana* and scattered tall shrubs of *Acacia inaequilatera* on reddish brown sandy clay loam on stony footslopes, low undulating hills and stony plains.	206.8	57.7
SA AstApty Te	*Acacia* low open heath	Low open heath of *Acacia stellaticeps, A. ptychophylla* over very open to open hummock grassland of *Triodia epactia* on dark reddish brown sandy loam sand plains and drainage areas/floodplains.	62.3	17.4
ME Cfl AtpAcoc CcCs Cyv	*Corymbia* low woodland	Low woodland of *Corymbia flavescens* over a high shrubland of *Acacia tumida* var. *pilbarensis, A. colei* var. *colei* with very open tussock grassland of **Cenchrus ciliaris* and **C. setiger* and very open sedges of *Cyperus vaginatus* on dark reddish brown sandy clay loam in medium drainage lines and drainage areas/floodplains.	18.6	5.2
MI Te Atp Ch	*Triodia* open hummock grassland	Open hummock grassland of *Triodia epactia* with high open shrubland of *Acacia tumida* var. *pilbarensis* and low open woodland of *Corymbia hamersleyana* in dark reddish brown sandy clay loam in minor drainage lines.	11.6	3.2
SA Aanc Te Ch Ast	*Acacia* open scrub	Open scrub of *Acacia ancistrocarpa* with very open hummock grassland of *Triodia epactia* with scattered low trees of *Corymbia hamersleyana* and low scattered shrubs of *Acacia stellaticeps* on dark reddish brown sandy loam sand plains.	9.5	2.6
Other Mapping Units				
OT	–	Cleared (C): completely devoid of vegetation; including tracks and overburden storage area slopes.	44.4	12.4
OT	–	Rehabilitation (R): rehabilitated mine slopes consisting of tall open shrubland of mixed *Acacia* spp. over scattered to very open hummock grassland of *Triodia epactia*.	5.5	1.5
		Total	**358.7**	**100.0**

5.1.3 Descriptions of Vegetation Associations

Code	SP TeTw Ch Ai
Vegetation association description (NVIS Level V)	Hummock grassland of *Triodia epactia, T. wiseana* with scattered low trees of *Corymbia hamersleyana* and scattered tall shrubs of *Acacia inaequilatera* on reddish brown sandy clay loam on stony footslopes, low undulating hills and stony plains.
Distribution and landforms	This vegetation (Plate 5.1) occurred extensively over the stony quartz, calcrete and ironstone plains, low undulating stony hills and footslopes in the Survey Area. Soft Spinifex (*Triodia epactia*) was generally the dominant *Triodia* however some stony rise areas also supported *Triodia wiseana* as a dominant. *Acacia ptychophylla* was sometimes present as a dominant species in the lower shrub stratum but not consistently across the entire association. Parts of this vegetation in the east of the Survey Area had been recently burnt (Plate 5.2), including site YSA-01.
Other associated species	Tall Shrubs: *Acacia ancistrocarpa, Grevillea pyramidalis* subsp. *leucadendron, G. wickhamii* and *Hakea lorea* subsp. *lorea*. Shrubs: *Acacia sphaerostachya*, *A. synchronicia*, *Senna glutinosa* subsp. *glutinosa, S. glutinosa* subsp. x *luerssenii* and *S. glutinosa* subsp. *pruinosa*. Low Shrubs: *Acacia ptychophylla, Pluchea tetranthera* and *Triumfetta chaetocarpa*. Herbs: *Arivela viscosa, Bonamia pilbarensis*, *Goodenia microptera, Rhynchosia minima, Trachymene oleracea* and *Trigastrotheca molluginea.* Grasses: *Eragrostis eriopoda, Eriachne aristidea* and *E. mucronata.*
Vegetation condition	Mostly Excellent. Some areas close to the drainage line supported some scattered **Cenchrus ciliaris* and were ranked as Very Good. Closer to the mine slope, parts of this vegetation in an area of previous ground disturbance were ranked as Good.
Sampling sites	YSA-01, YSA-04, YSA-06, YSA-07 and YSA-09.



Plate 5.1: Vegetation association SP TeTw Ch Ai (unburnt).



Plate 5.2: Vegetation association SP TeTw Ch Ai (burnt).

Code	SA AstApty Te
Vegetation association description (NVIS Level V)	Low open heath of *Acacia stellaticeps*, *A. ptychophylla* over very open to open hummock grassland of *Triodia epactia* on dark reddish brown sandy loam sand plains and drainage areas/floodplains.
Distribution and landforms	This vegetation (Plate 5.3) occurred in lower lying or sandy loam plains and floodplains, often adjacent to drainage lines. While the surface was occasionally stony, the substrate was a sandy loam. In some parts of this vegetation, there were small discrete areas of clay loam depressions that supported species usually found in heavier soils (e.g. the tussock grass, *Chrysopogon fallax*).
Other associated species	Shrubs: *Acacia ancistrocarpa, A. sphaerostachya, A. synchronicia* and *Senna glutinosa* subsp. *pruinosa.* Low shrubs: *Indigofera monophylla, Pluchea tetranthera* and *Senna notabilis.* Grasses: *Eriachne obtusa, Chrysopogon fallax* and *Dactyloctenium radulans.* Herbs: *Arivela viscosa* and *Goodenia muelleriana,*
Vegetation condition	Mostly Excellent. Some areas close to the drainage line supported some scattered **Cenchrus setiger* and were ranked as Very Good. Closer to the mine slope parts of this vegetation in an area of previous ground disturbance were ranked as Degraded, with some scattered **Calotropis procera* individuals also recorded.
Sampling sites	YSA-02, YSA-12 and YSA-14.



Plate 5.3: Vegetation association SA AstApty Te.

Code	SA Aanc Te Ch Ast
Vegetation association description (NVIS Level V)	Open scrub of *Acacia ancistrocarpa* with very open hummock grassland of *Triodia epactia* with scattered low trees of *Corymbia hamersleyana* and low scattered shrubs of *Acacia stellaticeps* on dark reddish brown sandy loam sand plains.
Distribution and landforms	This vegetation association (Plate 5.4) occurred in a single small area in the southwest of the Survey Area. It occurred on a low-lying area of plain with a sandy loam substrate.
Other associated species	Tall shrubs: *Acacia colei* var. *colei, A. inaequilatera, Grevillea pyramidalis* subsp. *leucadendron* and *G. wickhamii*. Low shrubs/Herbs: *Bonamia alatisemina, B. erecta*, *Hibiscus leptocladus*, *Senna notabilis* and *Trigastrotheca molluginea*. Grasses: *Eragrostis eriopoda* and *Eriachne pulchella*.
Vegetation condition	Excellent.
Sampling sites	YSA-11.



Plate 5.4: Vegetation association SA Aanc Te Ch Ast.

Code	ME Cfl AtpAcoc CcCs Cyv
Vegetation association description (NVIS Level V)	Low woodland of *Corymbia flavescens* over a high shrubland of *Acacia tumida* var. *pilbarensis*, *A. colei* var. *colei* with very open tussock grassland of **Cenchrus ciliaris* and **C. setiger* and very open sedges of *Cyperus vaginatus* on dark reddish brown sandy clay loam in medium drainage lines and drainage areas/floodplains.
Distribution and landforms	This vegetation (Plate 5.5) occurred in moderate-sized ephemeral drainage lines in the Survey Area. Three main branches of the drainage were recorded (two draining from the mine slope and one draining from the range of hills to the north); these converged into one broad, very shallowly incised drainage line (approximately 100 m wide) in the very south of the Survey Area. *Corymbia flavescens* ranged from scattered low trees to a low woodland and the clay loam creek bed was often bare and scoured in places. The level of **Cenchrus* spp. invasion also varied within this association; only scattered individuals were recorded in the tributaries, however **Cenchrus* spp. formed a tussock grassland south of the track, where the tributaries converged. Populations of several weed species, including **Calotropis procera*, were recorded in this vegetation association and signs of cattle (scats, tracks and grazing) were also noted. The two branches of this drainage line that drain directly off the OSA had small pools of permanent water, which are likely to have arisen following construction of the OSA (Plate 5.6; see Section 5.1.5 for further details). These pools supported some macrophytes (*Typha domingensis* and *Schoenoplectus subulatus*) within a small area; the remainder of the drainage line was ephemeral in nature and dry at the time of the survey. Areas of tree and shrub death were present around the permanent water and a white surface crust was also noted in these areas (Plate 5.7; discussed further in Section 5.1.8).
Other associated species	Low Trees/Tall Shrubs: **Calotropis procera, Carissa lanceolata* and **Vachellia farnesiana*. Shrubs: *Ehretia saligna* var. *saligna*. Low Shrubs: *Afrohybanthus aurantiacus, Crotalaria medicaginea* var. *neglecta, Sida rohlenae* subsp. *rohlenae*, *Triumfetta chaetocarpa* and *Waltheria indica*. Grasses: **Chloris virgata, Chrysopogon fallax*, **Echinochloa colona, Paspalidium clementii, P. rarum, Sporobolus australasicus* and *Triodia epactia*. Herbs/Climbers: *Boerhavia coccinea, Cucumis variabilis, Pluchea rubelliflora, Portulaca oleracea* and *Trachymene oleracea* subsp. *oleracea*.
Vegetation condition	Mostly Poor due to numerous aggressive weed species (including **Calotropis procera*) and impacts from cattle. Parts of the drainage line where surface crusting and shrub death were observed were ranked as Degraded. The branch of the drainage from the range of hills to the north was in Excellent condition.
Sampling sites	YSA-03, YSAR-05 and YSAR-13.



Plate 5.5: Vegetation association ME Cfl AtpAcoc CcCs Cyv.



Plate 5.6: Permanent water within vegetation association ME Cfl AtpAcoc CcCs Cyv.



Plate 5.7: White surface crusting evident in vegetation association ME Cfl AtpAcoc CcCs Cyv.

Code	MI Te Atp Ch
Vegetation association description (NVIS Level V)	Open hummock grassland of *Triodia epactia* with high open shrubland of *Acacia tumida* var. *pilbarensis* and low open woodland of *Corymbia hamersleyana* in dark reddish brown sandy clay loam in minor drainage lines.
Distribution and landforms	This vegetation (Plate 5.8) occurred in minor drainage lines draining from the range of hills to the north of the Survey Area. They were narrowly incised and had an indistinct, rocky creek bed but supported denser tree and shrub strata than the surrounding plains and low-lying hills.
Other associated species	Tall Shrubs: *Acacia colei* var. *colei, A. monticola*, *Grevillea pyramidalis* subsp. *leucadendron* and *G. wickhamii.* Shrubs: *Gossypium australe, Senna glutinosa* subsp. *glutinosa, Tephrosia rosea* var. *clementii* and *T. virens*. Low Shrubs: *Corchorus elachocarpus, Hibiscus burtonii, Indigofera monophylla* and *Isotropis atropurpurea*. Herbs: *Goodenia microptera, Trachymene oleracea* subsp. *oleracea* and *Trigastrotheca molluginea*. Grasses: *Chrysopogon fallax, Eragrostis eriopoda, Eulalia aurea* and *Paraneurachne muelleri*.
Vegetation condition	Excellent.
Sampling sites	YSAR-08, YSAR-10 and YSAR-15.



Plate 5.8: Vegetation association MI Te Atp Ch.

5.1.4 Water Features

Two water features were located during the survey: WYAR-01 (Plate 5.9) and WYAR-02 (Plate 5.10), locations shown on Figure 5.1. Both occurred at the toe of the OSA within the broader vegetation association ME Cfl AtpAcoc CcCs Cyv. Given their proximity to the mine OSA, it is assumed that these water features are artificial, due to altered hydrology of the area since the mine development. However, they do occur along existing ephemeral drainage lines which would flow intermittently.

Given the dry conditions leading up to the survey (Section 3.3.1), these pools appear to be predominantly seep-fed, although surface water flows off the mine OSA slope would also occur following rainfall events. While the water features contained surface water at the time of the survey, it is unknown whether these pools are permanent. Satellite imagery (Google Earth) and surface moisture radar data (Copernicus) indicate that the waterbody has retained surface water consistently since 2017.



Plate 5.9: Water feature WYAR-01 in the Survey Area.



Plate 5.10: Water feature WYAR-02 in the Survey Area.

Two macrophytic species (*Typha domingensis* and *Schoenoplectus subulatus*) were observed growing within the water at WYAR-01. A white surface crust in areas of previous inundation was observed at both water features, as well as some death of tree and shrub species (see Section 5.1.8).

5.1.5 Other Units

Two additional units were mapped separately to the vegetation associations: R (Rehabilitation) and C (Cleared).

Unit OT (R) was mapped in a small area of rehabilitated mine slope in the northern part of the Survey Area. Mature shrubs and spinifex were present, however the structure of the vegetation was not yet approaching that of the surrounding remnant vegetation. Bare patches were present throughout this area and regeneration of *Triodia epactia* was inconsistent; some areas resembled a very open hummock grassland, while other areas had only scattered hummock grasses. The vegetation could be broadly described as a tall open shrubland of *Acacia tumida* var. *pilbarensis*, *A. pyrifolia* over very open hummock grassland to scattered hummock grassland of *Triodia epactia* (Plate 5.11), but for the purpose of this report it was mapped as Rehabilitation OT (R). Scattered individuals of **Calotropis procera* were also recorded in this unit.

Unit OT (C) consisted of the cleared areas within the Survey Area, including the tracks and the OSA slopes in the northwest of the Survey Area (Plate 5.12).

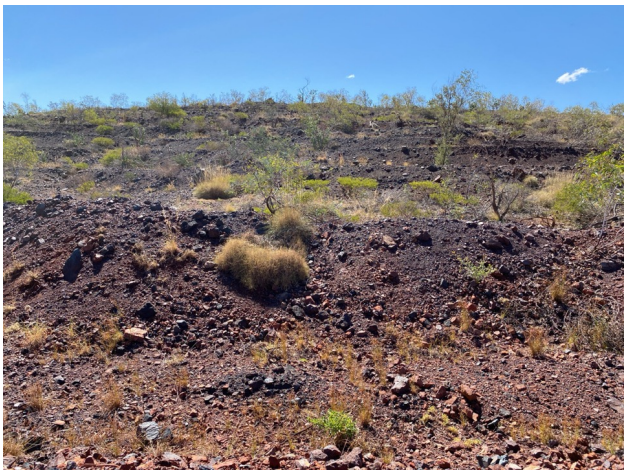


Plate 5.11: **Unit OT (R), consisting of rehabilitated mine slopes.**



Plate 5.12: **Overburden storage area (OSA) slopes, mapped as unit OT (C).**

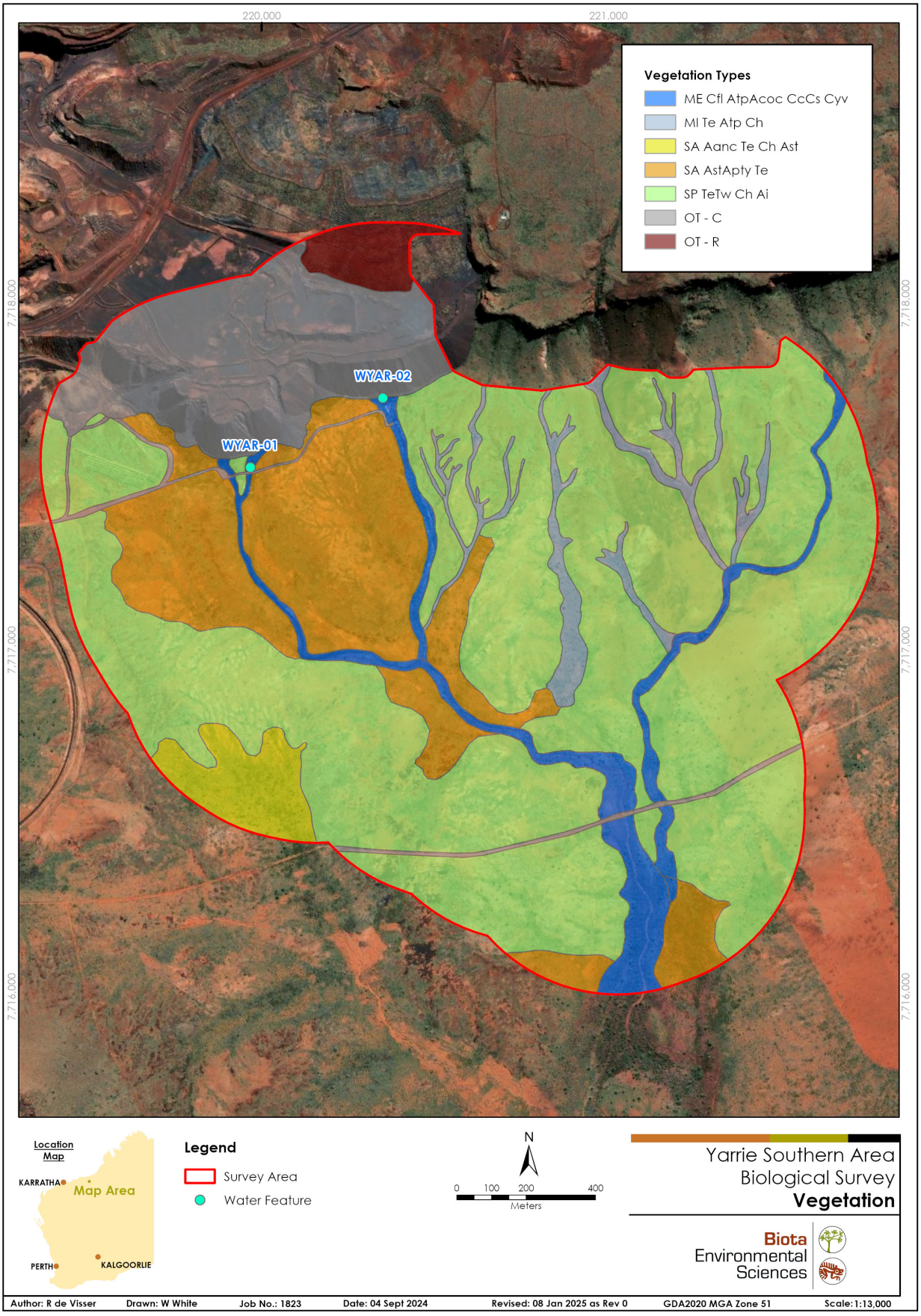


Figure 5.1: Vegetation mapping for the Survey Area.

5.1.6 Floristic Analysis: Validation of Vegetation Associations

At a 50% level of similarity, the sampling sites were divided into six groups (Table 5.2, Appendix 8). These showed some clear connections between floristic composition and the vegetation associations mapped. The floristic groups could be broadly discriminated by the presence and abundance of species in the spinifex stratum, coupled with the dominant tree or shrub present in the overstorey stratum.

On a practical mapping level, some adjustments to groupings were made to account for anomalies, such as instances where there were too few sampling sites per floristic group and mapping relied heavily on field observations; or when field observations and aerial imagery were found to be more representative of the differences in vegetation than the analysis grouping.

The six floristic groups (FG_a to FG_f) are briefly described below:

- FG_a contained only one site, YSAR-05, from the medium-sized drainage line (ME Cfl AtpAcoc CcCs Cyv). This site had slightly less cover of *Corymbia flavescens* and no **Cenchrus* spp. compared to the other two sites sampled within this drainage line. While it did not group with the other two sites in this vegetation association at a 50% similarity-level, this site did group with the other two sites at a 30% similarity level (see Appendix 8).
- FG_b contained the two other sites mapped as ME Cfl AtpAcoc CcCs CYv. This group was characterised by the dominant tree species *Corymbia flavescens* and the tall shrub *Acacia tumida* var. *pilbarensis* in the overstorey stratum, and weedy **Cenchrus* spp. tussock grasses and the native sedge *Cyperus vaginatus* in the understorey.
- FG_c contained two sites mapped from the vegetation association that occurred broadly throughout the stony plains of the Survey Area, SP TeTw Ch Ai. This group occurred on low stony rises with calcrete and quartz, and was characterised by having *Triodia wiseana* more dominant than *T. epactia*, and *Corymbia hamersleyana* as the dominant tree species.
- FG_d contained three sites mapped within the minor drainage line association (MI Te Atp Ch), as well as the single site mapped within association SA Aanc Te Ch Ast. This group was characterised by *Triodia epactia* as the dominant spinifex, and *Corymbia hamersleyana* scattered trees in the overstorey.
- FG_e contained all three sites mapped as SA AstApty Te on plains and floodplains. It was characterised by the dominance of the low shrub *Acacia stellaticeps* and the spinifex *Triodia epactia*.
- FG_f contained the three remaining sites in the stony plains association SP TeTw Ch Ai, characterised by having both species of spinifex, *Triodia epactia* and *T. wiseana*.

Table 5.2: Floristic groups at 50% similarity and the top five indicator species for each.

Floristic Group	Average Similarity (%)	Top Species Contributing to Similarity (Cumulative Similarity)	Vegetation Association/s
a	–	Not applicable; only one site in this group.	ME Cfl AtpAcoc CcCs Cyv
b	60.9	*Corymbia flavescens*, **Cenchrus* spp., *Acacia tumida* var. *pilbarensis*, *Cyperus vaginatus* (72.2%)	ME Cfl AtpAcoc CcCs Cyv
c	56.1	*Triodia wiseana*, *Corymbia hamersleyana* (74.3%)	SP TeTw Ch Ai
d	58.9	*Triodia epactia*, *Corymbia hamersleyana* (77.2%)	MI Te Atp Ch
			SA Aanc Te Ch Ast
e	71.9	*Acacia stellaticeps*, *Triodia epactia* (96.7%)	SA AstApty Te
f	63.3	*Triodia epactia*, *T. wiseana* (76.1%)	SP TeTw Ch Ai

5.1.7 Vegetation of Significance

No TECs or PECs were recorded in the Survey Area, and none are expected to occur based on their known distribution and species composition.

None of the vegetation association mapped within the Survey Area supported populations of significant flora, nor are they considered to be of elevated local or regional significance.

5.1.8 Vegetation Condition

The condition of the vegetation in the Survey Area is summarised in Table 5.3 and shown in Figure 5.2.

Vegetation condition ranged from Degraded to Excellent. While most of the Survey Area was in Excellent condition (Table 5.3), disturbance was observed in the form of weed invasion, impacts from cattle or other stock, and previous clearing or ground disturbance. Additionally, some tree and shrub death were observed in the areas of the drainage line near the Artificial wetland.

Table 5.3: Extent of vegetation condition categories in the Survey Area.

Condition	Extent in Survey Area		Notes
	Area (ha)	Proportion (%)	
Excellent	257.5	71.8	No disturbance noted. Some areas had been burnt recently but vegetation was recovering well post-fire.
Very Good	25.1	7.0	Minor (scattered) weeds present or signs of cattle within otherwise intact vegetation.
Good	7.2	2.0	Areas with evidence of some previous clearing or ground disturbance but with vegetation cover generally consistent with surrounding undisturbed areas (Plate 5.13).
Poor	19.2	5.3	Drainage lines with numerous weed species, including some **Calotropis procera*, and more obvious impacts from cattle including scats, tracks and grazed vegetation (Plate 5.14). Rehabilitated slopes mapped as unit OT (R), with bare patches, low cover of *Triodia* and scattered **Calotropis procera* (Plate 5.11).
Degraded	5.3	1.5	Confined to areas immediately adjacent to the OSA slope that appeared to be highly modified. Some areas along the base of the slope contained **Calotropis procera,* and parts of the drainage lines had areas of shrub and tree death (Plate 5.15).
Completely Degraded	44.4	12.4	Areas of mine slope (Plate 5.12) and cleared tracks. Devoid or almost devoid of native vegetation.
Total	**358.7**	**100.0**	



Plate 5.13: **Past ground disturbance within vegetation association SP TeTw Ch Ai, with condition ranked as Good.**



Plate 5.14: **Cattle tracks and weed species (**Calotropis procera* and **Cenchrus* spp. pictured) within vegetation association ME CfI AtpAcoc CcCs Cyv, with condition ranked as Poor.**



Plate 5.15: **Shrub death and white surface crust within vegetation association ME CfI AtpAcoc CcCs Cyv, with condition ranked as Degraded.**

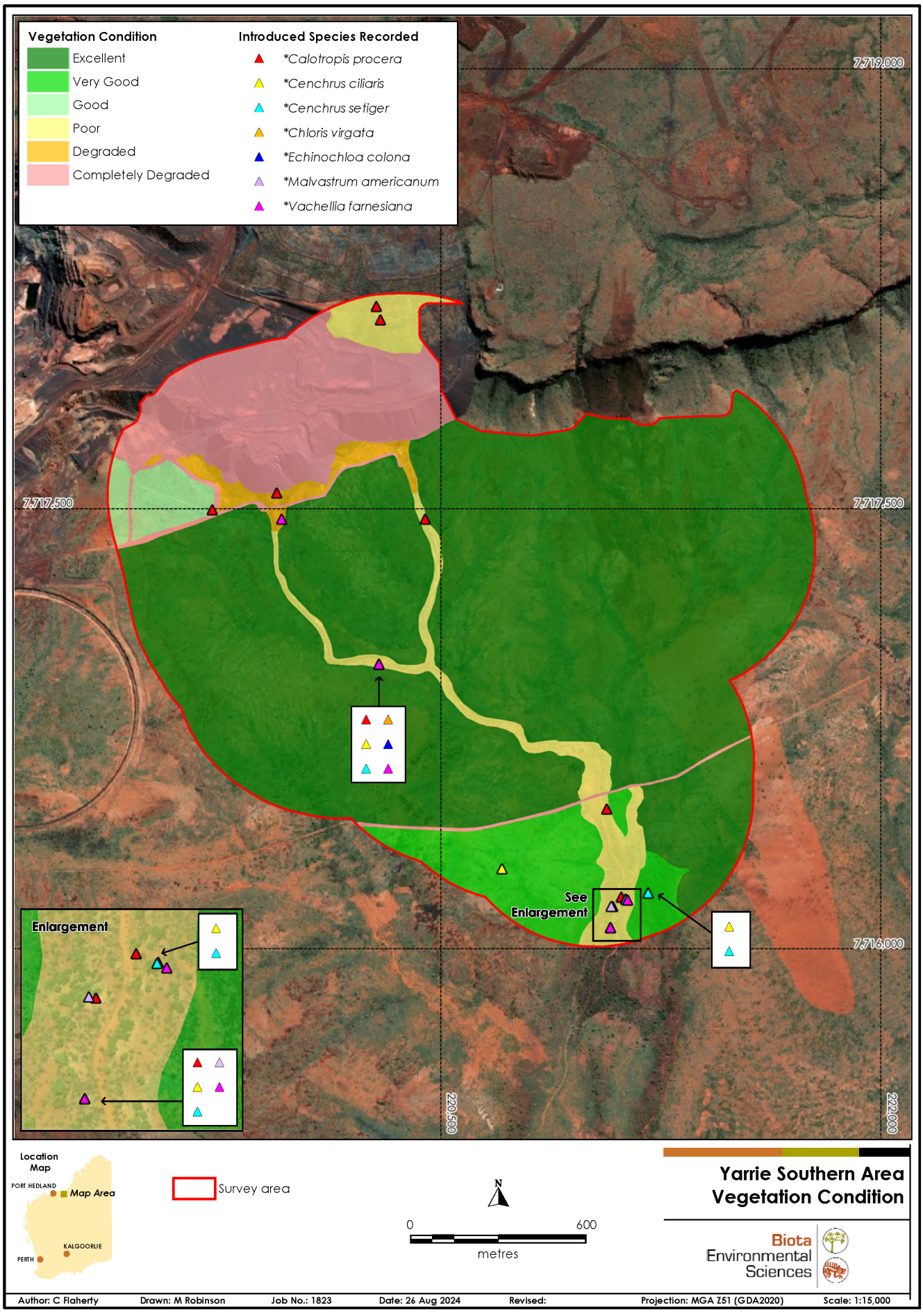


Figure 5.2: Vegetation condition mapping and locations of introduced flora within the Survey Area.

5.2 Flora

5.2.1 Overview

A total of 121 native vascular flora taxa from 69 genera and 33 families were recorded during the survey. Of these taxa, six could not be confirmed at species level, mostly due to insufficient material. Seven introduced flora species were recorded (Section 5.2.6). A full vascular flora species list is provided in Appendix 6.

The dominant native families and genera recorded from the Survey Area are presented in Table 5.4. These families and genera are typically well represented in species lists from this region.

Table 5.4: Dominant native families and genera recorded from the Survey Area.

Family	No. Native Species	Genus	No. Native Species
Fabaceae (peas, acacia family)	28	*Acacia*	11
Poaceae (grass family)	22	*Senna*	6
Malvaceae (mallow family)	14	*Eriachne*	5
Convolvulaceae (morning glory family)	5		

5.2.2 Sampling Adequacy

The species accumulation curve generated from the survey data is approaching a plateau, indicating that the sampling of the Survey Area was relatively thorough (Figure 5.3). However, the two estimates of species richness (ICE and Chao 2) suggest the actual number of species present in the sampled area was 192 to 195, indicating that 58-59% of the total flora (native and introduced) was recorded within quadrats/ relevés during sampling of the Survey Area (see Table 5.5). This proportion is lower than those reported in other surveys of a similar nature in the Pilbara region (e.g. 69% (Maia 2018) and 70% (Biota 2024)). This may be a reflection of the drier than usual conditions leading up to the current survey resulting in fewer than usual annual species being present (see Section 3.3.1). It should be noted that an additional 15 taxa were recorded during opportunistic sampling of the Survey Area; with the inclusion of these taxa, the current survey work has recorded between 66-67% of the predicted total number of taxa.

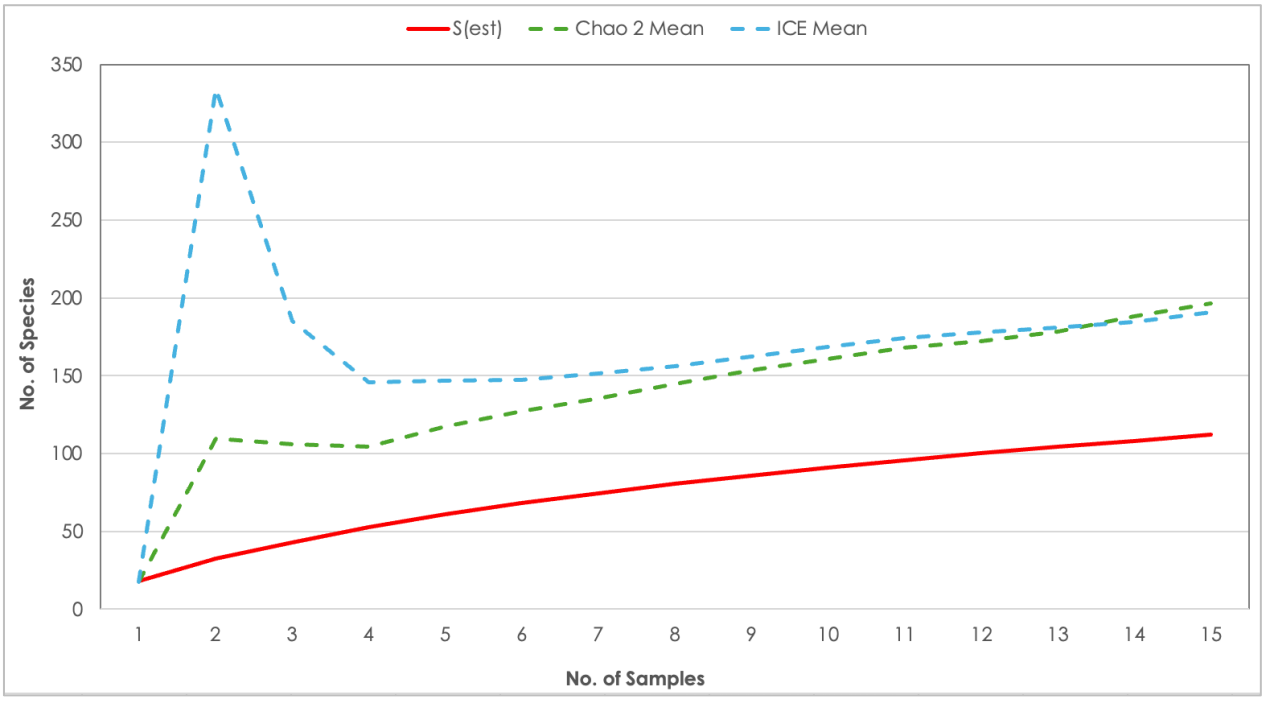


Figure 5.3: Species accumulation curve based on observation at the sampling sites (S(est)), together with two estimates of species richness (ICE and Chao 2).

Table 5.5: Recorded species richness compared with predicted species richness using incidence-based estimators (without opportunistic records).

Parameter		Number of Species (Native and Introduced)	Percent of Estimated Richness Recorded
Number of species recorded (from quadrats and relevés only)		113	
Estimated number of species	Chao 2 Mean	192	58.9%
	ICE Mean	195	57.9%

5.2.3 Unresolved Taxa

The majority (approximately 94%) of the recorded flora taxa were able to be identified to the lowest level possible within the current taxonomic framework. One specimen, identified as *Hibiscus* aff. *leptocladus*, did not fit the typical taxonomic description for the species. The taxonomist noted that leaves were more distinctly lobed on this specimen than usual, however the plant was virally infected and was also sterile, which made a positive identification of this specimen difficult. Given this, the specimen has been considered as *Hibiscus* sp. for the purposes of this report. The remaining taxa comprised those specimens for which insufficient material was present to confirm the species (being either juveniles or lacking reproductive material where this is needed for identification). None of the unresolved taxa are thought to represent significant species.

5.2.4 Species Richness

Species richness typically shows a positive relationship with various factors, including the size of the Survey Area, the diversity of habitats present, the amount of rainfall received in the locality, and the survey effort expended. The total number of native species recorded by the current study is shown in Figure 5.4, compared with the other surveys in the locality reviewed as part of the desktop study (see Section 4.7). Although species richness from the current study was lower than from other surveys of the locality, this was expected given that the Survey Area was a smaller size. The Cunderline North survey was also undertaken during optimal seasonal conditions. In addition, the Survey Area did not intersect a high diversity of habitat types: it predominantly comprised undulating stony plains and drainage lines, with no sampling sites on hill slopes, crests or in gorges, which would have provided additional species to the study.

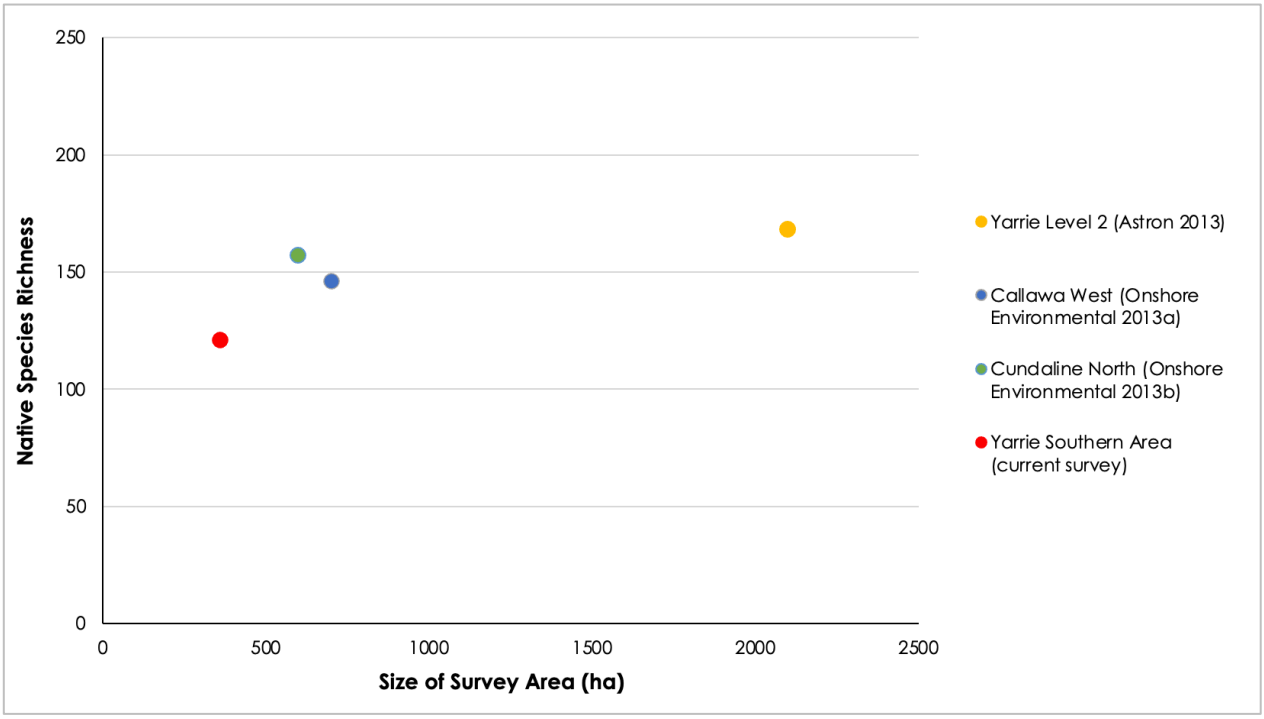


Figure 5.4: Species richness for the current Survey Area, compared to other surveys in the locality.

5.2.5 Significant Flora

No Threatened or Priority flora species were recorded during the survey.

Based on the level of on-ground survey effort and the vegetation associations mapped for the Survey Area, most of the significant flora identified as having the potential to occur in the Survey Area from the desktop study were ranked as 'unlikely to occur' following the survey (see Appendix 3). One species of significant flora is still considered to be moderately likely to occur in the Survey Area:

- ***Euphorbia clementii* (Priority 3)**
  Euphorbia clementii is an erect herb to 60 cm tall, which occurs on stony plains and hillslopes throughout the Chichester and Roebourne subregions of the Pilbara (WA Herbarium 2024). There are several previous records of this species from the Yarrie locality: the closest is in the hills 3.1 km northeast of the Survey Area, and there are three additional records from stony or sandy plains to the northwest (the closest of which is 8.5 km from the Survey Area). Suitable habitat may occur within the Survey Area in vegetation associations SP TeTw Ch Ai. Although this species was not recorded during the field survey, it may not have been present (or may have been more difficult to detect) due to the dry conditions. Given the proximity of the other records, it is still considered that this species may occur in the Survey Area.

5.2.6 Introduced Flora

Seven species of introduced flora were recorded from the Survey Area (Appendix 7). None of these species are listed as WoNS, however **Calotropis procera* (Plate 5.16) is a Declared Pest for the whole of WA under the BAM Act.

The DBCA designates a Weed Species Ranking for species in each major region of WA through the Weed Prioritisation Process (WPP) (see Department of Parks and Wildlife 2013). This takes into account the potential distribution, current distribution, ecological impact, invasiveness and feasibility of control to derive a broad qualitative weed species ranking, the aim of which is to guide specific management actions. Based on the most recent Pilbara ranking (DBCA 2023), **Calotropis procera* is listed as a Priority alert weed, requiring DBCA to be notified if the species is found on their managed land; this indicates the seriousness with which this species is viewed. All other weed species recorded from the Survey Area are ranked as High for ecological impact and Rapid for invasiveness, indicating that they are considered to be serious environmental weeds for the region.



Plate 5.16: The Declared Pest, **Calotropis procera*, at the toe of the OSA (left) and in a sandy creek bed in vegetation association ME Cfl AtpAcoc CcCs Cyv (right).

Table 5.6: Summary of introduced species recorded in the Survey Area, including WPP rankings for the Pilbara region.

Family	Species (Common Name)	Description (from WA Herbarium (2024), unless otherwise cited)	DBCA Pilbara Weed Species Rankings †		Distribution in the Survey Area
			Impact	Invasiveness	
Apocynaceae	**Calotropis procera* (Calotrope)^	Perennial shrub or small tree growing up to 4 m tall, which is native to Asia and sub-tropical parts of southeast Asia. It can form dense thickets on alluvial floodplains and over-grazed pastures in northern Australia (ALA 2023).	-	-	Recorded from 10 locations (seven opportunistic records and from sites YSA-03, YSAR-05 and YSAR-13), with a total of approximately 127 individuals recorded during the survey. Mostly recorded from the drainage line association (ME Cfl AtpAcoc CcCs Cyv) but also recorded in the Rehabilitation unit and in disturbed areas such as along the lower slope of the OSA.
Fabaceae	**Vachellia farnesiana* (Mimosa Bush)	Spreading, thorny shrub to 4 m tall, with dark grey bark, pinnate leaves, and yellow flowers in winter. Widespread from the Kimberley to near Perth, typically occurring along drainage systems and in adjacent low-lying areas (Hussey et al. 2007).	H	R	Recorded from four locations (two opportunistic records and from sites YSA-03 and YSAR-13), from the drainage line association ME Cfl AtpAcc CocCs Cyv, with an estimate of 33 individuals recorded during the survey.
Malvaceae	**Malvastrum americanum* (Spiked Malvastrum)	Erect, perennial herb or shrub generally to 0.5 m tall, with yellow or orange flowers from April to July. A common introduced species associated with mulga vegetation, hills, rockpiles, plains, drainage lines and floodplains. This species is widespread throughout the Kimberley, Pilbara, Gascoyne and Carnarvon bioregion.	H	R	Recorded from two locations (YSA-03 and an opportunistic record), both from the drainage line unit ME Cfl AtpAcoc CcCs Cyv in the south of the Survey Area. Only scattered individuals were observed in the understorey with an estimate of six individuals recorded during the survey.
Poaceae	**Cenchrus ciliaris* (Buffel Grass)	A perennial tussock grass growing to 1 m tall and flowering for most of the year, which was introduced by pastoralists as a fodder species and is now widespread through WA. This species has demonstrated allelopathic capacities, whereby it releases chemicals that inhibit the growth of other plants (Cheam 1984a, 1984b, Hussain et al. 2010), and it competes aggressively and effectively with native flora species. Commonly found along drainage lines, floodplains, in sandy coastal areas and disturbed sites, where it can form dense tussock grasslands. Reproduces by seed and short rhizomes and thought to be dispersed	H	R	Recorded from four sites and one opportunistic record. This was a dominant species in the understorey at two sites (YSA-03 and YSAR-13), most notably at site YSAR-13 where it was recorded at 20% cover in the drainage line (and was co-dominant with **C. setiger*).

Family	Species (Common Name)	Description (from WA Herbarium (2024), unless otherwise cited)	DBCA Pilbara Weed Species Rankings †		Distribution in the Survey Area
			Impact	Invasiveness	
		primarily by wind and water, but can also be spread through the movement of mammals, birds and vehicles.			
Poaceae (cont.)	**Cenchrus setiger* (Birdwood Grass)	An erect tussocky perennial grass, which grows in the same habitats as Buffel Grass but is usually less common in the Pilbara. Similarly introduced as a fodder species in pastoral areas and has since become a common weed in watercourses from Carnarvon to the Kimberley (Hussey et al. 2007).	H	R	Recorded from three sites and one opportunistic record, where it ranged from scattered individuals (YSA-02) to 20% cover (YSA-03).
	**Chloris virgata* (Feathertop Rhodes Grass)	Tufted perennial grass to 50 cm tall. This species is native to tropical Africa and has been recorded from roadsides and other disturbed sites throughout southern WA as well as the Pilbara, Kimberley and inland areas (Hussey et al. 2007).	H	R	One record of approximately 20 individuals of this species within site YSAR-13, within the drainage line vegetation association ME Cf AtpAcc CcCs Cyv.
	**Echinochloa colona* (Barnyard Grass)	Tufted annual grass growing to 60 cm, and flowering from February to July. It is a common weed of drainage lines and other damp habitats, particularly in the Pilbara and Kimberley. It can occur in moderate densities but does not appear to exclude other native species.	H	R	One record of approximately 20 individuals of this species within site YSAR-13, within the drainage line vegetation association ME Cfl AtpAcoc CcCs Cyv.

† Ecological Impact Rankings: L=Low; M=Medium; H=High; U=Unknown. Invasiveness rankings: S=Slow; M=Moderate; R=Rapid; U=Unknown.

^ Not ranked but listed as a Priority alert weed.

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6.0 Fauna Results

6.1 Fauna Habitats

Six distinct fauna habitats were identified within the Survey Area:

- Stony Plain;
- Sand Plain;
- Minor Drainage Lines;
- Artificial wetlands;
- Rehabilitation areas; and
- Cleared / Disturbed.

Fauna habitats are mapped in Figure 6.1 and Table 6.1 presents detailed information for each, including physical characteristics, dominant vegetation, area, proportion of the Survey Area, and a representative site picture taken during the survey.

Most of the Survey Area comprised plains (77.7%). The predominant fauna habitat was Stony Plain, accounting for over half of the Survey Area, with another 20% of the Survey Area comprising Sand Plain. The primary disturbances identified within the Survey Area were land clearing, habitat degradation by cattle, and weeds.

Based on reviews of aerial imagery and land systems, vegetation, and surface geology mapping (see 4.0), the fauna habitats identified are not confined to the Survey Area; all are common and widespread within the Chichester subregion (van Vreeswyk et al. 2004).

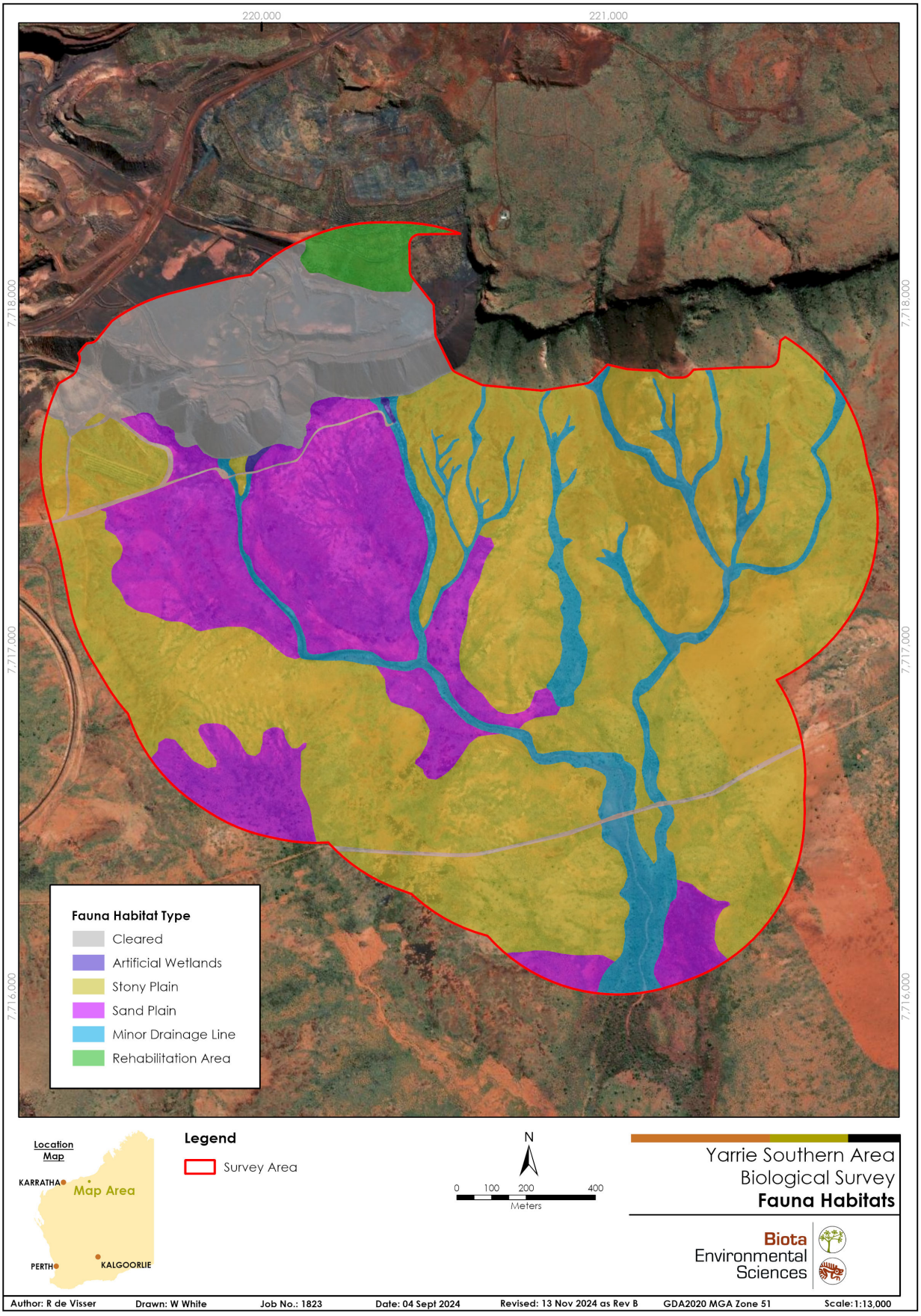


Figure 6.1: Fauna habitats within the Survey Area.

Table 6.1: Fauna habitats of the Survey Area.

Description and Condition	Significant Fauna Values for Species Likely to / May Occur	Representative Photo
Fauna Habitat: Stony Plain (Hummock grassland on rocky plain) **Extent within Survey Area:** 206.5 ha (56.9%) **Condition/Disturbance:** Vegetation mostly ranked as Excellent or Good condition. Some areas of recent fire, weeds and ground disturbance. **Description:** Scattered low trees of *Corymbia hamersleyana* and *C. opaca* over scattered tall shrubs of *Acacia inaequilatera* and *Grevillea wickhamii* over hummock grassland of *Triodia epactia* and *T. wiseana* on reddish brown sandy clay loam on stony footslopes, low stony hills and stony plains.	This habitat type is considered supporting habitat for the Northern Quoll (dispersing) and Grey Falcon (foraging). It provides suitable and important habitat for the Western Pebble-mound Mouse. It also provides supporting habitat for the Ghost Bat, Pacific Swift and Peregrine Falcon, which may also use it for aerial foraging.	
Fauna Habitat: Sand Plain (Low shrubland on sandy plain) **Extent within Survey Area:** 71.7 ha (19.8%) **Condition/Disturbance:** Vegetation mostly ranked as Excellent or Very Good condition, with some areas south of the Cleared habitat being Degraded due to ground disturbance. Some areas with extensive degradation by cattle. **Description:** Scattered low trees of *Corymbia hamersleyana* over low shrubland of *Acacia stellaticeps* with a small area of *A. ancistrocarpa* over open hummock grassland of *Triodia epactia* on dark reddish brown sandy loam plains.	This habitat type is considered critical denning and foraging habitat for the Bilby and supporting foraging habitat for the Grey Falcon. The Pacific Swift and Peregrine Falcon may also use this habitat type for aerial foraging, and it is potentially suitable for the Short-tailed Mouse and Brush-tailed Mulgara.	

Description and Condition	Significant Fauna Values for Species Likely to / May Occur	Representative Photo
Fauna Habitat: Minor drainage lines **Extent within Survey Area:** 32.2 ha (8.9%) **Condition/Disturbance:** Vegetation condition varying from Excellent to Poor; some areas having extensive degradation by cattle, and weeds also a contributor. **Description:** Minor drainage lines with dark reddish brown sandy clay loam creek beds, fringed by low open woodland of *Corymbia* spp. over high open shrubland of *Acacia tumida* var. *pilbarensis* over open hummock grassland of *Triodia epactia*.	Minor ephemeral drainages provide vegetated corridors through the landscape where water drains in a southerly direction off the rocky mesa to the north. These provide supporting habitat for species such as the Pilbara Olive Python and Northern Quoll which typically utilise these features to disperse, particularly while flowing. This is also considered supporting habitat for the Northern Quoll, Pilbara Leaf-nosed Bat, Bilby, Ghost Bat and Grey Falcon. The Glossy Ibis, Barn Swallow and migratory shorebirds may also use this habitat. The minor drainage lines were dry during the survey and do not appear to be regularly inundated.	
Fauna Habitat: Artificial wetland **Extent within Survey Area:** 2.4 ha (0.7%) **Condition/Disturbance:** Poor. White-surface crust and tree and shrub deaths observed in previously inundated areas. **Description:** Two Artificial wetland within the minor drainage lines at the toe of the OSA slope, appearing to arise primarily from mine seepage. One water feature contained macrophytes (*Typha domingensis* and *Schoenoplectus subulatus*).	No fauna species would utilise these areas as core habitat. It is considered supporting habitat for the Pilbara Olive Python (previous telemetry surveys have found an individual to reside here for at least 6 months (Biota 2023)) and species that forage aerially (e.g. the Grey Falcon, Peregrine Falcon, Pacific Swift, Pilbara Leaf-nosed Bat) and Ghost Bat, as prey species are locally abundant at water bodies.	

Description and Condition	Significant Fauna Values for Species Likely to / May Occur	Representative Photo
Fauna Habitat: Rehabilitation Area **Extent within Survey Area:** 5.5 ha (1.5%) **Condition/Disturbance:** Previously disturbed/cleared; rehabilitation vegetation in Good condition. **Description:** Rehabilitated mine slope. Mixed *Acacia* spp. over *Triodia epactia* on stony soils.	No fauna species would utilise these areas as core habitat.	
Fauna Habitat: Cleared **Extent within Survey Area:** 44.4 ha (12.2%) **Condition/Disturbance:** Degraded/Cleared. **Description:** OSA slope and tracks, devoid of native vegetation.	No fauna species would utilise these areas as core habitat. A small section at the southern end of the OSA slope contains loose rocky rubble that is considered supporting habitat for Pilbara Olive Python (previous telemetry surveys have located an individual here (Biota 2023) and the Northern Quoll (may provide temporary refuge).	

6.2 Significant Fauna Habitats

When assessing the value of habitat in the Survey Area, it is informative to consider the critical habitat for individual species of significance. Critical habitat for MNES species equates to "habitat critical to the survival of a species" as recognised for the purposes of the EPBC Act (Department of the Environment 2013). Additionally, BHP guidance defines habitats in further detail (BHP 2023a).

For each MNES species, fauna habitats may be classified as:

1. "critical", equivalent to "habitat critical to the survival of the species" (Commonwealth of Australia 2013) – this comprises habitat considered to potentially contain roosting, denning or breeding sites, primary foraging areas, or refugia during drought, fire or other stress; or
2. "supporting" – these comprise the remaining habitats of the Survey Area, which may be used on a transitory, dispersing or occasional basis, but do not represent critical habitat.

It is assumed that some proportion of critical habitat must be maintained across a species' range to ensure its persistence in the region. Supporting habitats may be used for less regular foraging or on a transitory, dispersing, or occasional basis, but do not represent critical habitat.

Potential habitat usage by significant fauna species, and whether habitat would constitute critical or supporting habitat for MNES species, is discussed in Sections 6.4 and 6.5. In summary, the extent of identified critical habitat for MNES species within the Survey Area is limited. All fauna habitats identified as being utilised, or having the potential to be utilised, by significant species within the Survey Area are not restricted to the Survey Area or locality, and occur contiguously with the same habitat types outside of the Survey Area.

6.3 Vertebrates Recorded by the Field Survey

A total of 55 vertebrate species were recorded in the Survey Area during the field survey, comprising 17 mammals (including 11 bat species), 33 birds and five reptiles (Table 6.2). The duration of the survey was adequate for a basic documentation of the fauna assemblage (see Figure 6.2), although a higher diversity of species would have been recorded with detailed survey methods. Two introduced species were recorded: European Cattle (**Bos primigenius taurus*) and Dog/Dingo (**Canis familiaris*).

Table 6.2: Vertebrate fauna species recorded from the Survey Area during the field survey.

Species	Common Name	Conservation Status	
		State	C'wealth
Mammals			
Dasyurus hallucatus	Northern Quoll	EN	EN
Osphranter robustus	Euro, Biggada		
Osphranter rufus	Red Kangaroo, Marlu		
Pseudomys chapmani	Western Pebble-mound Mouse	P4	
**Bos primigenius taurus*	European Cattle		
**Canis familiaris*	Dog/Dingo		
Rhinonicteris aurantia Pilbara form	Pilbara Leaf-nosed Bat	VU	VU
Saccolaimus flaviventris	Yellow-bellied Sheath-tailed Bat		
Taphozous georgianus	Common Sheath-tailed Bat		
Austronomus australis	White-striped Free-tailed Bat		
Chaerephon jobensis	Greater Northern Free-tailed Bat		
Ozimops lumsdenae	Northern Free-tailed Bat		
Chalinolobus gouldii	Gould's Wattled Bat		
Chalinolobus morio	Chocolate Wattled Bat		

Species	Common Name	Conservation Status	
		State	C'wealth
Nyctophilus geoffroyi	Lesser Long-eared Bat		
Scotorepens greyii	Little Broad-nosed Bat		
Vespadelus finlaysoni	Finlayson's Cave-bat		
Birds			
Eurostopodus argus	Spotted Nightjar		MA
Aegotheles cristatus	Australian Owlet-nightjar		
Ocyphaps lophotes	Crested Pigeon		
Geophaps plumifera	Spinifex Pigeon		
Geopelia cuneata	Diamond Dove		
Burhinus grallarius	Bush Stone-curlew		
Dacelo leachii	Blue-winged Kookaburra		
Todiramphus pyrrhopygius	Red-backed Kingfisher		
Merops ornatus	Rainbow Bee-eater		MA
Falco cenchroides	Nankeen Kestrel		MA
Eolophus roseicapilla	Galah		
Melopsittacus undulatus	Budgerigar		
Malurus assimilis	Purple-backed Fairywren		
Lichmera indistincta	Brown Honeyeater		
Melithreptus gularis	Black-chinned Honeyeater		
Gavicalis virescens	Singing Honeyeater		
Ptilotula keartlandi	Grey-headed Honeyeater		
Ptilotula penicillata	White-plumed Honeyeater		
Manorina flavigula	Yellow-throated Miner		
Acanthiza uropygialis	Chestnut-rumped Thornbill		
Artamus cinereus	Black-faced Woodswallow		
Cracticus nigrogularis	Pied Butcherbird		
Coracina novaehollandiae	Black-faced Cuckooshrike		MA
Lalage tricolor	White-winged Triller		
Pachycephala rufiventris	Rufous Whistler		
Colluricincla harmonica	Grey Shrikethrush		
Rhipidura leucophrys	Willie Wagtail		
Grallina cyanoleuca	Magpie-lark		MA
Corvus orru	Torresian Crow		
Poodytes carteri	Spinifexbird		
Emblema pictum	Painted Finch		
Taeniopygia castanotis	Australian Zebra Finch		
Anthus australis	Australian Pipit		MA
Reptiles			
Ctenophorus caudicinctus	Ring-tailed Dragon		
Ctenophorus isolepis	Military Dragon		
Ctenophorus nuchalis	Central Netted Dragon		
Ctenotus saxatilis	Rock Ctenotus		
Varanus gouldii	Bungarra or Sand Goanna		

* Introduced

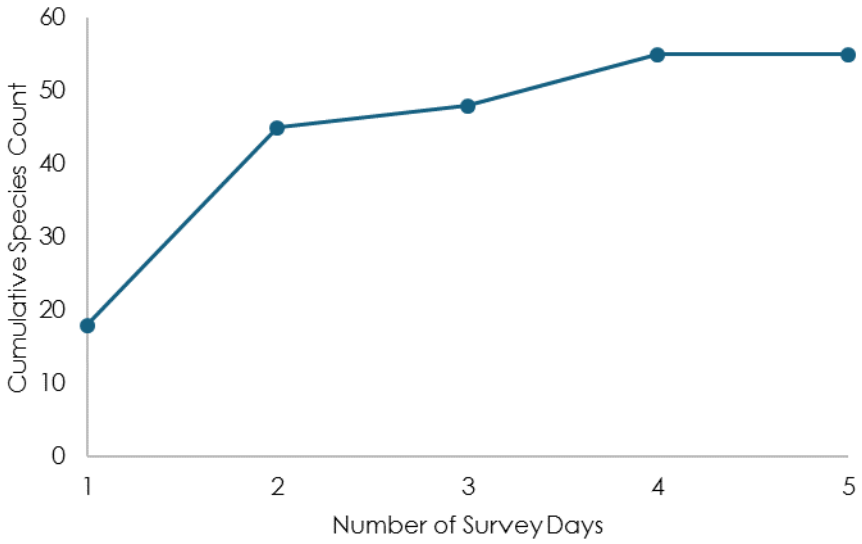


Figure 6.2: Fauna species accumulation curve from the field survey.

6.4 Significant Vertebrate Fauna of the Survey Area

6.4.1 Summary of Significant Fauna Recorded

During the field survey, three significant vertebrate fauna species were recorded, comprising:

- Northern Quoll (*Dasyurus hallucatus*) – secondary observation (scat) – Endangered under the BC Act and EPBC Act;
- Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia)* – call data – Vulnerable under the BC Act and EPBC Act; and
- Western Pebble-mound Mouse (*Pseudomys chapmani*) – secondary observation (inactive mounds) – DBCA Priority 4.

In addition, the Pilbara Olive Python (*Liasis olivaceus barroni*), listed as Vulnerable under the BC Act and EPBC Act, has been previously recorded within the Survey Area.

A summary of the significant species recorded within the Survey Area is presented in Table 6.3, and the species are discussed in detail in Sections 6.4.1.1 to 6.4.1.3 below. The locations of records from the current survey are mapped in Figure 6.3. Six avifauna species listed as Marine species under the EPBC Act were also recorded during the survey (see Section 6.4.1.4).

Table 6.3: Significant fauna occurring within the Survey Area during the current survey.

Species	Common Name	Conservation Status		Records
		State	C'wlth	
Dasyurus hallucatus	Northern Quoll	EN	EN	One scat recorded during survey.
Rhinonicteris aurantia Pilbara form	Pilbara Leaf-nosed Bat	VU	VU	53 total calls detected during survey from three ultrasonic audio recorders.
Pseudomys chapmani	Western Pebble-mound Mouse	P4		Four inactive pebble-mounds recorded.

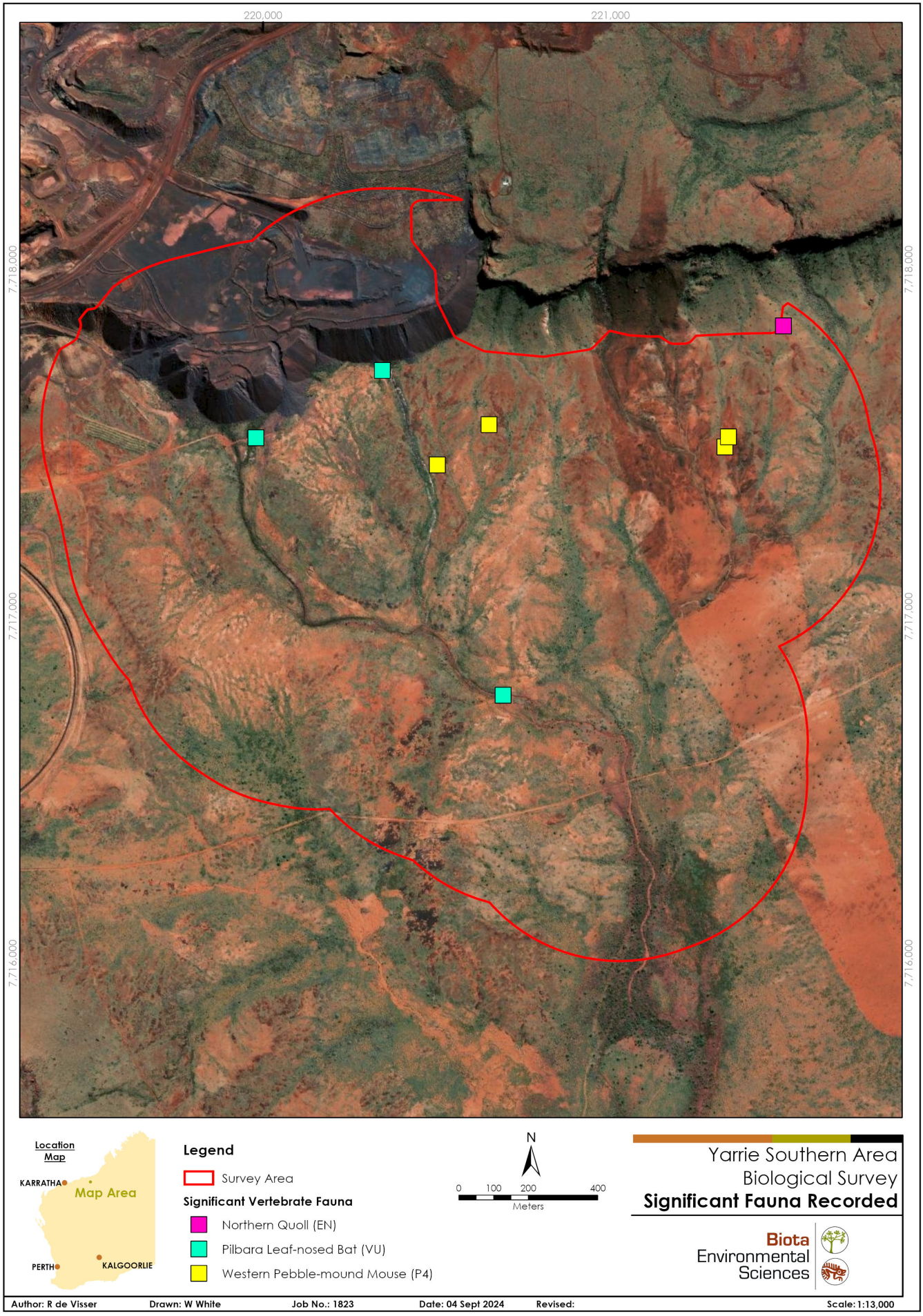


Figure 6.3: Significant vertebrate fauna recorded during the current survey from the Survey Area.

6.4.1.1 Northern Quoll *Dasyurus hallucatus*

The Northern Quoll is listed as Endangered under the BC Act and EPBC Act. Historically common across northern Australia, its distribution has declined dramatically and it is now restricted to the Pilbara, Kimberley, parts of the Northern Territory, and near-coastal Queensland (DCCEEW 2023a). Northern Quolls are particularly susceptible to cane toad poisoning and face a myriad of other threats, including predation by feral cats, hot fires, grazing and habitat loss (DCCEEW 2023a).

A Northern Quoll scat was found during a targeted search on the 9th of May 2024 (Plate 6.1 and Plate 6.2). The observation was along the foot slopes of a major ridgeline in the northeastern section of the Survey Area (Figure 6.3). The exact age of the scat could not be determined. However, its position suggests that it had likely remained undisturbed by rainfall or wind.



Plate 6.1: Northern Quoll scat.



Plate 6.2: Site where Northern Quoll scat was observed.

Ground-truthing during the survey confirmed that habitats meeting the definition of critical habitat (Commonwealth of Australia 2013, BHP 2023a) for the Northern Quoll were absent from the Survey Area, however supporting habitat was present. The Minor Drainage Line fauna habitat meets the definition of supporting habitat as it may be used for foraging and dispersal (Commonwealth of Australia 2016, BHP 2023a).

Within the Pilbara, Northern Quoll have shown a preference for rocky areas, including stony plains supporting either hard or soft spinifex grasslands (Cook 2010, Cowan et al. 2022). The species has also been recorded in other habitat areas, including shrublands, sandy plains and tussock grasslands (Cowan et al. 2022). Therefore, the Stony Plain and Sand Plain fauna habitats are also considered to provide supporting habitat for Northern Quoll. The remaining habitats in the Survey Area are not considered to be prospective for the Northern Quoll as they contain little in the way of vegetative cover, den or shelter locations, making quolls vulnerable to predators such as dingos, feral cats and foxes.

As a scat was recorded in the Survey Area, this species is known to occur, and there are multiple records (Figure 4.6) and critical habitat for the species immediately adjacent and in proximity to the Survey Area.

6.4.1.2 Pilbara Leaf-nosed Bat *Rhinonicteris aurantia* Pilbara form

The Pilbara Leaf-nosed Bat is listed as Vulnerable under the BC Act and EPBC Act. The Pilbara form of *Rhinonicteris aurantia* occurs in the Pilbara, Ashburton and Little Sandy Desert bioregions (Bat Call WA 2021a). The Pilbara population is considered a single interbreeding group composed of multiple colonies (Umbrello et al. 2022). The species requires caves with stable warm and humid conditions for roosting (DCCEEW 2024b). There are currently 17 known Category 1 or 2 diurnal roost sites (Bat Call WA 2021a). The species forages both within and around roost caves, as well as along waterbodies with fringing vegetation that supports prey species, typically extending up to 20 km from the roost site and utilizing a relatively wide variety of habitats (Threatened Species Scientific

Committee 2016, Bat Call WA 2021a). Foraging areas near known or suspected roost sites may be critical to the species' survival. Areas with complex vegetation and permanent or ephemeral water, such as drainage lines, have the highest foraging potential. The species will also use a range of other habitats and traverse through less suitable habitat to foraging sites (Bat Call WA 2021a).

Pilbara Leaf-nosed Bat calls were recorded at three of the four ultrasonic recorder locations (Table 6.4; Figure 6.3). The number of detections was highest at YSA-01BAT, likely due to the waterbody present (WYAR-01) encouraging drinking and foraging at this location. It is not possible to determine if the records represent numerous individuals or a single individual calling repeatedly. Given the low number of detections at all three sites, these records likely represent individuals flying by or occasionally foraging.

Table 6.4 Pilbara Leaf-nosed Bat recorded in the Survey Area.

Site	Landform	Night	Number of Detections	Time of First Detection	Time of Last Detection
YSA-01BAT	Minor drainage – permanent water pool	6/5/2024	28	18:56	5:04
		7/5/2024	17	18:37	5:02
YSA-02BAT	Minor drainage – permanent water pool	6/5/2024	5	19:31	3:14
YSA-03BAT	Minor drainage - dry	8/5/2024	3	19:53	2:45

Ground-truthing during the survey confirmed that habitat meeting the definition of critical habitat (Commonwealth of Australia 2013) for the Pilbara Leaf-nosed Bat was absent, and no suitable roosting or breeding locations were identified within the Survey Area. However, critical habitat was present in the form of two permanent water sources (WYAR-01 and WYAR-02) within 8.7 km of Category 1-3 caves. This definition is based on Bat Call (2021a), which notes all known permanent and natural Pilbara Leaf-nosed Bat roosts occur within flying range of a permanent water source, with the longest linear distance being 8.7 km. Fauna monitoring by Biologic (2022a) identified six known nocturnal refuge sites within 5 km of the Survey Area, the nearest (CCAL-04) being approximately 2 km southwest of the current Survey Area. Biologic (2022a) also recorded one Category 3 cave (CYAR-01) approximately 3.5 km southwest of the current Survey Area.

The Minor Drainage Line fauna habitat is considered suitable foraging habitat for the Pilbara Leaf-nosed Bat, particularly as it connects to rocky hills outside of the Survey Area (Threatened Species Scientific Committee 2016). Fringing vegetation has three layers (open woodland over high open shrubland over low open hummock grassland), although it is not vegetatively complex. The drainages were dry during the survey and appear to only occasionally be temporarily inundated following significant rainfall events. The WYAR-01 waterbody appeared to be an artificial water source seeping through the OSA which has been present in the Survey Area since at least February 2022. However, drainage line habitat was also heavily degraded by weeds and cattle.

The species was documented during the current survey, with multiple contemporary records and known caves located immediately adjacent to and in proximity with critical habitat (roosts) within the Survey Area.

6.4.1.3 Western Pebble-mound Mouse *Pseudomys chapmani*

The Western Pebble-mound Mouse is listed as a Priority 4 species by the DBCA. The species is widespread through suitable habitat in the extensive ranges of central and southern Pilbara and smaller ranges of the Little Sandy Desert, and formerly also occurred in the Gascoyne and Murchison regions pre-1970s (van Dyck and Strahan 2008). Suitable habitat consists of stony gentle slopes and plateaus of rocky ranges with hard spinifex; there are often occasional eucalypts and scattered shrubs, and mounds are usually in close proximity to drainage lines (van Dyck and Strahan 2008).

This species is well known for constructing pebble-mounds, which consist of even-sized small pebbles (usually <5 g) that may cover 0.5 – 9 m^2 and be up to 0.5 m high (Start et al. 2000). These

mounds are communal and used by successive generations. Individuals will maintain burrows surplus to apparent needs (not all 'active' mounds house individuals); this is possibly advantageous to their boom-and-bust life cycle, as mounds can be occupied during 'boom' times (van Dyck and Strahan 2008).

Four inactive mounds of the Western Pebble-mound Mouse were recorded during the current survey at three search locations: YSA-01DS, YSA-05DS (two mounds) and YSA-09DS (Plate 6.3 to Plate 6.6; Figure 6.3). All observations were within the Stony Plain fauna habitat. This habitat type is required for the presence of the Western Pebble-mound Mouse in the Survey Area as it represents the species preferred habitat type. There has been limited detailed survey effort in recent years in areas with previous records of individuals or active mounds. While the desktop study identified numerous records from the locality, recent records comprised many other inactive mounds (Eco Logical 2012, Astron 2013, Biologic 2014a), while older records included an active mound within 4 km northwest of the Survey Area (Astron 2013) and several trapping records from 1993 within 4 km northeast of the Survey Area (DBCA Threatened Fauna search). The lack of active mounds recorded on the current survey and recent surveys from the locality may indicate that there is not currently a population residing in the Survey Area. However, it could also be due to limited survey effort. As the species clearly inhabited the area previously, it is possible that the species still occurs in the Survey Area or in connected habitat outside of the Survey Area.



Plate 6.3: **Inactive *P. chapmani* mound at YSA-01DS.**



Plate 6.4: **Inactive *P. chapmani* mound at YSA-09DS.**



Plate 6.5: **Inactive *P. chapmani* mound at YSA-05DS.**



Plate 6.6: **Inactive *P. chapmani* mound at YSA-05DS.**

6.4.1.4 EPBC Act Marine Listed Birds

The EPBC Act maintains a list of fauna species recognised as MNES that are protected under the Act. Marine species are included under the Act, including bird species that rely upon marine environments for survival.

However, the Act also erroneously lists some species that do not actually rely upon the marine environment for survival, but instead primarily utilise terrestrial environments and in some cases, are often widespread and common (Garnett 2013).

The six Marine listed species recorded during the survey fit into this category; none rely upon marine environments for survival, and all are relatively common and widespread. The species are the Spotted Nightjar (*Eurostopodus argus*), Rainbow Bee-eater (*Merops ornatus*), Nankeen Kestrel (*Falco cenchroides*), Black-faced Cuckoo-shrike (*Coracina novaehollandiae*), Magpie-lark (*Grallina cyanoleuca*) and Australian Pipit (*Anthus australis*). These species are not of genuine significance in the context of the survey and are therefore not discussed further.

6.5 Significant Vertebrate Fauna Potentially Occurring

An assessment of the likelihood of occurrence of significant fauna species within the Survey Area identified one species known to occur, five species that were considered likely to occur (i.e. have a high likelihood of occurrence), and seven species that may occur (i.e. have a moderate likelihood of occurrence) (Appendix 4).

Species known to occur (previously recorded) in the Survey Area:

- Pilbara Olive Python (*Liasis olivaceus barroni*) – BC Act and EPBC Act Vulnerable.

Species considered likely to occur in the Survey Area:

- Bilby, Dalgyte (*Macrotis lagotis*) – BC Act and EPBC Act Vulnerable;
- Ghost Bat (*Macroderma gigas*) – BC Act and EPBC Act Vulnerable;
- Pacific Swift (*Apus pacificus*) – BC Act and EPBC Act Migratory;
- Grey Falcon (*Falco hypoleucos*) – BC Act and EPBC Act Vulnerable; and
- Peregrine Falcon (*Falco peregrinus*) – BC Act Other Specially Protected Fauna.

Species considered to have a moderate likelihood of occurrence in the Survey Area:

- Brush-tailed Mulgara (*Dasycercus blythi*) – DBCA Priority 4;
- Short-tailed Mouse (*Leggadina lakedownensis*) – DBCA Priority 4;
- Common Sandpiper (*Actitis hypoleucos*) – BC Act and EPBC Act Migratory;
- Oriental Plover (*Charadrius veredus*) – BC Act and EPBC Act Migratory;
- Oriental Pratincole (*Glareola maldivarum*) – BC Act and EPBC Act Migratory;
- Barn Swallow (*Hirundo rustica*) – BC Act and EPBC Act Migratory; and
- Glossy Ibis (*Plegadis falcinellus*) – BC Act and EPBC Act Migratory.

An additional 21 species were considered unlikely to occur (Appendix 4) and are not discussed further.

6.5.1 Significant Fauna known to occur

6.5.1.1 Pilbara Olive Python (*Liasis olivaceus barroni*)

The Pilbara Olive Python is listed as Vulnerable under the BC Act and EPBC Act. There is no reliable information on the historical distribution of the Pilbara Olive Python and no published evidence that it has significantly contracted in range. Currently the species is confined to ranges in the Pilbara and islands of the Dampier Archipelago, with one isolated population known from Mount Augustus in the Gascoyne region (Bush and Maryan 2011).

Preferred habitat for the Pilbara Olive Python includes gorges, escarpments, rocky outcrops and permanent drainages with fringing vegetation (Pearson 2003, Bush and Maryan 2011). Refuges include caves, rocky crevices, gorges containing rockpools (where it can lie in an ambush position) and occasionally in trees overhanging water (Pearson 2003, Bush and Maryan 2011). Radio-telemetry studies indicate that individuals are usually in close proximity to water and rock outcrops that attract suitable prey (Pearson 2003). The Pilbara Olive Python is often associated with ephemeral or permanent water but may also be recorded in rocky habitats some distance from these features in transitory or dispersal habitat (Biota, in prep).

No Pilbara Olive Pythons were recorded during the survey. A live individual has previously been recorded in the Survey Area, most recently in November 2023 (Biota 2023). Ongoing monitoring of Pilbara Olive Pythons in the locality using radio-telemetry recorded an adult male in the loose rocks at the base of the OSA where the drainage meets the mine feature. This individual was initially captured on the 3rd of April 2023. Subsequent monitoring over the following months tracked its movements, whereupon it was found to reside at the seepage until November 2023. During the current survey, the individual was located on two occasions using a handheld yagi antenna and was recorded having moved east out of the Survey Area and into a rocky escarpment (Figure 6.4). Based on the recorded movements of this individual, the Survey Area contains 28.8 ha (24%) of the individual's overall area of utilisation (see Figure 6.4). However, much of this is comprised of cleared area (21.9 ha) with radio-tracking indicating that movements are primarily constrained to the permanent water source WYAR-01.

Ground-truthing during the survey confirmed that habitats meeting the definition of critical habitat (Commonwealth of Australia 2013) for the Pilbara Olive Python were absent from the Survey Area. However, the use of mine legacy features, such as the OSA within the Survey Area remains poorly understood. Based on the observed persistence of an individual using this feature for a period of at least six months, this area could be classified as supporting habitat (Threatened Species Scientific Committee 2008). The drainage lines running from north to south, beginning at the toe of the OSA in the northwest section of the Survey Area, are also considered supporting habitat. These areas may be used by the python to ambush prey when the system contains water and potentially for transient use, as the eucalypts along the edges provide hollows for refuge. While these habitats may periodically serve as foraging grounds, the other habitats within the Survey Area are generally not considered favourable for Pilbara Olive Python dispersal due to the lack of vegetative cover and shelter, leaving individuals vulnerable to predators such as dingoes, feral cats, and foxes.

As the species was recorded in 2023 within the Survey Area, it is known to occur.

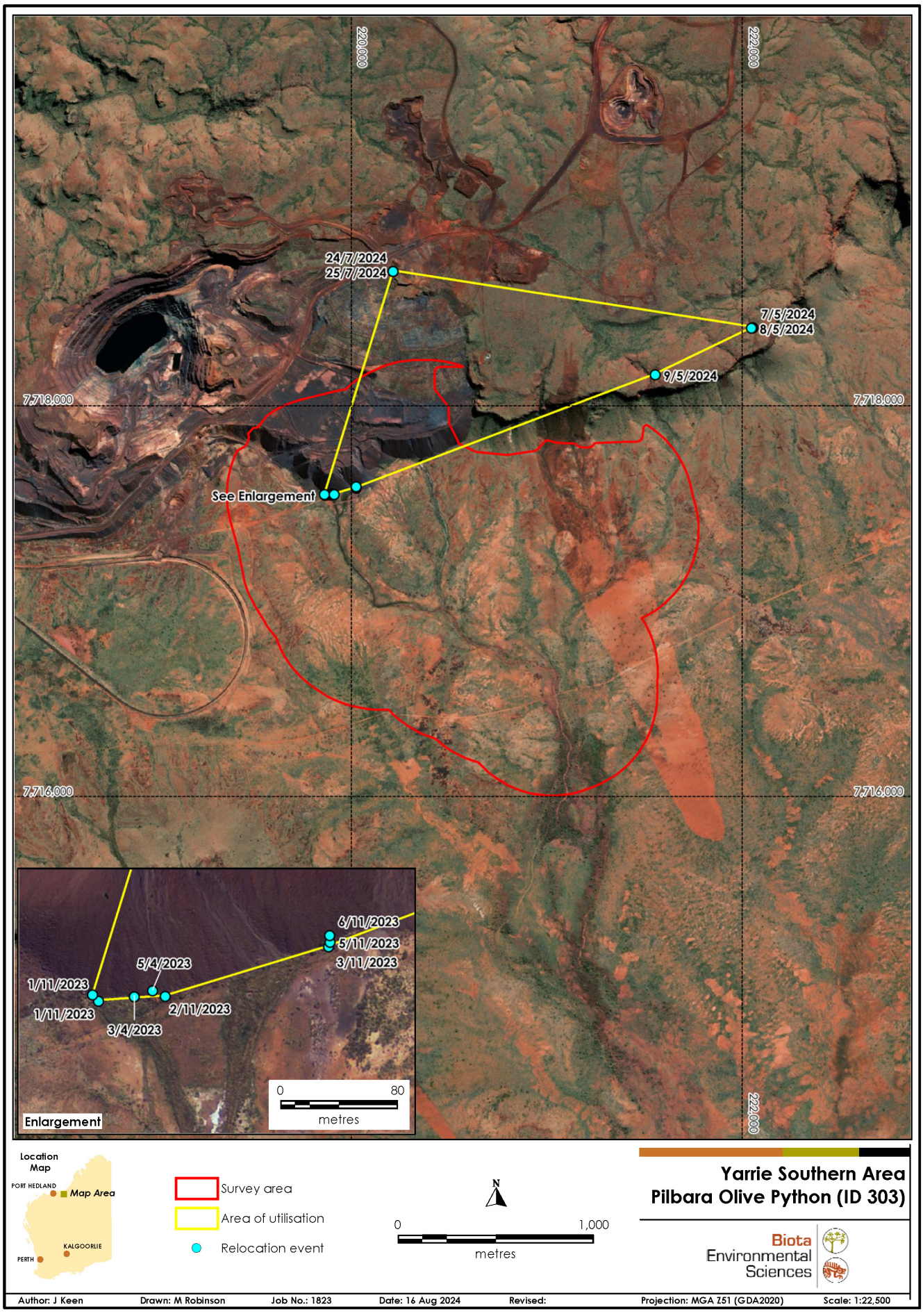


Figure 6.4: **Pilbara Olive Python movements relative to the Survey Area based on radio-tracking of an adult male.**

6.5.2 Significant Fauna Likely to Occur (High Likelihood)

6.5.2.1 Bilby, Dalgyte (*Macrotis lagotis*)

The Bilby, or Dalgyte, is listed as Vulnerable under the BC Act and EPBC Act. It is a medium-sized marsupial adapted for digging, and creates extensive burrow systems for shelter which may also be utilised by a number of other fauna species including snakes, lizards and other marsupials (Moritz et al. 1997). Since European colonisation, the Bilby's distribution has contracted by 80%; it is now restricted to the drier and less fertile areas of the Tanami and Great Sandy Deserts in WA, with an isolated population in southwest Queensland (DCCEEW 2023b). The remaining populations of the greater bilby occupy three main habitats: open tussock grassland on uplands and hills, *Acacia aneura* (mulga) woodland/shrubland growing on ridges and rises, and hummock grassland in plains and alluvial areas (Woinarski et al. 2014).

Bilbies are highly mobile compared to other medium-sized mammals and use multiple burrows, indicating that they are well adapted to the resource variability in arid environments (DCCEEW 2023b). Bilbies are typically found in scattered, low-density colonies, each occupying areas ranging from 5 to 20 ha (Moritz et al. 1997). A single bilby may use up to 18 burrows, sometimes up to 1 km apart, and may use up to three different burrows in a night (Dziminski et al. 2020). While detailed information on their population dynamics and movement within these colonies remains limited (Moritz et al. 1997), bilbies are known to move between suitable habitats in response to environmental factors such as rainfall and fire, which affect the availability of food and shelter (Southgate 2006).

No evidence of the Bilby was recorded within the Survey Area during the current survey. Numerous records in the locality were identified from the desktop study, the closest approximately 3 km from suitable habitat within the Survey Area boundary and as recent as 2022. It is possible that home ranges of these individuals extend into the current Survey Area. The Sand Plain fauna habitat is considered critical denning and foraging habitat (Dziminski and Carpenter 2018). Additionally, the ephemeral Minor Drainage Line habitat present within the Survey Area would be considered suitable supporting habitat (Dziminski and Carpenter 2018). Given the presence of recent nearby records, as well as critical and supporting habitat, the Bilby is considered likely to occur within the Survey Area.

6.5.2.2 Ghost Bat (*Macroderma gigas*)

The Ghost Bat is listed as Vulnerable under both the BC Act and EPBC Act. Ghost Bats previously occurred across most of inland and northern Australia, but are now restricted to the tropical and subtropical north of the continent (Churchill 2008). The current distribution of this species is fragmented, with each population showing some genetic differentiation (Armstrong and Wilmer 2004). In the Pilbara, Ghost Bats usually occur alone or in small colonies, however there are some large colonies in abandoned mines (Bat Call WA 2021b).

Ghost Bats occur in a broad range of habitats, with distribution influenced by the availability of suitable caves for roost sites and prey biomass; individuals are known to forage over areas of up to 60 ha (Churchill 2008). Roost sites include caves, rock crevices and disused mine adits (Bat Call WA 2021b).

There is limited knowledge of foraging habitat, but GPS data suggests that bats prefer to forage on productive plain areas with thin mature woodland over patchy or clumped tussock or hummock grass (*Triodia* spp.) on sand or stony ground [with] isolated trees, and within trees on the edge of thin thickets on the plains, or trees along the edges of watercourse woodlands (as they support the species preferred vantage points) (Bat Call WA 2021b). Similarly, Biologic (2022b, 2022a, 2023) found stony plains to be suitable foraging habitat, but also identified drainage areas and floodplains as highly suitable. Ghost Bats typically forage up to 12 km from their diurnal roost (Bat Call WA 2021b).

Ground-truthing during the survey confirmed that habitats meeting the definition of critical habitat (Commonwealth of Australia 2013) for the Ghost Bat were absent from the Survey Area. No Ghost Bats were recorded during the current survey and no suitable roosting or breeding locations were

identified within the Survey Area. Records from the locality were identified during the desktop study, with the closest being approximately 1.5 km south, recorded in 2022. In addition, targeted fauna monitoring by Biologic (2023) identified 29 suitable caves in the locality, 14 were classified as Category 3 caves, four were Category 4 caves, two were Category 2 caves and the remaining nine required confirmation of their use by Ghost Bat. This included one transitory diurnal roost and 13 nocturnal refuges, with the closest approximately 2 km southwest of the Survey Area. Two Category 2 caves were also recorded within 5 km southwest (CYAR-01 and CYAR-04).

The Minor Drainage Line and Stony Plain habitats in the Survey Area likely have some foraging potential, with eucalypts along the edge of the minor drainage line providing vantage points for locating prey. While these habitats typically represent critical foraging habitat as they are within 12 km of a critical roost (Category 2 caves CYAR-01 and CYAR-03), they are unlikely to be productive due to a lack of mature trees and understory. Therefore, they are not considered critical habitat as per the Commonwealth of Australia (2013). However, given the quantity and proximity of previous records, the Ghost Bat is likely to occur in the Survey Area as an occasional foraging visitor or while travelling through to more productive foraging areas. Therefore, these habitats may provide supporting habitat for the species.

6.5.2.3 Pacific Swift (*Apus pacificus*)

The Pacific Swift (previously Fork-tailed Swift) is listed as Migratory under both the BC Act and EPBC Act. It occurs as a non-breeding migrant across much of Australia from September to April, particularly in the northern half of the continent. In general, the species is most common closer to the coast but occurs over much of the Pilbara and Kimberley. In Australia, the species is entirely aerial in habit, foraging for flying insects and even sleeping on the wing. It is highly mobile, often occurring in association with unsettled weather and low pressure systems (Johnstone and Storr 1998).

No Pacific Swifts were recorded from the Survey Area, however the survey was conducted outside the peak period of occurrence. One regional record was identified in the desktop study, approximately 7 km northwest of the Survey Area, and the Survey Area falls within the published distribution for this species (Menkhorst et al. 2017). It is considered likely to occur in the airspace over the Survey Areas sporadically between September and April. Occurrence would be most likely in association with the passage of low-pressure systems or other unsettled weather conditions but would not be limited to these conditions. The species may use airspace over all fauna habitats within the Survey Areas.

6.5.2.4 Grey Falcon (*Falco hypoleucos*)

The Grey Falcon is listed as Vulnerable under the BC Act and EPBC Act. The species is sparsely distributed across much of arid inland and northern Australia, occurring mainly on lightly wooded plains and along major watercourses (Johnstone et al. 2013). Breeding usually takes place in taller trees such as river red gums, or on isolated man-made structures such as communications towers.

The Grey Falcon was not recorded during the current survey, however the Survey Area falls within the published distribution for this species, which is highly mobile, and there is suitable habitat present. Three previous regional records were identified during the desktop study, the closest approximately 25 km west (in 1977 and 1999). Ground-truthing during the survey confirmed that habitats meeting the definition of critical habitat (Commonwealth of Australia 2013) for the Grey Falcon were absent from the Survey Area. The Sand Plain and Minor Drainage Line fauna habitat provides supporting habitat for foraging, especially when it is near minor drainage lines that contain water, and is therefore considered supporting habitat (Department of the Environment 2013). Given its wide-ranging distribution and the presence of supporting habitat within the Survey Area, the Grey Falcon is likely to occur sporadically while foraging.

6.5.2.5 Peregrine Falcon (*Falco peregrinus*)

The Peregrine Falcon is listed as Other Specially Protected Fauna under the BC Act. Its distribution is spread widely throughout most of Australia, but it is absent from most deserts and the Nullarbor Plain (Johnstone and Storr 1998). This species inhabits a wide range of habitats including forests, woodlands, wetlands and open country (Pizzey and Knight 2007). Individuals maintain large

home ranges of up to 30 km^2, and nest in recesses of cliff faces, tree hollows and along rivers (Johnstone and Storr 1998).

The Peregrine Falcon was not recorded during the current survey. Three previous regional records were identified during the desktop study, the closest approximately 25 km west (in 1989 and 1999). The Sand Plain, Stony Plain and Minor Drainage Line represent suitable foraging habitats in the Survey Area, and this species is highly mobile. It is therefore considered that the Peregrine Falcon is likely to occasionally occur in the Survey Area while foraging.

6.5.3 Significant Fauna that May Occur (Moderate Likelihood)

6.5.3.1 Brush-tailed Mulgara (*Dasycercus blythi*)

The Brush-tailed Mulgara is listed as a Priority 4 species by DBCA. It was split from the Crest-tailed Mulgara in 2005 and re-assessed in 2023 (Newman-Martin et al. 2023). Its historical distribution is uncertain as fossil remains of the two species are difficult to differentiate; fossil remains have been found all throughout the arid zone. The preferred habitat of the Brush-tailed Mulgara is spinifex (*Triodia* spp.) grasslands on sandplains and sandy swales, where they dig deep burrows and are usually solitary (van Dyck and Strahan 2008). They consume a wide range of prey, including insects, arthropods and small vertebrates. Compared to other dasyurids, they are relatively long-lived; both sexes can reproduce for multiple years. Populations typically experience 'boom-and-bust' cycles dependent on rainfall and the subsequent increase in prey abundance (van Dyck and Strahan 2008).

No evidence of Brush-tailed Mulgara was recorded on the current survey, and numerous other surveys in the locality previously failed to record any evidence. A relatively recent (2019) record was identified in the desktop study approximately 7 km northwest of the Survey Area (although with low GPS accuracy), and the Survey Area is within the published distribution (van Dyck and Strahan 2008). The Sand Plain would provide suitable habitat, thus the species may occur within the Survey Area.

6.5.3.2 Short-tailed Mouse (*Leggadina lakedownensis*)

The Short-tailed Mouse is listed as a Priority 4 species by DBCA. The species is distributed across northern Australia and tropical savannahs; genetic studies indicate that the Pilbara individuals are a distinct lineage from the remaining populations (van Dyck and Strahan 2008). They occupy a wide range of habitats including tussock grasslands on cracking clays, a variety of grassland habitats (particularly seasonally inundated sandy clay soils) but are also known to occur in eucalypt and melaleuca woodlands, samphire, acacia shrublands and on stony ranges (Jones and Parish 2006).

The Short-tailed Mouse was not recorded during the current survey, however the Survey Area is within the published distribution for this species (van Dyck and Strahan 2008). While the desktop study identified only one previous regional record (from 1988, approximately 4 km west of the Survey Area), there has been limited detailed survey effort in the locality; most of the surveys were basic, or targeted other species. There is suitable habitat within the Survey Area within both the Stony Plain and Sand Plain fauna habitats. This species may therefore occur in the Survey Area.

6.5.3.3 Common Sandpiper (*Actitis hypoleucos*)

The Common Sandpiper is listed as Migratory under the BC Act and EPBC Act. It is a non-breeding migrant from Asia, present throughout Australia between late July and March. They are usually observed in small flocks or as solitary individuals, rarely with large flocks of other shorebirds (Menkhorst et al. 2017). Habitat preferences are for margins of coastal and inland wetlands, including mangroves/mangrove creeks, rocky shorelines, riverbanks, sewage ponds, and less often intertidal flats (Morcombe 2000).

No Common Sandpipers were recorded during the current survey. Four regional records were identified for the locality by the desktop study, the most recent from 2007, and the closest approximately 13 km southwest of the Survey Area. The Minor Drainage Line fauna habitat is

potentially suitable foraging habitat when the systems contain water, particularly along the banks and fringing vegetation. The species may occur in the Survey Area in low numbers as a non-breeding visitor.

6.5.3.4 Oriental Plover (*Charadrius veredus*)

The Oriental Plover is listed as Migratory under the BC Act and EPBC Act. The species breeds in Mongolia, northern China and southern Siberia, and is a non-breeding summer migrant to Australia, occurring primarily from September to April (Johnstone and Storr 1998). However, unlike most shorebird species, they are not tied to wetland and coastal habitats while in Australia. Their preferred foraging habitats are sparsely vegetated open areas, including short-grassed or bare plains, bare wetland margins, and recently burnt areas (Johnstone and Storr 1998). This also includes similar man-made habitats, such as sports fields and airfields. The species will also use tidal mudflats, beaches, sewage ponds and freshwater wetland areas, primarily while on migration, or for roosting during the heat of the day (Johnstone and Storr 1998, Menkhorst et al. 2017). They are mobile in response to conditions, and disperse across inland northern Australia during the wet season (Minton et al. 2013).

No Oriental Plovers were recorded during the current survey, although it is noted that the survey was conducted outside the peak period of occurrence. One regional record was identified in the desktop study, approximately 7 km northwest of the Survey Area, and the Survey Area falls within the published distribution for this species (Menkhorst et al. 2017). The edges of the Minor Drainage Line fauna habitat would provide suitable foraging habitat. The Oriental Plover may therefore occur in the Survey Area, primarily between September and April.

6.5.3.5 Oriental Pratincole (*Glareola maldivarum*)

The Oriental Pratincole is listed as Migratory under the BC Act and EPBC Act. This species is a non-breeding migrant to Australia and is typically present from October to May, with the largest numbers present from December to March (Johnstone and Storr 1998, Sitters et al. 2004). The Oriental Pratincole often uses broadly similar foraging habitats to the Oriental Plover, including short-grassed or bare plains, bare wetland margins. However, Oriental Pratincoles take most of their insect prey aerially (Johnstone and Storr 1998), and so will forage over a wider range of open habitat types, and occasionally over more wooded areas. Oriental Pratincoles will also use tidal mudflats, beaches, sewage ponds and freshwater wetlands, primarily roosting during the heat of the day. They are highly mobile and responsive to environmental conditions, dispersing towards inland northern Australia during the wet season, occasionally gathering in exceptionally high numbers (Sitters et al. 2004).

No Oriental Pratincoles were recorded during the current survey and no regional records were identified by the desktop study. However, there has been limited survey effort from December to March, the peak period of occurrence, and the Survey Area is within the published distribution for the species. The Minor Drainage Line and surrounding open habitats represent potentially suitable foraging habitat for the Oriental Pratincole, and it may therefore occur in the Survey Area.

6.5.3.6 Barn Swallow (*Hirundo rustica*)

The Barn Swallow is listed as Migratory under the BC Act and EPBC Act. Breeding across the northern hemisphere, the subspecies present in Australia migrates from northeast Asia to northern Australia over the summer months, occurring regularly along the northern coast of Australia and irregularly further south (Menkhorst et al. 2017). They forage aerially over open country, particularly near water, and will also occur in *Melaleuca* woodland, mesophyll shrub thickets and tussock grasslands; often congregating in areas with high densities of flying insects (DCCEEW 2024c).

No Barn Swallows were recorded during the current survey and no regional records were identified in the desktop study, however the Survey Area falls within the published distribution of the species. Given the Barn Swallow's aerial foraging habits, they may forage above all fauna habitats present within the Survey Area. The Minor Drainage Line represent the most suitable habitat when containing water. The Barn Swallow may occur in the Survey Area as an occasional non-breeding visitor.

6.5.3.7 Glossy Ibis (*Plegadis falcinellus*)

The Glossy Ibis is listed as Migratory under the BC Act and EPBC Act. They are widely distributed globally but within Western Australia are primarily found in well-watered flatlands of the Kimberley and Swan Coastal Plain (Johnstone and Storr 1998). Preferred habitat includes shallow freshwater wetlands and adjacent flats, river pools, and flooded samphire, and also occasionally dry grasslands (Johnstone and Storr 1998).

The Glossy Ibis was not recorded during the current survey. Two regional records from 2007 were identified by the desktop study, the closest approximately 7 km northwest of the Survey Area. The Minor Drainage Line fauna habitat provides potentially suitable foraging habitat when containing water, with the eucalypts along the edge being potentially suitable roost trees. The Glossy Ibis may therefore occur in the Survey Area as an occasional seasonal visitor.

7.0 Discussion

A detailed and targeted flora and vegetation and a basic and targeted terrestrial vertebrate fauna survey was conducted from the 6th May to 10th May 2024. While the survey was undertaken at an appropriate timing in the post-wet season, conditions were drier than usual for the collection of flora, which is considered a minor limitation of the study.

7.1 Vegetation and Flora

Five vegetation associations were mapped in the Survey Area (Section 5.1.3), comprising:

- One association on low undulating hills and stony plains:
  - SP TeTw Ch Ai: Hummock grassland of *Triodia epactia, T. wiseana* with scattered low trees of *Corymbia hamersleyana* and scattered tall shrubs of *Acacia inaequilatera* on reddish brown sandy clay loam on stony footslopes, low undulating hills and stony plains.
- Two associations on sandy loam sand plains and floodplains:
  - SA AstApty Te: Low open heath of *Acacia stellaticeps, A. ptychophylla* over very open to open hummock grassland of *Triodia epactia* on dark reddish brown sandy loam sand plains and drainage areas/floodplains; and
  - SA Aanc Te Ch Ast: Open scrub of *Acacia ancistrocarpa* with very open hummock grassland of *Triodia epactia* with scattered low trees of *Corymbia hamersleyana* and low scattered shrubs of *Acacia stellaticeps* on dark reddish brown sandy loam sand plains.
- Two associations on medium to minor drainage lines:
  - ME Cfl AtpAcoc CcCs Cyv: Low woodland of *Corymbia flavescens* over a high shrubland of *Acacia tumida* var. *pilbarensis, A. colei* var. *colei* with very open tussock grassland of **Cenchrus ciliaris* and **C. setiger* and very open sedges of *Cyperus vaginatus* on dark reddish brown sandy clay loam in medium drainage lines and drainage areas/floodplains; and
  - MI Te Atp Ch: Open hummock grassland of *Triodia epactia* with high open shrubland of *Acacia tumida* var. *pilbarensis* and low open woodland of *Corymbia hamersleyana* in dark reddish brown sandy clay loam in minor drainage lines.

Two additional units were mapped in the Survey Area: cleared areas (unit OT (C); accounting for 12.4% of the Survey Area) and rehabilitation on mine slopes (unit OT (R); accounting for 1.5% of the Survey Area).

Neither the desktop study nor the field survey identified any TEC or PECs within 40 km. None of the vegetation associations within the Survey Area supported populations of significant flora, nor are they considered to be of elevated local or regional significance.

Most of the vegetation (71.8%) was in Excellent condition. Parts of the Survey Area were affected to some degree by weed invasion and minor degradation from livestock, which is expected given the proximity of the area to the Yarrie pastoral station and the presence of two presumably artificial wetlands. The vegetation types in the poorest condition were associated with the ephemeral drainages and the areas adjacent to the mine OSA.

A total of 121 native vascular flora species from 69 genera and 33 families were recorded during the survey, none of which were significant species. Seven introduced flora species were recorded, one of which, **Calotropis procera*, is listed as a Declared Pest for the whole of WA under the BAM Act. The post-survey likelihood assessment indicates that no significant flora are likely to occur in the Survey Area, however one Priority 3 flora species (*Euphorbia clementii*) remains ranked as 'may occur' (moderate likelihood of occurrence), given that conditions at the time of the survey were likely too dry to detect its presence (Appendix 3).

Analysis indicated that approximately 66-67% of the total flora was recorded during the survey, which is slightly lower than other surveys in the region, likely due to the dry seasonal conditions or the limited types of habitats/ landforms within the Survey Area. The species richness recorded from the Survey Area was comparable to other surveys in the Yarrie locality, when taking into consideration the smaller size of the Survey Area.

7.2 Fauna

Six fauna habitats were identified within the Survey Area, comprising:

- Stony Plain;
- Sand Plain;
- Minor drainage lines;
- Artificial wetland;
- Rehabilitation areas; and
- Cleared areas.

None of these habitats are restricted to the Survey Area and all are widespread in the locality and in the broader Chichester subregion.

The Sand Plain is considered critical habitat for the Bilby (Dziminski and Carpenter 2018). However, no signs of the species were recorded during the current survey. The hummock grassland on rocky plains is provides important habitat for the Western Pebble-mound Mouse (Department of the Environment 2013). Additionally, the Artificial Wetland habitat represents critical habitat for Pilbara Leaf-nosed Bat as well as supporting habitat Northern Quoll, Grey Falcon and Pilbara Olive Python. The habitats present for Ghost Bats typically represent critical foraging habitat as they are within 12 km of a critical roost (Category 2 caves CYAR-01 and CYAR-03), however, they are unlikely to be productive due to a lack of mature trees and understory. Therefore, these are not considered critical habitat as per the Commonwealth of Australia (2013).

Suitable habitat is also present within the Survey Area for other significant fauna, including the Short-tailed Mouse, Brush-tailed Mulgara, Peregrine Falcon, Pacific Swift, Barn Swallow, Glossy Ibis, and several migratory shorebirds.

A total of 55 vertebrate species were recorded in the Survey Area during the current survey, comprising 17 mammals (including 11 bat species), 33 birds and five reptiles.

Three significant vertebrate fauna species were recorded during the field survey:

- Northern Quoll (*Dasyurus hallucatus*) – Endangered under the BC Act and EPBC Act;
- Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia)* – Vulnerable under the BC Act and EPBC Act; and
- Western Pebble-mound Mouse (*Pseudomys chapman*i) – DBCA Priority 4.

In addition, the Pilbara Olive Python (*Liasis olivaceus barroni*; Vulnerable under the BC Act and EPBC Act) is known to occur, having previously been recorded within the Survey Area. A further six avifauna species listed as Marine species under the EPBC Act were also recorded during the current survey.

Although not recorded, another five fauna species of significance have been assessed as likely to occur in the Survey Area; these include

- Bilby, Dalgyte (*Macrotis lagotis*) – BC Act and EPBC Act Vulnerable;
- Ghost Bat (*Macroderma gigas*) – BC Act and EPBC Act Vulnerable;

- Pacific Swift (*Apus pacificus*) – BC Act and EPBC Act Migratory;
- Grey Falcon (*Falco hypoleucos*) – BC Act and EPBC Act Vulnerable; and
- Peregrine Falcon (*Falco peregrinus*) – BC Act Other Specially Protected Fauna.

A further seven species were considered to have a moderate likelihood of occurrence in the Survey Area, these include:

- Brush-tailed Mulgara (*Dasycercus blythi*) – DBCA Priority 4;
- Short-tailed Mouse (*Leggadina lakedownensis*) – DBCA Priority 4;
- Common Sandpiper (*Actitis hypoleucos*) – BC Act and EPBC Act Migratory;
- Oriental Plover (*Charadrius veredus*) – BC Act and EPBC Act Migratory;
- Oriental Pratincole (*Glareola maldivarum*) – BC Act and EPBC Act Migratory;
- Barn Swallow (*Hirundo rustica*) – BC Act and EPBC Act Migratory; and
- Glossy Ibis (*Plegadis falcinellus*) – BC Act and EPBC Act Migratory.

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8.0 Glossary

BAM Act	Western Australian *Biosecurity and Agriculture Management Act 2007*
BC Act	Western Australian *Biodiversity Conservation Act 2016.*
BCH	Benthic Communities and Habitats.
Biota	Biota Environmental Sciences.
DBCA	Department of Biodiversity, Conservation and Attractions.
EIA	Environmental Impact Assessment.
EPA	Environmental Protection Authority of Western Australia.
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999.*
IBRA	Interim Biogeographic Regionalisation for Australia.
Landform	A geomorphological unit that is largely defined by its surface form and location in the Study Area.
MNES	Matter of National Environmental Significance.
PEC	Priority Ecological Community.
sp. (plural: spp.)	Abbreviation of "species".
Study Area	The 40 km buffer area surrounding the Survey Area.
Survey Area	The area in which the on-ground survey was conducted.
Taxon (plural: taxa)	A taxonomic entity, typically at species level or below.
TEC	Threatened Ecological Community.

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Appendix 1

Framework for Significance Rankings of Communities and Species in WA

CONSERVATION CODES

For Western Australian Fauna and Flora

Threatened, Extinct and Specially Protected fauna or flora[1] are species[2] which have been adequately searched for and are deemed to be, in the wild, threatened, extinct or in need of special protection, and have been gazetted as such.

The *Wildlife Conservation (Specially Protected Fauna) Notice 2018* and the *Wildlife Conservation (Rare Flora) Notice 2018* have been transitioned under regulations 170, 171 and 172 of the *Biodiversity Conservation Regulations 2018* to be the lists of Threatened, Extinct and Specially Protected species[3] under Part 2 of the *Biodiversity Conservation Act 2016.*

Categories of Threatened, Extinct and Specially Protected fauna and flora are:

T Threatened species

Listed by order of the Minister as Threatened in the category of critically endangered, endangered or vulnerable under section 19(1), or is a rediscovered species to be regarded as threatened species under section 26(2) of the *Biodiversity Conservation Act 2016* (BC Act).

Threatened fauna is the species of fauna that are listed as critically endangered, endangered or vulnerable threatened species.

Threatened flora is the species of flora that are listed as critically endangered, endangered or vulnerable threatened species.

The assessment of the conservation status of threatened species is in accordance with the BC Act listing criteria and the requirements of Ministerial Guideline (Number 1) and Ministerial Guideline (Number 2) that adopts the use of the International Union for Conservation of Nature (IUCN) Red List of Threatened Species Categories and Criteria[4], and is based on the national distribution of the species.

CR Critically endangered species

Threatened species considered to be "*facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with criteria set out in the ministerial guidelines*".

Listed as critically endangered under section 19(1)(a) of the BC Act in accordance with the criteria set out in section 20 and the ministerial guidelines.

Examples of use:

- The western ringtail possum (*Pseudocheirus occidentalis*) is listed as a critically endangered threatened species under the *Biodiversity Conservation Act 2016.*
- Western ringtail possum is listed as critically endangered under the *Biodiversity Conservation Act 2016.*
- Listing reference in a table: column heading: BC Act, row text: CR.

EN Endangered species

Threatened species considered to be "*facing a very high risk of extinction in the wild in the near future, as determined in accordance with criteria set out in the ministerial guidelines*".

Listed as endangered under section 19(1)(b) of the BC Act in accordance with the criteria set out in section 21 and the ministerial guidelines.

Examples of use:

- *Caladenia hopperiana* is listed as an endangered threatened species under the *Biodiversity Conservation Act 2016.*
- *Caladenia hopperiana* is listed as endangered under the *Biodiversity Conservation Act 2016.*
- Listing reference in a table: column heading: BC Act, row text: EN.

VU Vulnerable species

Threatened species considered to be "*facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with criteria set out in the ministerial guidelines*".

Listed as vulnerable under section 19(1)(c) of the BC Act in accordance with the criteria set out in section 22 and the ministerial guidelines.

Examples of use:

- The forest red-tailed black cockatoo (*Calyptorhynchus banksii naso*) is listed as a vulnerable threatened species under the *Biodiversity Conservation Act 2016.*
- Forest red-tailed black cockatoo is listed as vulnerable under the *Biodiversity Conservation Act 2016.*
- Listing reference in a table: column heading: BC Act, row text: VU.

Extinct species

Listed by order of the Minister as extinct under section 23(1) of the BC Act as extinct or extinct in the wild.

EX Extinct species

Species where "*there is no reasonable doubt that the last member of the species has died*", and listing is otherwise in accordance with the ministerial guidelines (section 24 of the BC Act).

Examples of use:

- *Acacia kingiana* is listed as an extinct species under the *Biodiversity Conservation Act 2016.*
- *Acacia kingiana* is listed as extinct under the *Biodiversity Conservation Act 2016.*
- Listing reference in a table: column heading: BC Act, row text: EX.

EW Extinct in the wild species

Species that *"is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; and it has not been recorded in its known habitat or expected habitat, at appropriate seasons, anywhere in its past range, despite surveys over a time frame appropriate to its life cycle and form*", and listing is otherwise in accordance with the ministerial guidelines (section 25 of the BC Act).

Currently there are no fauna or flora species listed as extinct in the wild.

SP Specially protected species

Listed by order of the Minister as specially protected under section 13(1) of the BC Act. Meeting one or more of the following categories: species of special conservation interest; migratory species; cetaceans; species subject to international agreement; or species otherwise in need of special protection.

Species that are listed as threatened species (critically endangered, endangered, or vulnerable) or extinct species under the BC Act cannot also be listed as specially protected species.

MI Migratory species

Fauna that periodically or occasionally visit Australia or an external Territory or the exclusive economic zone; or the species is subject of an international agreement that relates to the protection of migratory species and that binds the Commonwealth; and listing is otherwise in accordance with the ministerial guidelines (section 15 of the BC Act).

Migratory species include birds that are subject to an agreement between the government of Australia and the governments of Japan (JAMBA)[5], China (CAMBA)[6] or The Republic of Korea (ROKAMBA)[7], and fauna subject to the *Convention on the Conservation of Migratory Species of Wild Animals* (Bonn Convention)[8], an environmental treaty under the United Nations Environment Program. Migratory species listed under the BC Act are a subset of the migratory animals, that are known to visit Western Australia, protected under the international agreements or treaties, excluding species that are listed as Threatened species.

Examples of use:

- The wedge-tailed shearwater (*Ardenna pacifica*) is listed as a specially protected migratory species under the *Biodiversity Conservation Act 2016.*
- Wedge-tailed shearwater is listed as migratory under the *Biodiversity Conservation Act 2016.*
- Listing reference in a table: column heading: BC Act, row text: MI.

CD **Species of special conservation interest (conservation dependent)**

Species of special conservation need that are dependent on ongoing conservation intervention to prevent it becoming eligible for listing as threatened, and listing is otherwise in accordance with the ministerial guidelines (section 14 of the BC Act).

Currently only fauna are listed as species of special conservation interest.

Examples of use:

- The wambenger, south-western brush-tailed phascogale (*Phascogale tapoatafa wambenger*) is listed as a specially protected species of special conservation interest under the *Biodiversity Conservation Act 2016.*
- Wambenger, south-western brush-tailed phascogale, is listed as conservation dependent under the *Biodiversity Conservation Act 2016.*
- Listing reference in a table: column heading: BC Act, row text: CD.

OS **Species otherwise in need of special protection (other specially protected)**

Species otherwise in need of special protection to ensure their conservation, and listing is otherwise in accordance with the ministerial guidelines (section 18 of the BC Act).

Currently only fauna are listed as species otherwise in need of special protection.

Examples of use:

- The dugong (*Dugong dugon*) is listed as a specially protected species otherwise in need of special protection under the *Biodiversity Conservation Act 2016.*
- Dugon is listed as other specially protected fauna under the *Biodiversity Conservation Act 2016.*
- Listing reference in a table: column heading: BC Act, row text: OS.

P **Priority species**

Priority is not a listing category under the BC Act.

All fauna and flora are protected in WA following the provisions in Part 10 of the BC Act. The protection applies even when a species is not listed as threatened or specially protected, and regardless of land tenure (State managed land (Crown land), private land, or Commonwealth land).

Species that may possibly be threatened species that do not meet the criteria for listing under the BC Act because of insufficient survey 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 prioritisation for survey and evaluation of conservation status so that consideration can be given to potential listing as threatened.

Species that are adequately known, meet criteria for near threatened, or are rare but not threatened, or that have been recently removed from the threatened species list or conservation dependent or other specially protected fauna lists for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring.

Assessment of priority status is based on the Western Australian distribution of the species, unless the distribution in WA is part of a contiguous population extending into adjacent States, as defined by the known spread of locations.

1 **Priority 1: Poorly-known species - known from few locations, none on conservation lands**

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, for example, 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 for threatened listing and appear to be under immediate threat from known threatening processes. These species are in urgent need of further survey.

Examples of use:

- *Borya stenophylla* is listed as a Priority 1 species by the Department of Biodiversity, Conservation and Attractions.
- *Borya stenophylla* is listed as Priority 1 on the DBCA Priority Flora List.
- Listing reference in a table: column heading: DBCA, row text: P1.

2 Priority 2: Poorly-known species - known from few locations, some on conservation lands

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, for example, 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 for threatened listing and appear to be under threat from known threatening processes. These species are in urgent need of further survey.

Examples of use:

- *Caladenia nivalis* is listed as a Priority 2 species by the Department of Biodiversity, Conservation and Attractions.
- *Caladenia nivalis* is listed as Priority 2 on the DBCA Priority Flora List.
- Listing reference in a table: column heading: DBCA, row text: P2.

3 Priority 3: Poorly-known species - known from several locations

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. These species need further survey.

Examples of use:

- *Acacia nitidula* is listed as a Priority 3 species by the Department of Biodiversity, Conservation and Attractions.
- *Acacia nitidula* is listed as Priority 3 on the DBCA Priority Flora List.
- Listing reference in a table: column heading: DBCA, row text: P3.

4 Priority 4: Rare, Near Threatened and other species in need of monitoring

(a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection but could be if present circumstances change. These species are usually represented on conservation lands.

(b) Near Threatened. Species that are considered to have been adequately surveyed and that are close to qualifying for vulnerable but are not listed as a conservation dependent specially protected species.

(c) Species that have been removed from the list of threatened species or lists of conservation dependent or other specially protected species, during the past five years for reasons other than taxonomy.

(d) Other species in need of monitoring.

Examples of use:

- *Banksia aculeata* is listed as a Priority 4 species by the Department of Biodiversity, Conservation and Attractions.
- *Banksia aculeata* is listed as Priority 4 on the DBCA Priority Flora List.
- Listing reference in a table: column heading: DBCA, row text: P4.

[1] The definition of flora includes algae, fungi, and lichens.

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

[3] Schedules are not referred to when stating the listing status of threatened, extinct or specially protected species under the BC Act. See the examples provided under each listing category.

[4] Western Australia has assigned species to threat categories using the *IUCN Red List of Threatened Species Categories and Criteria* since 1996 (referencing all criteria). At the national level, threatened species listings under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) reference only some of the IUCN criteria (http://www.environment.gov.au/biodiversity/threatened/nominations/forms-and-guidelines).

[5] JAMBA - first included in the WA migratory species list in 1980.

[6] CAMBA - first included in the WA migratory species list in 2010.

[7] ROKAMBA - first included in the WA migratory species list in 2010.

[8] Bonn Convention (Birds) - first included in the WA migratory species list in 2015.

Commonwealth Environment Protection and Biodiversity Conservation Act 1999

Many of the species that are specially protected at State level are also listed as Threatened species at the Commonwealth level, as one of the Matters of National Environmental Significance (MNES) identified under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (the EPBC Act). These may be classified as 'critically endangered', 'endangered', 'vulnerable' or 'lower risk', consistent with IUCN categories:

1. **Critically Endangered (CR):** a taxon is Critically Endangered when it is facing an extremely high risk of extinction in the wild in the immediate future.
2. **Endangered (EN):** a taxon is Endangered when it is not Critically Endangered but is facing a very high risk of extinction in the wild in the near future.
3. **Vulnerable (VU):** a taxon is Vulnerable when it is not Critically Endangered or Endangered but is facing a high risk of extinction in the wild in the medium-term future.
4. **Lower Risk (LR):** a taxon is Lower Risk when it has been evaluated, does not satisfy the criteria for any of the categories Critically Endangered, Endangered or Vulnerable. Taxa included in the Lower Risk category can be separated into three subcategories:
    - **Conservation Dependent (CD).** Taxa which are the focus of a continuing taxon-specific or habitat-specific conservation program targeted towards the taxon in question, the cessation of which would result in the taxon qualifying for one of the threatened categories above within a period of five years.
    - **Near Threatened (NT).** Taxa which do not qualify for Conservation Dependent, but which are close to qualifying for Vulnerable.
    - **Least Concern (LC).** Taxa which do not qualify for Conservation Dependent or Near Threatened.

In addition, numerous **Migratory (MI)** species are listed as MNES under the EPBC Act (some of which are also listed as Threatened). Migratory species are those animals that migrate to Australia and its external territories, or pass through or over Australian waters during their annual migrations. The list of migratory species consists of those species listed under the following international conventions:

1. Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention);
2. China-Australia Migratory Bird Agreement (CAMBA);
3. Japan-Australia Migratory Bird Agreement (JAMBA); and,
4. Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA).

Marine (MA) species are also protected under the EPBC Act, and are listed to ensure the long-term conservation of the species. Marine species include all Australian sea snakes, seals, crocodiles, dugongs, marine turtles, seahorses and seabirds that naturally occur in the Commonwealth marine area.

Under the terms of the EPBC Act, an action (e.g. a project or development) is required to be referred to the Australian Government Environment Minister for approval if it has, will have, or is likely to have, a significant impact on an MNES. The term 'action' includes projects and developments subsequent to commencement of the Act, however there are a number of exemptions (e.g. projects in Commonwealth areas). According to Department of the Environment (2013), a 'significant impact' is an impact which is important, notable, or of consequence, having regard to its context or intensity. Whether or not an action is likely to have a significant impact depends upon the sensitivity, value, and quality of the environment which is impacted, and upon the intensity, duration, magnitude and geographic extent of the impacts.

References:

Department of the Environment (2013). Matters of National Environmental Significance - Significant Impact Guidelines 1.1 *Environment Protection and Biodiversity Conservation Act 1999*. Department of the Environment, Canberra, Australia.

Appendix 2

Database Search Results

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. Please see the caveat for interpretation of information provided here.

Report created: 22-Feb-2024

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

Caveat
Acknowledgements

Summary

Matters of National Environment 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 (Ramsar	1
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	14
Listed Migratory Species:	12

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 https://www.dcceew.gov.au/parks-heritage/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 Lands:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	17
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None
Habitat Critical to the Survival of Marine Turtles:	None

Extra Information

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

State and Territory Reserves:	None
Regional Forest Agreements:	None
Nationally Important Wetlands:	1
EPBC Act Referrals:	6
Key Ecological Features (Marine):	None
Biologically Important Areas:	None
Bioregional Assessments:	None
Geological and Bioregional Assessments:	None

Details

Matters of National Environmental Significance

Wetlands of International Importance (Ramsar Wetlands) [Resource Information]

Ramsar Site Name	Proximity	Buffer Status
Eighty-mile beach	30 - 40km upstream from Ramsar site	In buffer area only

Listed Threatened Species [Resource Information]

Status of Conservation Dependent and Extinct are not MNES under the EPBC Act.
Number is the current name ID.

Scientific Name	Threatened Category	Presence Text	Buffer Status
BIRD			
Calidris acuminata Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat known to occur within area	In feature area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area	In feature area
Erythrotriorchis radiatus Red Goshawk [942]	Endangered	Species or species habitat may occur within area	In feature area
Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat known to occur within area	In feature area
Pezoporus occidentalis Night Parrot [59350]	Endangered	Species or species habitat likely to occur within area	In feature area
Polytelis alexandrae Princess Parrot, Alexandra's Parrot [758]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Tringa nebularia			
Common Greenshank, Greenshank [832]	Endangered	Species or species habitat likely to occur within area	In buffer area only
MAMMAL			
Dasyurus hallucatus			
Northern Quoll, Digul [Gogo-Yimidir], Wijingadda [Dambimangari], Wiminji [Martu] [331]	Endangered	Species or species habitat known to occur within area	In feature area
Macroderma gigas			
Ghost Bat [174]	Vulnerable	Breeding known to occur within area	In feature area
Macrotis lagotis			
Greater Bilby [282]	Vulnerable	Species or species habitat known to occur within area	In feature area
Rhinonicteris aurantia (Pilbara form)			
Pilbara Leaf-nosed Bat [82790]	Vulnerable	Roosting known to occur within area	In feature area
REPTILE			
Liasis olivaceus barroni			
Pilbara Olive Python [66699]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Liopholis kintorei			
Great Desert Skink, Tjakura, Warrarna, Mulyamiji, Tjalapa, Nampu [83160]	Vulnerable	Species or species habitat may occur within area	In buffer area only

Listed Migratory Species [Resource Information]

Scientific Name	Threatened Category	Presence Text	Buffer Status
Migratory Marine Birds			
Apus pacificus			
Fork-tailed Swift [678]		Species or species habitat likely to occur within area	In feature area
Migratory Terrestrial Species			
Hirundo rustica			
Barn Swallow [662]		Species or species habitat may occur within area	In feature area
Motacilla cinerea			
Grey Wagtail [642]		Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Motacilla flava Yellow Wagtail [644]		Species or species habitat likely to occur within area	In feature area
Migratory Wetlands Species			
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area	In feature area
Calidris acuminata Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat known to occur within area	In feature area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area	In feature area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area	In feature area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area	In feature area
Glareola maldivarum Oriental Pratincole [840]		Species or species habitat may occur within area	In feature area
Pandion haliaetus Osprey [952]		Species or species habitat likely to occur within area	In buffer area only
Tringa nebularia Common Greenshank, Greenshank [832]	Endangered	Species or species habitat likely to occur within area	In buffer area only

Other Matters Protected by the EPBC Act

Listed Marine Species			[Resource Information]
Scientific Name	Threatened Category	Presence Text	Buffer Status
Bird			

Scientific Name	Threatened Category	Presence Text	Buffer Status
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area	In feature area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area overfly marine area	In feature area
Bubulcus ibis as Ardea ibis Cattle Egret [66521]		Species or species habitat may occur within area overfly marine area	In feature area
Calidris acuminata Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat known to occur within area	In feature area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area overfly marine area	In feature area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area overfly marine area	In feature area
Chalcites osculans as Chrysococcyx osculans Black-eared Cuckoo [83425]		Species or species habitat may occur within area overfly marine area	In feature area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area overfly marine area	In feature area
Glareola maldivarum Oriental Pratincole [840]		Species or species habitat may occur within area overfly marine area	In feature area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Hirundo rustica Barn Swallow [662]		Species or species habitat may occur within area overfly marine area	In feature area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area overfly marine area	In feature area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area overfly marine area	In feature area
Motacilla flava Yellow Wagtail [644]		Species or species habitat likely to occur within area overfly marine area	In feature area
Pandion haliaetus Osprey [952]		Species or species habitat likely to occur within area	In buffer area only
Rostratula australis as Rostratula benghalensis (sensu lato) Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area overfly marine area	In feature area
Tringa nebularia Common Greenshank, Greenshank [832]	Endangered	Species or species habitat likely to occur within area overfly marine area	In buffer area only

Extra Information

Nationally Important Wetlands		[Resource Information]
Wetland Name	State	Buffer Status
De Grey River	WA	In buffer area only

EPBC Act Referrals				[Resource Information]
Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Controlled action				
Spinifex Ridge Molybdenum Project	2006/3104	Controlled Action	Post-Approval	In buffer area only

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Not controlled action				
Development of the Cundaline and Callawa iron ore deposits	2008/4235	Not Controlled Action	Completed	In feature area
Goldsworthy Extension Project	2005/2280	Not Controlled Action	Completed	In feature area
Improving rabbit biocontrol: releasing another strain of RHDV, sthrn two thirds of Australia	2015/7522	Not Controlled Action	Completed	In feature area
Telfer Gold Mine Project - Mine and Borefield Extensions and Upgrade of Storage	2002/787	Not Controlled Action	Completed	In buffer area only
Telfer Gold Mine Project - Power Supply and Infrastructure Corridor	2002/786	Not Controlled Action	Completed	In buffer area only

Caveat

1 PURPOSE

This report is designed to assist in identifying the location of matters of national environmental significance (MNES) and other matters protected by the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) which may be relevant in determining obligations and requirements under the EPBC Act.

The report contains the mapped locations of:

- World and National Heritage properties;
- Wetlands of International and National Importance;
- Commonwealth and State/Territory reserves;
- distribution of listed threatened, migratory and marine species;
- listed threatened ecological communities; and
- other information that may be useful as an indicator of potential habitat value.

2 DISCLAIMER

This report is not intended to be exhaustive and should only be relied upon as a general guide as mapped data is not available for all species or ecological communities listed under the EPBC Act (see below). Persons seeking to use the information contained in this report to inform the referral of a proposed action under the EPBC Act should consider the limitations noted below and whether additional information is required to determine the existence and location of MNES and other protected matters.

Where data are available to inform the mapping of protected species, the presence type (e.g. known, likely or may occur) that can be determined from the data is indicated in general terms. It is the responsibility of any person using or relying on the information in this report to ensure that it is suitable for the circumstances of any proposed use. The Commonwealth cannot accept responsibility for the consequences of any use of the report or any part thereof. To the maximum extent allowed under governing law, the Commonwealth will not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance

3 DATA SOURCES

Threatened ecological communities

For threatened ecological communities where the distribution is well known, maps are generated based on information contained in recovery plans, State vegetation maps and 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

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

Where little information is available for a 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 detailed distribution mapping methods are used to update these distributions

4 LIMITATIONS

The following species and ecological communities have not been mapped and do not appear in this report:

- threatened species listed as extinct or considered vagrants;
- some recently listed species and ecological communities;
- some listed migratory and listed marine species, which are not listed as threatened species; and
- migratory species that are very widespread, vagrant, or only occur in Australia in small numbers.

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

- listed migratory and/or listed marine seabirds, which are not listed as threatened, have only been mapped for recorded
- seals which have only been mapped for breeding sites near the Australian continent

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

Refer to the metadata for the feature group (using the Resource Information link) for the currency of the information.

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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Extract from Naturemap Search (Significant Species only)

TAXON	CLASS	CONS	KINGDOM
Actitis hypoleucos	BIRD	MI	Animalia
Apus pacificus	BIRD	MI	Animalia
Calidris acuminata	BIRD	MI	Animalia
Charadrius veredus	BIRD	MI	Animalia
Dasycercus blythi	MAMMAL	P4	Animalia
Dasyurus hallucatus	MAMMAL	EN	Animalia
Falco hypoleucos	BIRD	VU	Animalia
Falco peregrinus	BIRD	OS	Animalia
Gallinago megala	BIRD	MI	Animalia
Gallinago stenura	BIRD	MI	Animalia
Lagorchestes conspicillatus subsp. *leichardti*	MAMMAL	P4	Animalia
Leggadina lakedownensis	MAMMAL	P4	Animalia
Liasis olivaceus subsp. *barroni*	REPTILE	VU	Animalia
Macroderma gigas	MAMMAL	VU	Animalia
Macrotis lagotis	MAMMAL	VU	Animalia
Plegadis falcinellus	BIRD	MI	Animalia
Pseudomys chapmani	MAMMAL	P4	Animalia
Rhinonicteris aurantia	MAMMAL	P4	Animalia
Rhinonicteris aurantia (Pilbara)	MAMMAL	VU	Animalia
Tringa glareola	BIRD	MI	Animalia
Tringa nebularia	BIRD	MI	Animalia
Corchorus sp. Yarrie (J. Bull & D. Roberts CAL 01.05)	DICOT	P1	Plantae
Croton aridus	DICOT	P3	Plantae
Eragrostis crateriformis	MONOCOT	P3	Plantae
Eremophila maculata subsp. *filifolia*	DICOT	P1	Plantae
Euphorbia clementii	DICOT	P3	Plantae
Fimbristylis sp. Shay Gap (K.R. Newbey 10293)	MONOCOT	P1	Plantae
Fuirena incrassata	MONOCOT	P3	Plantae
Heliotropium parviantrum	DICOT	P1	Plantae
Indigofera ammobia	DICOT	P3	Plantae
Nicotiana umbratica	DICOT	P3	Plantae
Rothia indica subsp. *australis*	DICOT	P3	Plantae

Appendix 3

Flora Likelihood Assessment

Taxon	Habit and Habitat (WA Herbarium 2024)	Database Searches					Previous Surveys			Likelihood of Occurrence within the Survey Area	
		Nature Map	ALA	EPBC PMST	DBCA WAHerb	DBCA TPFL	Onshore (2013a)	Onshore (2013b)	Astron (2013)	Initial Ranking based on Desktop Study (NR = nearest record)	Final Ranking Including Results of Survey
Priority 1											
Acacia cyperophylla var. *omearana*	Tree to 10 m tall, with 'minni-ritchi' bark. Grows on stony and gritty alluvium, usually along drainage lines.		✓							May occur: suitable habitat may occur along larger drainage lines in the survey area, but this species generally occurs further west around Nullagine. (NR ~14 km SW)	Unlikely to occur: not recorded during the survey despite good on-ground coverage of creeklines.
Corchorus sp. Yarrie (J. Bull & D. Roberts CAL 01.05)	Herb or shrub <1 m tall, with hairy stems, cylindrical fruit and yellow flowers. Grows in gullies and drainage lines on skeletal ironstone soils.	✓	✓		✓					Unlikely to occur: two records in proximity however no rocky gullies or drainage lines occur in survey area. (NR = 2.1 km SW)	Unlikely to occur: no suitable habitat found in the survey area.
Eremophila maculata subsp. *filifolia*	Shrub to 3 m tall with long narrow leaves and a red or pale yellow corolla (Brown and Buirchell 2011). Found on spinifex plains.	✓	✓		✓					May occur: suitable habitat may be present, but taxon is very infrequently recorded; currently restricted to one plain ~1 km south of the De Grey River. (NR = 24.9 km W)	Unlikely to occur: not recorded during the survey despite good on-ground coverage of spinifex plains.
Euploca parviantrum	Small, spindly annual herb with white flowers that grows on spinifex plains.	✓	✓		✓					Unlikely to occur: while suitable habitat may occur, species is infrequently recorded and only one record from 1946 in the locality. (NR = 26.8 km W)	Unlikely to occur: not recorded during the survey despite good on-ground coverage of spinifex plains.
Fimbristylis sp. Shay Gap (K.R. Newbey 10293)	Tufted annual sedge to 15 cm tall; inflorescence of 3-many spikelets in June to July. Found on sandy soil and drainage lines.	✓			✓					Unlikely to occur: suitable habitat may occur but taxon is infrequently recorded; single record from 1984 in the locality. (NR = 18.7 km NW)	Unlikely to occur: suitable habitat may be present in the survey area, however taxon is very infrequently recorded.
Hibiscus krichauffianus	Low or ascending shrub to 0.7 m tall with purple-pink flowers in March or October. Found on red sandy soils.		✓							May occur: no records on Florabase, but two records of "*Hibiscus* aff. *krichauffianus*" returned from the ALA database (indicating that the entity has affinities to *krichauffianus*). Suitable habitat may occur. (NR ~25 km NW)	Unlikely to occur: suitable habitat may be present however species was not recorded during the survey despite good ground coverage.

Taxon	Habit and Habitat (WA Herbarium 2024)	Database Searches					Previous Surveys			Likelihood of Occurrence within the Survey Area	
		Nature Map	ALA	EPBC PMST	DBCA WAHerb	DBCA TPFL	Onshore (2013a)	Onshore (2013b)	Astron (2013)	**Initial Ranking based on Desktop Study** (NR = nearest record)	**Final Ranking Including Results of Survey**
Priority 2											
Goodenia hartiana	Erect to spreading, multi-stemmed perennial herb to low shrub. Occurs on sand, sand dune swales and sandhills.	✓	✓		✓					May occur on sandy patches. Only one record from the locality. (NR = 19.1 km NNE)	Unlikely to occur: limited areas of sandy substrate in the survey area and no sand dunes were present.
Priority 3											
Croton aridus	Monoecious, multi-stemmed, evergreen shrub to 1.5 m tall with yellow flowers in August. Grows in deep red sand, pindan soil, sandplains or ridges and spinifex sandplains.	✓	✓		✓					May occur on sandy patches. Ten records occur in the locality, all from the Nita land system. (NR = 18.3 km N)	Unlikely to occur: limited areas of sandy substrate in the survey area and no sand dunes were present.
Euphorbia clementii	Erect herb to 60 cm tall, growing on gravelly hill sides and stony ground.	✓	✓		✓	✓				Likely to occur: suitable habitat present in the survey area and several records from the locality, including four in proximity. (NR = 3.1 km NE)	May occur: suitable habitat was present in the survey area; this annual species may not have been detected due to poor seasonal conditions.
Fuirena incrassata	Annual sedge to 30 cm tall. Found in sand, sandy clay in swamps, creek beds, claypans, semi-saline lakes.	✓								Unlikely to occur: suitable habitat may occur but species is infrequently recorded, and there are no records anywhere in the vicinity; it is unclear why this species was returned by the NatureMap search. (NR = 150 km NE)	Unlikely to occur: no suitable habitat in the survey area and not known from the locality.
Gymnanthera cunninghamii	Erect shrub to 2 m tall with cream-yellow-green flowers in January to December. Grows in sandy soils.		✓							May occur in creeklines. Only one record in the locality, from the ALA database. (NR ~35 km WNW)	Unlikely to occur: not recorded during the survey despite good on-ground coverage of creeklines.

Taxon	Habit and Habitat (WA Herbarium 2024)	Database Searches					Previous Surveys			Likelihood of Occurrence within the Survey Area	
		Nature Map	ALA	EPBC PMST	DBCA WAHerb	DBCA TPFL	Onshore (2013a)	Onshore (2013b)	Astron (2013)	**Initial Ranking based on Desktop Study** (NR = nearest record)	**Final Ranking Including Results of Survey**
Indigofera ammobia	Many-stemmed shrub to 50 cm tall with purple flowers in September. Grows on red sand and sand dunes.	✓			✓	✓				May occur on sandy patches. (NR = 36.0 km W)	Unlikely to occur: limited areas of sandy substrate in the survey area and no sand dunes were present.
Nicotiana umbratica	Erect, short-lived annual or perennial herb to 70 cm tall, growing on shallow soils and rocky outcrops.	✓	✓		✓					Unlikely to occur: no suitable habitat in the survey area. (NR = 37.9 km NW)	Unlikely to occur: no suitable habitat (rocky hills or gullies) in the survey area.
Rothia indica subsp. *australis*	Prostrate annual herb to 0.3 m tall, growing in sand hills and sandy flats.	✓			✓					May occur on sandy patches. (NR = 37.9 km NW)	Unlikely to occur: limited areas of sandy substrate in the survey area and no sand dunes were present.
Triodia acutispicula	Resinous hummock grass to 1.5 m tall with bi-textured glabrous lemmas. Grows on sandy soils, river levees, pindan plains, rocky hill slopes and outcrops.		✓							Unlikely to occur: suitable habitat unlikely to be present, and species typically occurs in the Kimberley. Only one record from 1982 returned from ALA database, and this was noted to be from a mixed sample (with *T. schinzii*). (NR ~18 km NW)	Unlikely to occur: not recorded during the survey.

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Appendix 4

Fauna Likelihood Assessment

Family	Species Name	Common Name	Conservation Status		Preferred Habitat	Occurrence in Locality	Preferred Habitat in Survey Area	Likelihood of Occurrence in Survey Area
			State	Federal				
REPTILES								
Scincidae	*Lerista separanda*		P2		Dune crests and sandy areas.	One DBCA database record (2006) c. 50 km northwest.	Low	Unlikely to occur / Low
Scincidae	*Liopholis kintorei*	Great Desert Skink	VU	VU	Spinifex (*Triodia* spp.) on arid sandy, clay or loamy flats	Returned from EPBC PMST search only; no database records within desktop study area.	Low	Unlikely to occur / Low
Pythonidae	*Liasis olivaceus barroni*	Pilbara Olive Python	VU	VU	Rocky areas within the Pilbara, showing a preference for rocky gorges containing water in streams and rock pools.	One WA Museum voucher specimen (1969) collected from a generalised location 0-80 km southwest. Several records at 'Cattle Gorge' c. 10 km northwest by previous surveys in 2014 and 2021, and eight individuals captured in 2023 by a previous unpublished targeted survey by Biota ~10-40km northwest.	Moderate	Recorded (previously)
MAMMALS								
Dasyuridae	*Dasycercus blythi*	Brush-tailed Mulgara, Ampurta	P4		Spinifex grasslands on sand plains and sandy swale between low dunes from southwestern Queensland across the Simpson, Tanami, and Great Sandy Deserts of southern and central Northern Territory and central Western Australia.	Several DBCA database records, two recent (2019) from c. 7 km northwest (±50 km).	Moderate	May occur / Moderate
Dasyuridae	*Dasyurus hallucatus*	Northern Quoll	EN	EN	Rocky areas and tall open coastal eucalypt forests, sandstone escarpment.	Numerous DBCA database records, closest (2019) c. 2 km south. Also recorded on five previous surveys in the locality, most recently in 2022.	Moderate	Recorded
Thylacomyidae	*Macrotis lagotis*	Bilby, Dalgyte	VU	VU	Acacia shrubland, open tussock grassland on uplands and hills, mulga woodland / shrubland growing on ridges and rises, and hummock grassland in plains and alluvial areas.	Numerous DBCA database records, closest (2019) c. 2 km west. Also recorded on two previous surveys in the locality, most recently in 2022.	Moderate	Likely to occur / High
Macropodidae	*Lagorchestes conspicillatus leichardti*	Spectacled Hare-wallaby (mainland)	P4		Tropical spinifex (*Triodia* spp.) or tussock grasslands with mid-dense tree and shrub cover.	Two WA Museum voucher specimens (1899 and 1983) collected from generalised locations 20-50 km northwest, and one fossil record c. 18 km east.	Low	Unlikely to occur / Low
Muridae	*Leggadina lakedownensis*	Short-tailed Mouse	P4		Tussock grasslands on cracking clays, variety of grassland habitats particularly seasonally inundated sandy clay soils, but also known to occur in eucalypt and melaleuca woodlands, samphire, acacia shrublands and stony ranges.	One DBCA database historical record (1988) c. 4 km west.	Yes	May occur / Moderate
Muridae	*Pseudomys chapmani*	Western Pebble-mound Mouse	P4		Stony hillsides with hummock grasslands in the central and eastern parts of the Pilbara	Numerous DBCA database records, closest (2019) c. 2 km southwest. Also recorded on three previous surveys in the locality, most recently in 2014.	Yes	Recorded
Rhinonycteridae	*Rhinonicteris aurantia*	Pilbara Leaf-nosed Bat	VU	VU	Across northern Australia, reliant on roost sites in caves or mine adits with stable, very hot (28–32°C) and very humid (96–100%) microclimates.	Numerous DBCA database records, closest (2019 and 2022) c. 1.5 km south. Also recorded on four previous surveys in the locality, most recently in 2022.	Foraging only	Recorded
Megadermatidae	*Macroderma gigas*	Ghost Bat	VU	VU	Occurs in a broad range of habitats, with distribution being influenced by the availability of suitable caves and mines for roost sites.	Numerous DBCA database records, closest (2019) c. 1.5 km south. Also recorded on four previous surveys in the locality, most recently in 2022.	Foraging only	Likely to occur / High

Family	Species Name	Common Name	Conservation Status		Preferred Habitat	Occurrence in Locality	Preferred Habitat in Survey Area	Likelihood of Occurrence in Survey Area
			State	Federal				
BIRDS								
Apodidae	*Apus pacificus*	Pacific Swift	MI	MI; MA	Thought to be exclusively aerial.	One DBCA database record (2007) c. 7 km northwest.	Foraging only	Likely to occur / High
Charadriidae	*Charadrius veredus*	Oriental Plover	MI	MI; MA	Open plains, bare, rolling country, muddy or sandy wastes near inland swamps or tidal mudflats; bare claypans, margins of coastal marshes; grassy airfields, sports fields, lawns and coastal dune areas.	One DBCA database record (2007) c. 7 km northwest.	Yes	May occur / Moderate
Rostratulidae	*Rostratula australis*	Australian Painted Snipe	EN	EN	Distribution generally correlates to areas of wetland throughout Western Australia.	Returned from EPBC PMST search only; no database records within desktop study area.	Low	Unlikely to occur / Low
Scolopacidae	*Calidris acuminata*	Sharp-tailed Sandpiper	MI	MI; MA	Freshwater wetlands.	One DBCA database record (2005) c. 25 km west.	Low	Unlikely to occur / Low
Scolopacidae	*Calidris ferruginea*	Curlew Sandpiper	CR; MI	CR; MI; MA	Intertidal zones.	Returned from EPBC PMST search only; no database records within desktop study area.	Low	Unlikely to occur / Low
Scolopacidae	*Calidris melanotos*	Pectoral Sandpiper	MI	MI; MA	Shallows and margins of freshwater wetlands, occasionally coastal or estuarine intertidal flats and flooded samphire.	Returned from EPBC PMST search only; no database records within desktop study area.	Low	Unlikely to occur / Low
Scolopacidae	*Gallinago stenura*	Pin-tailed Snipe	MI	MI; MA	Shallow margins of well-vegetated freshwater wetlands, including sewage ponds, and damp grasslands.	One WA Museum voucher specimen (1985) collected from a generalised location 10–30 km northwest.	Low	Unlikely to occur / Low
Scolopacidae	*Gallinago megala*	Swinhoe's Snipe	MI	MI; MA	Shallow margins of well-vegetated freshwater wetlands, including sewage ponds, and damp grasslands	One WA Museum voucher specimen (1979) collected from a generalised location 10–30 km northwest.	Low	Unlikely to occur / Low
Scolopacidae	*Actitis hypoleucos*	Common Sandpiper	MI	MI; MA	Margins of coastal and inland wetlands, including mangroves/mangrove creeks, rocky shorelines, riverbanks, sewage ponds, but less often intertidal flats.	Four DBCA database records (2001 - 2007), closest c. 13 km southwest.	Low	May occur / Moderate
Scolopacidae	*Tringa glareola*	Wood Sandpiper	MI	MI; MA	Shallow freshwater wetlands and wetland margins, particularly those with taller fringing vegetation, including sewage ponds.	One DBCA database record (2007) c. 13 km southwest.	Low	Unlikely to occur / Low
Scolopacidae	*Tringa nebularia*	Common Greenshank	MI	EN; MI; MA	Inhabits a variety of coastal and freshwater habitats, intertidal flats and adjacent sandy beaches, mangrove fringes, shallow freshwater wetlands and wetland margins, salt ponds, less commonly on sandy beaches.	One DBCA database record (2005) c. 25 km west.	Low	Unlikely to occur / Low
Glareolidae	*Glareola maldivarum*	Oriental Pratincole	MI	MI; MA	Primarily forages aerially over open country, roosts on bare ground near water (e.g. tidal flats, sandy beaches, margins of freshwater wetlands).	Returned from EPBC PMST search only; no database records within desktop study area.	Yes	May occur/ Moderate
Laridae	*Hydroprogne caspia*	Caspian Tern	MI	MI; MA	Sheltered coastal waters, estuaries, and larger inland water bodies (including larger rivers, reservoirs, fresh and salt lakes, salt ponds).	One DBCA database record (2007) c. 13 km southwest.	Foraging only	Unlikely to occur/ Low
Fregatidae	*Fregata ariel*	Lesser Frigatebird	MI	MI; MA	Aerial over tropical coasts and seas, breeding on offshore islands.	One historical generalised ALA record (1973) c. 19 km northwest.	Low	Unlikely to occur / Low
Threskiornithidae	*Plegadis falcinellus*	Glossy Ibis	MI	MI; MA	Shallows of wetlands and floodplains, occasionally dry grasslands.	Two DBCA database records (2007), closest c. 7 km northwest.	Marginal	May occur / Moderate
Pandionidae	*Pandion haliaetus*	Osprey	MI	MI; MA	Estuaries, coasts and offshore islands, less commonly large inland wetlands.	Returned from EPBC PMST search only; no database records within desktop study area.	Low	Unlikely to occur / Low

Family	Species Name	Common Name	Conservation Status		Preferred Habitat	Occurrence in Locality	Preferred Habitat in Survey Area	Likelihood of Occurrence in Survey Area
			State	Federal				
Accipitridae	*Erythrotriorchis radiatus*	Red Goshawk	VU	EN	Tall open forest and woodland, especially along watercourses with tall eucalypts and melaleucas, potentially occupying wider range of habitats post-breeding.	Returned from EPBC PMST search only; no database records within desktop study area.	Low	Unlikely to occur / Low
Falconidae	*Falco hypoleucos*	Grey Falcon	VU	VU	Lightly wooded or untimbered arid plains, especially those that are crossed by major watercourses lined with taller trees, or isolated man-made structures such as communications towers.	Three DBCA database historical records (1977 and 1999), closest c. 25 km west.	Moderate	Likely to occur / High
Falconidae	*Falco peregrinus*	Peregrine Falcon		OS	Most habitats, favouring areas with concentrations of bird prey (e.g. wetlands, coastal cliffs with seabird colonies, cities with large numbers of feral pigeons). Cliff faces preferred for breeding, but also in trees (using old stick nests of other species or tree hollows) where cliffs are in short supply.	Three DBCA database historical records (1989 and 1999), closest c. 25 km west. One eBird record (2022) c. 36 km southwest.	Moderate	Likely to occur / High
Psittacidae	*Polytelis alexandrae*	Princess Parrot	P4	VU	Sand dunes and sand flats in the arid zone.	Returned from EPBC PMST search only; no database records within desktop study area.	Low	Unlikely to occur / Low
Psittacidae	*Pezoporus occidentalis*	Night Parrot	CR	EN	Old growth spinifex, often in association with samphire.	Returned from EPBC PMST search only; no database records within desktop study area.	Low	Unlikely to occur / Low
Hirundinidae	*Hirundo rustica*	Barn Swallow	MI	MI	Open country with low vegetation, often near manmade structures.		Yes	May occur / Moderate
Motacillidae	*Motacilla tschutschensis*	Eastern Yellow Wagtail	MI	MI; MA	Short grasslands and bare ground (including sports ovals, agricultural areas), wetland margins, sewage ponds.	Returned from EPBC PMST search only; no database records within desktop study area.	Low	Unlikely to occur / Low
Motacillidae	*Motacilla cinerea*	Grey Wagtail	MI	MI; MA	A variety of habitats near water, particularly along fast-flowing freshwater waterways. Rare migrant to the Kimberley region, vagrant elsewhere in the state.	Returned from EPBC PMST search only; no database records within desktop study area.	Low	Unlikely to occur / Low

Appendix 5

Flora Raw Site Data

Yarrie Southern Area Site YSA-01

Described by CEF
Date 7/05/2024
Type Quadrat 50x50m
Coord (central) Zone 51 221516 mE, 7716634 mN; 120.327715 E -20.628890 S
Habitat Low stony rise.
Soil Reddish brown (2.5 YR 4/3) sandy clay loam.
Rock Type Calcrete, quartz.
Vegetation Open hummock grassland of *Triodia wiseana* with scattered low trees of *Corymbia hamersleyana* and scattered tall shrubs of *Grevillea pyramidalis* subsp. *leucadendron*.
Veg Condition Excellent.
Fire Age Burnt 1-2 years ago.
Notes Much of area to the west is burnt. Most tall shrubs in the area are resprouting.

Species	Cover (%)	Height (cm)	Specimen Code	Notes
Acacia inaequilatera	0.1	50		Juvenile; resprouting after fire.
Acacia ptychophylla	0.1	10	YSA01-06	Juvenile.
Arivela viscosa	0.1	25		
Corchorus sp.	0.1	10	YSA01-04	PLDK determination: "*C. ? elachocarpus*; inadequate material; sterile."
Corymbia hamersleyana	1	500	YSA01-01	Much of bark has been shed and is on ground
Dolichocarpa crouchiana	0.1	10	YSA01-10	
Euploca cunninghamii	0.1	10	YSA01-11	PLDK confirmed.
Goodenia microptera	0.1	15	YSA01-08	
Goodenia muelleriana	0.1	15	YSA01-09	
Grevillea pyramidalis subsp. *leucadendron*	0.5	420		
Hakea lorea subsp. *lorea*	0.1	190	YSA01-05	
Hibiscus sp.	0.1	15	YSA01-07	PLDK determination: "*H.* aff. *leptocladus* leaves lobed however plant virally infected and also sterile."
Hibiscus leptocladus	0.1	10	YSA01-14	PLDK confirmed: "sens. lat.; taxon under review."
Pluchea tetranthera	0.1	25	YSA01-15	
Ptilotus axillaris	0.1	5	YSA01-13	
Ptilotus exaltatus	0.1	5		
Ptilotus fusiformis	0.1	10	YSA01-16	
Senna notabilis	0.1	5		
Solanum diversiflorum	0.1	20	YSA01-17	
Tephrosia sp. Bungaroo Creek (M.E. Trudgen 11601)	0.1	15	YSA01-12	
Tephrosia sp. NW Eremaean (S. van Leeuwen et al. PBS)	0.1	10	YSA01-03	
Trigastrotheca molluginea	0.1	10		
Triodia wiseana	20	15	YSA01-02	



YSA01

Yarrie Southern Area Site YSA-02

Described by CEF
Date 7/05/2024
Type Quadrat 50x50m
Coord (central) Zone 51 221241 mE, 7716179 mN; 120.325013 E -20.632959 S
Habitat Sandy plain.
Soil Dark reddish brown (2.5YR 3/3) sandy loam.
Rock Type Ironstone; minimal rocks/stones on surface.
Vegetation Open heath of *Acacia stellaticeps* over open hummock grassland of *Triodia epactia.*
Veg Condition Very Good: some cow scats and tracks, some weeds due to proximity to creek.
Fire Age Very long unburnt.
Notes Small clayey patches throughout quadrat.

Species	Cover (%)	Height (cm)	Specimen	Notes
Acacia sphaerostachya	0.1	130	YSA02-08	
Acacia stellaticeps	60	150	YSA02-01	
Acacia tumida var. *pilbarensis*	0.1	250	YSA02-04	
Afrohybanthus aurantiacus	0.1	15		
Arivela viscosa	0.1	10		
**Cenchrus ciliaris*	0.1	15		N=2.
**Cenchrus setiger*	0.1	25		N=15.
Chrysopogon fallax	0.1	110		
Corchorus sp.	0.1	10	YSA01-04=	PLDK determination: "C. ? *elachocarpus* inadequate material; sterile."
Corymbia flavescens	0.1	25		Juvenile.
Dactyloctenium radulans	0.1	5		
Digitaria ctenantha	0.1	5	YSA02-07	
Eragrostis cumingii	0.1	5		
Eriachne obtusa	0.1	25	YSA02-03	
Evolvulus alsinoides var. *villosicalyx*	0.1	5		
Goodenia muelleriana	0.1	10	YSA02-06	
Ipomoea muelleri	0.1	5	YSA02-05	
Paraneurachne muelleri	0.1	15		
Perotis rara	0.1	10		
Pluchea tetranthera	0.1	15	YSA01-15=	
Pterocaulon sphacelatum	0.1	10		
Senna notabilis	0.1	5		
Sporobolus australasicus	0.1	10		
Triodia epactia	15	60	YSA02-02	
Zornia muelleriana subsp. *congesta*	0.1	15	YSA02-05B	



YSA02

Yarrie Southern Area Site YSA-03

Described by CEF
Date 7/05/2024
Type Quadrat 25x100m
Coord (central) Zone 51 221068 mE 7716120 mN; 120.323340E, -20.633460 S
Habitat Creekline/floodplain (sandy defined channel is just to the east).
Soil Dark reddish brown (2.5YR 3/4) clay loam.
Vegetation Tussock grassland of **Cenchrus ciliaris*, **C. setiger* with tall shrubland of *Acacia tumida* var. *pilbarensis*, (**Vachellia farnesiana*, **Calotropis procera*) and low woodland of *Corymbia flavescens*.
Veg Condition Poor: cattle damage and weeds.
Fire Age No sign of recent fire.

Species	Cover (%)	Height (cm)	Specimen Code	Notes
Acacia colei var. *colei*	0.1	145	YSA03-02	
Acacia tumida var. *pilbarensis*	9	400	YSA03-01	
Calotropis procera	1	200		N=20.
**Cenchrus ciliaris*	20	45		
**Cenchrus setiger*	20	45		
Chrysopogon fallax	0.1	65		
Corymbia flavescens	11	800	YSA03-01	
Crotalaria medicaginea var. *neglecta*	0.1	25	YSA03-05	
Cucumis melo	0.1	5	YSA03-06	N=1.
Cucumis variabilis	0.1	35		
Cyperus vaginatus	0.1	55		
Ehretia saligna var. *saligna*	0.1	120	YSA03-08	N=3; grazed.
**Malvastrum americanum*	0.1	55		N=3.
Paspalidium clementii	0.1	10		
Pluchea rubelliflora	0.1	20	YSA03-07	
Portulaca oleracea	0.1	5		
Senna notabilis	0.1	10		
Sida rohlenae subsp. *rohlenae*	0.1	55	YSA03-03	
Sida sp.	0.1	10	YSA03-10	Inadequate material.
Solanum sp.	0.1	50	YSA03-04	Inadequate material.
**Vachellia farnesiana*	2	250		N=10.
Waltheria indica	0.1	25	YSA03-09	



YSA03

Yarrie Southern Area Site YSA-04

Described by CEF
Date 7/05/2024
Type Quadrat 50x50m
Coord (central) Zone 51 220614mE, 7716556 mN; 120.319056 E, -20.629463 S
Habitat Stony plain.
Soil Dark reddish brown (2.5YR 3/4) sandy loam.
Rock Type Calcrete, ironstone, quartz.
Vegetation Open hummock grassland of *Triodia epactia, T. wiseana* over low open shrubland of *Acacia stellaticeps*.
Veg Condition Excellent.
Fire Age No sign of recent fire.
Notes *Triodia wiseana* mostly on parts of quadrat with exposed calcrete rock. Scattered low trees of *Corymbia hamersleyana* just outside quadrat.

Species	Cover (%)	Height (cm)	Specimen Code	Notes
Acacia ancistrocarpa	0.1	180		
Acacia inaequilatera	1	270		
Acacia stellaticeps	4	60		
Acacia synchronicia	0.1	180	YSA04-04	
Bonamia pilbarensis (Port Hedland form; densely indumented)	0.1	5	YSA04-03	
Cassytha capillaris	0.1	50	YSA04-02	
Corchorus elachocarpus	0.1	15	YSA04-06	PLDK confirmed.
Eriachne aristidea	0.1	10		
Eriachne obtusa	0.1	15		
Euphorbia trigonosperma	0.1	5	YSA04-07	
Goodenia stobbsiana	0.1	10		
Grevillea wickhamii	0.5	300		Sterile.
Panicum australiense var. *australiense*	0.1	5	YSA04-09	
Pluchea tetranthera	0.1	15	YSA01-15=	
Polycarpaea corymbosa var. *corymbosa*	0.1	5		
Ptilotus exaltatus	0.1	5		
Senna glutinosa subsp. *glutinosa*	0.1	120		
Senna glutinosa subsp. *pruinosa*	0.1	210		
Senna glutinosa subsp. x *luerssenii*	0.1	120		
Senna notabilis	0.1	10		
Solanum lasiophyllum	0.1	10		
Solanum sp.	0.1	15	YSA03-04=	Inadequate material.
Trachymene oleracea subsp. *oleracea*	0.1	5		Seedling.
Tribulus suberosus	0.1	15		
Triodia epactia	18	50	YSA04-01	
Triodia wiseana	12	40	YSA04-05	
Triumfetta chaetocarpa	0.1	5	YSA04-08	



YSA04

Yarrie Southern Area Site YSA-06

Described by CEF
Date 7/05/2024
Type Quadrat 50x50m
Coord (central) Zone 51 220677 mE, 7716283 mN; 120.319616 E -20.631938 S
Habitat Low calcrete rise.
Soil Dark reddish brown (2.5YR 3/3) sandy loam
Rock Type Calcrete, ironstone, quartz.
Vegetation Hummock grassland of *Triodia wiseana*, (*T. epactia*) with low open woodland of *Corymbia hamersleyana* and scattered tall shrubs of *Acacia inaequilatera*.
Veg Condition Very Good: small patch of **Cenchrus ciliaris.*
Fire Age Very long unburnt.

Species	Cover (%)	Height (cm)	Specimen Code	Notes
Acacia ancistrocarpa	0.1	150		
Acacia bivenosa	0.1	150	YSA06-03	
Acacia elachantha	0.1	120	YSA06-08	
Acacia inaequilatera	1	250		
Acacia ptychophylla	0.1	110	YSA06-01	
Acacia stellaticeps	0.1	100		
Boerhavia coccinea	0.1	5	YSA06-05	
Cenchrus ciliaris	0.1	25		N=20; grazed.
Corymbia hamersleyana	2	600	YSA06-02	
Eragrostis eriopoda	0.1	25	YSA06-09	
Evolvulus alsinoides var. *villosicalyx*	0.1	5		
Goodenia muelleriana	0.1	25	YSA06-10	
Grevillea pyramidalis subsp. *leucadendron*	0.1	250		
Grevillea wickhamii	0.1	280		Sterile.
Indigofera monophylla	0.1	60	YSA06-04	Sens. lat.
Notoleptopus decaisnei	0.1	5		
Pluchea tetranthera	0.1	50		
Rhynchosia minima	0.1	5		
Senna glutinosa subsp. *glutinosa*	0.1	55		
Sida rohlenae subsp. *rohlenae*	0.1	35	YSA06-07	
Trigastrotheca molluginea	0.1	15		
Triodia epactia	2	60		
Triodia wiseana	55	70		



YSA06

Yarrie Southern Area Site YSA-07

Described by CEF
Date 8/05/2024
Type Quadrat 50x50m
Coord (central) Zone 51 220715 mE, 7717236 mN; 120.320135 E -20.623337 S
Habitat Stony plain.
Soil Reddish brown (2.5YR 4/4) silty loam.
Rock Type Calcrete, ironstone, quartz.
Vegetation Open hummock grassland of *Triodia epactia* and *T. wiseana* with low open shrubland of *Acacia stellaticeps*.
Veg Condition Excellent.
Fire Age Burnt 3-5 years ago.
Notes Several *Acacia inaequilatera* but most juvenile. Thought there was also some *Triodia wiseana* just north of the quadrat. *Grevillea wickhamii* just outside quadrat.

Species	Cover (%)	Height (cm)	Specimen Code
Acacia inaequilatera	0.1	180	
Acacia ptychophylla	0.1	80	
Acacia sphaerostachya	0.1	55	YSA07-01
Acacia stellaticeps	2	75	
Acacia synchronicia	0.1	250	
Grevillea pyramidalis subsp. *leucadendron*	0.1	250	
Pluchea tetranthera	0.1	25	
Senna glutinosa subsp. x *luerssenii*	0.1	180	
Triodia epactia	15	50	
Triodia wiseana	1	40	



YSA07

Yarrie Southern Area Site YSA-09

Described by CEF
Date 8/05/2024
Type Quadrat 50x50m
Coord (central) Zone 51 221529mE 7717472 mN; 120.327976E -20.621327 S
Habitat Low west-facing hill.
Soil Dark reddish brown (2.5YR 3/4) silty clay loam.
Rock Type Basalt, calcrete, ironstone, quartz.
Vegetation Hummock grassland of *Triodia epactia, T. wiseana* with scattered low shrubs of *Acacia ptychophylla* and scattered tall shrubs of *Acacia inaequilatera*.
Veg Condition Excellent.
Fire Age No sign of recent fire.

Species	Cover (%)	Height (cm)	Specimen Code	Notes
Acacia inaequilatera	1	250		
Acacia ptychophylla	1.5	70		
Bonamia pilbarensis	0.1	10	YSA09-01	
Fimbristylis dichotoma	0.1	5	YSA09-02	
Grevillea wickhamii	0.1	300		Sterile.
Senna glutinosa subsp. x *luerssenii*	0.1	150		
Triodia epactia	20	50		
Triodia wiseana	14	45	YSA09-01	



YSA09

Yarrie Southern Area Site YSA-11

Described by CEF
Date 8/05/2024
Type Quadrat 50x50m
Coord (central) Zone 51220033 mE 7716651 mN120.313507 E -20.628519 S
Habitat Sandy plain; sandy surface, not rocky.
Soil Dark reddish brown (2.5YR 3/3) sandy loam.
Rock Type Ironstone.
Vegetation Tall open scrub of *Acacia ancistrocarpa* over hummock grassland of *Triodia epactia* with scattered low shrubs of *Acacia stellaticeps* and scattered low trees of *Corymbia hamersleyana*.
Veg Condition Excellent.
Fire Age Very long unburnt.

Species	Cover (%)	Height (cm)	Specimen Code	Notes
Acacia ancistrocarpa	51	320		
Acacia colei var. *colei*	0.1	200	YSA11-03	
Acacia inaequilatera	0.1	190		
Acacia ptychophylla	0.1	110		
Acacia stellaticeps	1	85		
Boerhavia sp.	0.1	5		Inadequate material; dead.
Bonamia alatisemina	0.1	25	YSA11-05	
Bonamia erecta	0.1	25		
Corymbia hamersleyana	1	500	YSA11-04	
Eragrostis eriopoda	0.1	35	YSA11-02	
Eriachne pulchella	0.1	5		
Grevillea pyramidalis subsp. *leucadendron*	0.1	210		
Grevillea wickhamii	0.1	190		Sterile.
Hibiscus leptocladus	0.1	25	=YSA01-14	
Indigofera monophylla	0.1	35		
Senna notabilis	0.1	5		
Trigastrotheca molluginea	0.1	5		
Triodia epactia	50	50	YSA11-01	



YSA11

Yarrie Southern Area Site YSA-12

Described by CEF
Date 9/05/2024
Type Quadrat 50x50m
Coord (central) Zone 51220040 mE, 7717279 mN; 120.313669 E, -20.622850 S
Habitat Loamy plain next to creek.
Soil Reddish brown (2.5 YR 4/3) silty clay loam.
Rock Type Basalt, ironstone, quartz.
Vegetation Low open heath of *Acacia stellaticeps* over very open hummock grassland of *Triodia epactia*.
Veg Condition Very Good: cattle tracks and scats through quadrat.
Fire Age No sign of recent fire.
Notes Some areas with rocky surface and some small patches of open silty/clay depressions.

Species	Cover (%)	Height (cm)	Specimen Code
Acacia ptychophylla	0.1	70	
Acacia sphaerostachya	0.1	180	YSA12-01
Acacia stellaticeps	55	55	
Eriachne obtusa	0.1	25	YSA12-02
Triodia epactia	5	60	



YSA12

Yarrie Southern Area Site YSA-14

Described by CEF
Date 9/05/2024
Type Quadrat 50x50m
Coord (central) Zone 51 219782 mE, 7717129 mN; 120.311169, E -20.624164 S
Habitat Plain; some sections stony, some silty.
Soil Dark reddish brown (2.5YR 3/4) silty loam.
Rock Type Basalt, calcrete, ironstone, quartz.
Vegetation Low open heath of *Acacia stellaticeps*, (*A. ptychophylla*) over open hummock grassland of *Triodia epactia*.
Veg Condition Excellent.
Fire Age No sign of recent fire.

Species	Cover (%)	Height (cm)	Specimen Code	Notes
Acacia ancistrocarpa	0.1	95		
Acacia ptychophylla	1	80		
Acacia stellaticeps	40	100		
Acacia synchronicia	0.1	220		
Grevillea wickhamii	0.1	60		Sterile juvenile.
Indigofera monophylla	0.1	45		
Senna glutinosa subsp. *pruinosa*	0.1	150		
Senna glutinosa subsp. x *luerssenii*	0.1	150		
Triodia epactia	15	45		



YSA14

Yarrie Southern Area Site YSAR-05

Described by CEF
Date 8/05/2024
Type Relevé 25x100m
Coord (central) Zone 51 220420 mE, 7717509 mN; 120.317347 E -20.620827 S
Habitat Medium creekline, shallowly incised
Soil Dark reddish brown (2.5YR 3/4) sandy loam.
Rock Type Ironstone.
Vegetation Tall shrubland of *Acacia tumida* var. *pilbarensis*, *A. colei* var. *colei* with very open hummock grassland of *Triodia epactia* and scattered low trees of *Corymbia flavescens*.
Veg Condition Poor: some weeds; salt crust potentially causing death of shrubs.
Fire Age No sign of recent fire.
Notes Salt crust; dead Acacias present. Some juvenile *Corymbia flavescens* present. Narrowly incised towards the southern end of relevé.

Species	Cover (%)	Height (cm)	Specimen Code	Notes
Acacia colei var. *colei*	5	220	YSAR05-01	
Acacia tumida var. *pilbarensis*	15	400		
Afrohybanthus aurantiacus	0.1	10		
Calotropis procera	0.1	50		N=2.
Corymbia flavescens	1	550		
Cucumis variabilis	0.1	5		
Cyperus vaginatus	0.5	130		
Paspalidium rarum	0.1	5	YSAR05-03	
Pluchea dentex	0.1	50	YSAR05-02	
Rhynchosia minima	0.1	25		
Senna notabilis	0.1	5		
Sida sp. Pilbara (A.A. Mitchell PRP 1543)	0.1	15	YSAR05-04	
Stemodia grossa	0.1	10		
Trachymene oleracea subsp. *oleracea*	0.1	5		Seedling.
Triodia epactia	4	50		



YSAR05

Yarrie Southern Area Site YSAR-08

Described by CEF
Date 8/05/2024
Type Relevé 40 x 60 m
Coord (central) 51220869 mE, 7717213 mN; 120.321604 E, -20.623569 S
Habitat Minor creekline, with broad and very shallowly incised bed.
Soil Dark reddish brown (2.5YR 3/4) silty clay loam.
Rock Type Ironstone.
Vegetation Hummock grassland of *Triodia epactia* with low open woodland of *Corymbia hamersleyana* and scattered tall shrubs of *Acacia tumida* var. *pilbarensis* and scattered tussock grasses of *Chrysopogon fallax*.
Veg Condition Very Good: cattle scats and grazing.
Fire Age No sign of recent fire.

Species	Cover (%)	Height (cm)	Specimen Code	Notes
Acacia colei var. *colei*	0.1	200		
Acacia monticola	0.1	250		
Acacia tumida var. pilbarensis	1	280		
Afrohybanthus aurantiacus	0.1	25		
Chrysopogon fallax	1	50		
Corchorus elachocarpus	0.1	20	=YSA04-06	
Corymbia flavescens	0.1	20		Juvenile.
Corymbia hamersleyana	4	500		
Cymbopogon ambiguus	0.1	120		
Eragrostis eriopoda	0.1	30		
Eulalia aurea	0.1	50		
Goodenia microptera	0.1	25		
Gossypium australe	0.1	45		
Grevillea pyramidalis subsp. *leucadendron*	0.1	25		Juvenile.
Hibiscus burtonii	0.1	25	YSAR08-02	
Indigofera monophylla	0.1	15		
Paraneurachne muelleri	0.1	25		
Pterocaulon sphacelatum	0.1	25	YSAR08-03	
Rhynchosia minima	0.1	25		
Tephrosia rosea var. *clementii*	0.1	70	YSAR08-01	
Trigastrotheca molluginea	0.1	20		
Triodia epactia	35	70		



YSAR08

Yarrie Southern Area Site YSAR-10

Described by CEF
Date 8/05/2024
Type Relevé 25x100m
Coord (Central) Zone 51 221443 mE 7717514 mN;120.327157 E, -20.620939 S
Habitat Minor creekline.
Soil Reddish brown (2.5 YR 4/3) sandy clay loam.
Rock Type Ironstone.
Vegetation Open hummock grassland of *Triodia epactia* with tall open shrubland of *Acacia tumida* var. *pilbarensis* and low open woodland of *Corymbia hamersleyana*.
Veg Condition Excellent.
Fire Age No sign of recent fire.

Species	Cover (%)	Height (cm)	Specimen Code	Notes
Acacia colei var. colei	0.1	120		
Acacia ptychophylla	0.1	45		
Acacia tumida var. *pilbarensis*	3	250		
Afrohybanthus aurantiacus	0.1	20		
Corymbia hamersleyana	3			
Eriachne obtusa	0.1	25		
Grevillea wickhamii	0.1	150		Sterile.
Indigofera monophylla	0.1	40		
Pluchea tetranthera	0.1	25		
Solanum sp.	0.1	15	YSA10-01	Inadequate material.
Trachymene oleracea subsp. *oleracea*	0.1	5		
Trigastrotheca molluginea	0.1	10		
Triodia epactia	15	25		



YSAR10

Yarrie Southern Area Site YSAR-13

Described by CEF
Date 9/05/2024
Type Relevé 25x100m
Coord (Central) Zone 51 220225 mE, 7716980 mN; 120.315397 E, -20.625573 S
Habitat Bed and banks of moderate-sized creek; incised in some places.
Soil Dark reddish brown (2.5YR 3/4) silty loam.
Rock Type None present.
Vegetation Low open woodland of *Corymbia flavescens* over very open sedgeland of *Cyperus vaginatus* and tall open shrubland of *Acacia tumida* var. *pilbarensis* and very open tussock grassland of **Cenchrus ciliaris*.
Veg Condition Poor; cattle grazing, scats, tracks, weeds.
Fire Age No sign of recent fire.

Species	Cover (%)	Height (cm)	Specimen Code	Notes
Acacia colei var. *colei*	0.1	210	YSAR13-07	
Acacia colei var. *colei*	0.1	220	YSAR13-01	
Acacia tumida var. pilbarensis	2	250		
Arivela viscosa	0.1	25		
Boerhavia coccinea	0.1	5	YSAR13-06	
**Calotropis procera*	0.1	210		N=10; in flower.
Carissa lanceolata	0.1	230	YSAR13-12	
**Cenchrus ciliaris*	2	50		
**Cenchrus setiger*	2	35		
**Chloris virgata*	0.1	55	YSAR13-05	N=20.
Chrysopogon fallax	0.1	120		
Corymbia flavescens	8	800		
Cucumis variabilis	0.1	25		
Cyperus vaginatus	6	80		
Dactyloctenium radulans	0.1	10		
Dysphania rhadinostachya	0.1	5		Inadequate material to determine subsp.
**Echinochloa colona*	0.1	25	YSAR13-09	N=20.
Eriachne tenuiculmis	0.1	35		
Euphorbia trigonosperma	0.1	10	YSAR13-10	
Grevillea wickhamii	0.1	25		Sterile.
Ipomoea muelleri	0.1	5	YSAR13-04	
Paspalidium clementii	0.1	10		
Pluchea rubelliflora	0.1	25	YSAR13-04	
Portulaca oleracea	0.1	2		
Senna notabilis	0.1	5		
Sesbania cannabina	0.1	140	YSAR13-03	
Sida rohlenae subsp. *rohlenae*	0.1	30	YSAR13-08	
Sida sp. Pilbara (A.A. Mitchell PRP 1543)	0.1	25	YSAR13-11	
Solanum diversiflorum	0.1	35	=YSA01-17	
Solanum sp.	0.1	55	=YSA03-04	Inadequate material.
Sporobolus australasicus	0.1	5		
Trianthema triquetrum	0.1	15	YSAR13-02	
Triumfetta chaetocarpa	0.1	35	=YSA04-08	
**Vachellia farnesiana*	0.1	250		N=15.



YSAR13

Yarrie Southern Area Site YSAR-15

Described by CEF
Date 9/05/2024
Type Relevé 25x100m
Coord (Central) Zone 51 220707mE, 7717408 mN
Habitat Minor creek.
Soil Dark reddish brown (2.5YR 3/4) sandy loam.
Rock Type Ironstone.
Vegetation Hummock grassland of *Triodia epactia* with tall open shrubland of *Acacia tumida* var. *pilbarensis* and scattered low trees of *Corymbia hamersleyana*.
Veg Condition Excellent.
Fire Age No sign of recent fire.

Species	Cover (%)	Height (cm)	Specimen Code
Acacia tumida var. *pilbarensis*	2	400	
Afrohybanthus aurantiacus	0.1	25	
Corchorus parviflorus	0.1	40	YSAR15-03
Corymbia hamersleyana	1	450	
Dampiera candicans	0.1	25	
Gossypium robinsonii	0.1	120	
Hibiscus coatesii	0.1	75	YSAR15-02
Indigofera monophylla	0.1	60	
Isotropis atropurpurea	0.1	48	YSAR15-04
Jasminum didymum subsp. *lineare*	0.1	5	
Pluchea tetranthera	0.1	30	
Senna glutinosa subsp. *glutinosa*	0.1	150	
Senna notabilis	0.1	5	
Tephrosia virens	0.1	160	YSAR15-01
Trachymene oleracea subsp. *oleracea*	0.1	5	
Triodia epactia	50	45	
Triumfetta chaetocarpa	0.1	25	=YSA04-08



YSAR15

Appendix 6

List of Vascular Flora Recorded from the Survey Area

Family	Species	Status/Notes
Aizoaceae	*Trianthema triquetrum*	
Amaranthaceae	*Achyranthes aspera*	
	Gomphrena cunninghamii	
	Ptilotus axillaris	
	Ptilotus exaltatus	
	Ptilotus fusiformis	
Apocynaceae	**Calotropis procera*	Weed (Declared Pest)
	Carissa lanceolata	
Araliaceae	*Trachymene oleracea* subsp. *oleracea*	
Asteraceae	*Pluchea dentex*	
	Pluchea ferdinandi-muelleri	
	Pluchea rubelliflora	
	Pluchea tetranthera	
	Pterocaulon sphacelatum	
Boraginaceae	*Ehretia saligna* var. *saligna*	
	Euploca cunninghamii	
Caryophyllaceae	*Polycarpaea corymbosa* var. *corymbosa*	
Chenopodiaceae	*Dysphania rhadinostachya* (insufficient material; subsp. not determined)	
Cleomaceae	*Arivela viscosa*	
Combretaceae	*Terminalia circumalata*	
Convolvulaceae	*Bonamia alatisemina*	
	Bonamia erecta	
	Bonamia pilbarensis	
	Evolvulus alsinoides var. *villosicalyx*	
	Ipomoea muelleri	
Cucurbitaceae	*Cucumis melo*	
	Cucumis variabilis	
Cyperaceae	*Cyperus vaginatus*	
	Fimbristylis dichotoma	
	Schoenoplectus subulatus	
Euphorbiaceae	*Euphorbia australis* var. *subtomentosa*	
	Euphorbia trigonosperma	
Fabaceae	*Acacia ancistrocarpa*	
	Acacia bivenosa	
	Acacia colei var. colei	
	Acacia elachantha	
	Acacia inaequilatera	
	Acacia monticola	
	Acacia ptychophylla	
	Acacia sphaerostachya	
	Acacia stellaticeps	
	Acacia synchronicia	
	Acacia tumida var. *pilbarensis*	
	Cajanus cinereus	
	Crotalaria medicaginea var. *neglecta*	
	Indigofera monophylla	
	Isotropis atropurpurea	
	Rhynchosia minima	

Family	Species	Status/Notes
	Senna artemisioides subsp. *oligophylla*	
	Senna glutinosa subsp. *glutinosa*	
	Senna glutinosa subsp. *pruinosa*	
	Senna glutinosa subsp. x *luerssenii*	
	Senna notabilis	
	Senna symonii	
	Sesbania cannabina	
	Tephrosia rosea var. *clementii*	
	Tephrosia virens	
	Tephrosia sp. Bungaroo Creek (M.E. Trudgen 11601)	
	Tephrosia sp. NW Eremaean (S. van Leeuwen et al. PBS 0356)	
	**Vachellia farnesiana*	Weed
	Zornia muelleriana subsp. *congesta*	
Goodeniaceae	*Dampiera candicans*	
	Goodenia microptera	
	Goodenia muelleriana	
	Goodenia stobbsiana	
Lauraceae	*Cassytha capillaris*	
Malvaceae	*Corchorus elachocarpus*	
	Corchorus sp. (insufficient material; sterile)	*Corchorus ? elachocarpus* (insufficient material; sterile)
	Corchorus parviflorus	
	Gossypium australe	
	Gossypium robinsonii	
	Hibiscus burtonii	
	Hibiscus coatesii	
	Hibiscus leptocladus	
	Hibiscus sp.	*Hibiscus* aff. *leptocladus* (atypical specimen)
	**Malvastrum americanum*	Weed
	Sida rohlenae subsp. *rohlenae*	
	Sida sp. Pilbara (A.A. Mitchell PRP 1543)	
	Sida sp. (insufficient material)	
	Triumfetta chaetocarpa	
	Waltheria indica	
Molluginaceae	*Trigastrotheca molluginea*	
Moraceae	*Ficus brachypoda*	
Myrtaceae	*Corymbia flavescens*	
	Corymbia hamersleyana	
	Corymbia zygophylla	
Nyctaginaceae	*Boerhavia coccinea*	
	Boerhavia sp. (insufficient material)	
Oleaceae	*Jasminum didymum* subsp. *lineare*	
Phyllanthaceae	*Notoleptopus decaisnei*	
Plantaginaceae	*Stemodia grossa*	
Poaceae	**Cenchrus ciliaris*	Weed

Family	Species	Status/Notes
	**Cenchrus setiger*	Weed
	**Chloris virgata*	Weed
	Chrysopogon fallax	
	Cymbopogon ambiguus	
	Cymbopogon obtectus	
	Dactyloctenium radulans	
	Digitaria ctenantha	
	**Echinochloa colona*	Weed
	Eragrostis cumingii	
	Eragrostis eriopoda	
	Eriachne aristidea	
	Eriachne obtusa	
	Eriachne pulchella	
	Eriachne tenuiculmis	
	Eriachne sp. (insufficient material)	
	Eulalia aurea	
	Panicum australiense var. *australiense*	
	Paraneurachne muelleri	
	Paspalidium clementii	
	Paspalidium rarum	
	Perotis rara	
	Sporobolus australasicus	
	Triodia epactia	
	Triodia longiceps	
	Triodia wiseana	
Portulacaceae	*Portulaca oleracea*	
Proteaceae	*Grevillea pyramidalis* subsp. *leucadendron*	
	Grevillea wickhamii (sterile; subsp. not determined)	
	Hakea lorea subsp. *lorea*	
Rubiaceae	*Dolichocarpa crouchiana*	
Solanaceae	*Solanum diversiflorum*	
	Solanum lasiophyllum	
	Solanum sp. (insufficient material)	
Typhaceae	*Typha domingensis*	
Violaceae	*Afrohybanthus aurantiacus*	
Zygophyllaceae	*Tribulus suberosus*	

Appendix 7

Introduced Flora Locations

Site	Species	Date	Field No	Cover (%)	Height (cm)	Number of Individuals	Easting	Northing
Opportunistic	**Calotropis procera*	6-May-24				30	219940	7717554
Opportunistic	**Calotropis procera*	7-May-24				1	221115	7716175
Opportunistic	**Calotropis procera*	7-May-24				4	221086	7716143
Opportunistic	**Calotropis procera*	9-May-24				10	219720	7717496
Opportunistic	**Calotropis procera*	7-May-24				30	221065	7716476
YSA-03	**Calotropis procera*	7-May-24		1	200	20	221068	7716120
YSAR-05	**Calotropis procera*	7-May-24		0.1	50	2	220420	7717509
YSAR-13	**Calotropis procera*	9-May-24		0.1	210	10	220225	7716980
Opportunistic	**Calotropis procera*	24-Jul-24				10	220293	7718144
Opportunistic	**Calotropis procera*	24-Jul-24				10	220279	7718189
Opportunistic	**Cenchrus ciliaris*	7-May-24				100	221131	7716169
YSA-02	**Cenchrus ciliaris*	7-May-24		0.1	15	2	221173	7716202
YSA-03	**Cenchrus ciliaris*	7-May-24		20	45	3000	221068	7716120
YSA-06	**Cenchrus ciliaris*	7-May-24		0.1	25	20	220677	7716283
YSAR-13	**Cenchrus ciliaris*	9-May-24		2	50	250	220225	7716980
Opportunistic	**Cenchrus setiger*	7-May-24		15		2000	221130	7716168
YSA-02	**Cenchrus setiger*	7-May-24		0.1	25	15	221173	7716202
YSA-03	**Cenchrus setiger*	7-May-24		20	45	3000	221068	7716120
YSAR-13	**Cenchrus setiger*	9-May-24		2	35	250	220225	7716980
YSAR-13	**Chloris virgata*	9-May-24	YSAR13-05	0.1	55	20	220225	7716980
YSAR-13	**Echinochloa colona*	9-May-24	YSAR13-09	0.1	25	20	220225	7716980
Opportunistic	**Malvastrum americanum*	7-May-24				3	221081	7716144
YSA-03	**Malvastrum americanum*	7-May-24		0.1	55	3	221068	7716120
Opportunistic	**Vachellia farnesiana*	7-May-24				6	221137	7716165
Opportunistic	**Vachellia farnesiana*	9-May-24				2	219956	7717465
YSA-03	**Vachellia farnesiana*	7-May-24		2	250	10	221068	7716120
YSAR-13	**Vachellia farnesiana*	9-May-24		0.1	250	15	220225	7716980

Appendix 8

Selected Inputs and Outputs of the PRIMER Floristic Analysis

Rationalised species list for PRIMER analysis

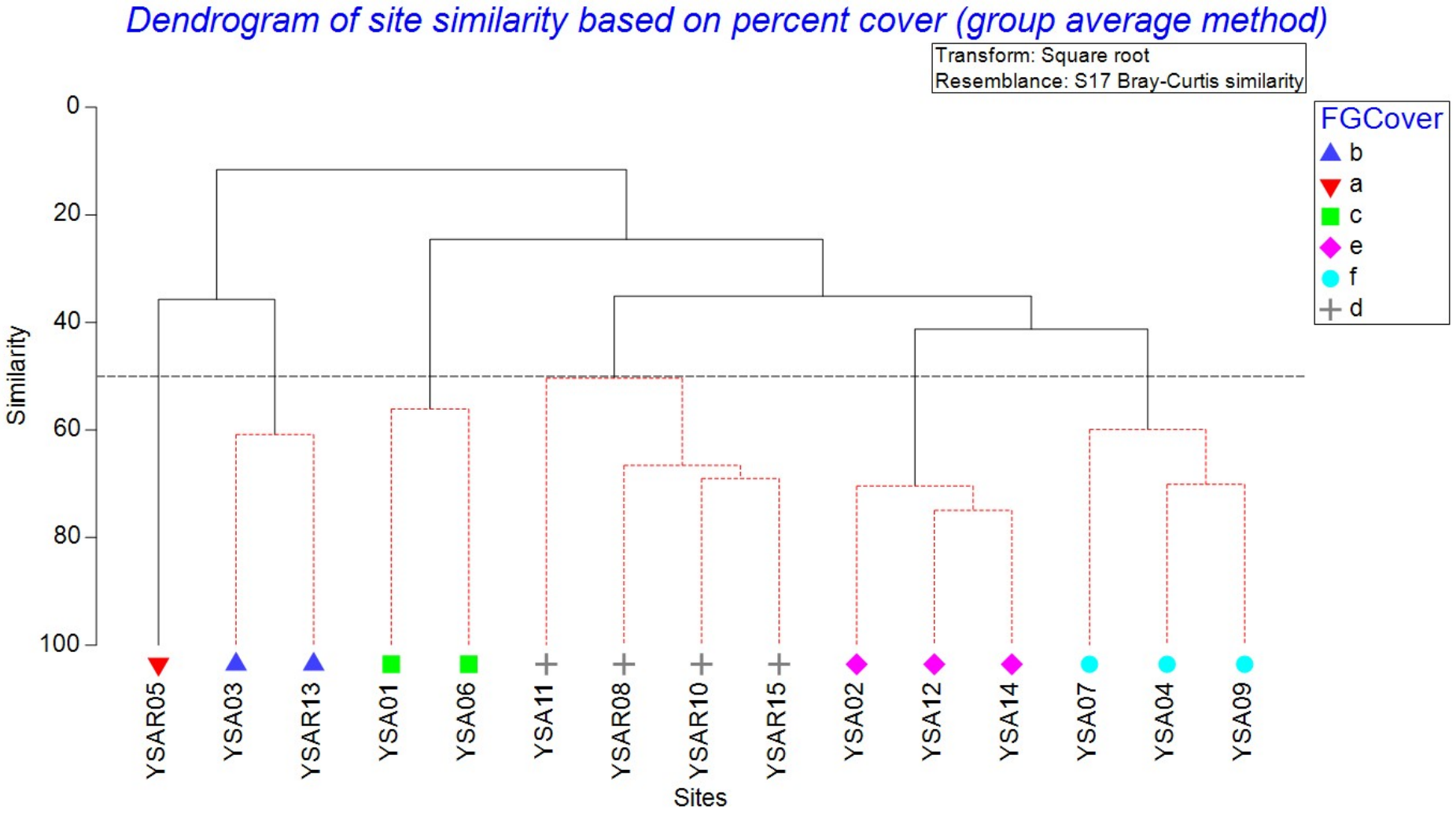
Original Taxon	**Treated as Following for PRIMER**
Cenchrus ciliaris	Cenchrus spp.
Cenchrus setiger	Cenchrus spp.
Chloris virgata	Omitted; weed
Fimbristylis dichotoma	Omitted; singleton
Cymbopogon ambiguus	Omitted; singleton
Digitaria ctenantha	Omitted; singleton
Echinochloa colona	Omitted; weed
Eragrostis cumingii	Omitted; singleton
Eriachne aristidea	Omitted; singleton
Eriachne pulchella	Omitted; singleton
Eriachne tenuiculmis	Omitted; singleton
Eulalia aurea	Omitted; singleton
Panicum australiense var. *australiense*	Omitted; singleton
Paspalidium rarum	Omitted; singleton
Hakea lorea subsp. *lorea*	Omitted; singleton
Tribulus suberosus	Omitted; singleton
Acacia bivenosa	Omitted; singleton
Acacia elachantha	Omitted; singleton
Acacia monticola	Omitted; singleton
Crotalaria medicaginea var. *neglecta*	Omitted; singleton
Isotropis atropurpurea	Omitted; singleton
Sesbania cannabina	Omitted; singleton
Tephrosia rosea var. *clementii*	Omitted; singleton
Tephrosia sp. Bungaroo Creek (M.E. Trudgen 11601)	Omitted; singleton
Tephrosia sp. NW Eremaean (S. van Leeuwen et al. PBS 0356)	Omitted; singleton
Tephrosia virens	Omitted; singleton
Vachellia farnesiana	Omitted; weed
Zornia muelleriana subsp. *congesta*	Omitted; singleton
Cucumis melo	Omitted; singleton
Notoleptopus decaisnei	Omitted; singleton
Corchorus sp. *(Corchorus ? elachocarpus)*	*Corchorus elachocarpus*
Corchorus parviflorus	Omitted; singleton
Gossypium australe	Omitted; singleton
Gossypium robinsonii	Omitted; singleton
Hibiscus burtonii	Omitted; singleton
Hibiscus coatesii	Omitted; singleton
Malvastrum americanum	Omitted; weed
Waltheria indica	Omitted; singleton
Hibiscus sp. *(Hibiscus* aff. *leptocladus)*	*Hibiscus leptocladus*
Sida sp.	Omitted; indeterminate taxon
Polycarpaea corymbosa var. *corymbosa*	Omitted; singleton
Ptilotus axillaris	Omitted; singleton
Ptilotus fusiformis	Omitted; singleton
Dysphania rhadinostachya	Omitted; singleton
Trianthema triquetrum	Omitted; singleton
Boerhavia sp.	Omitted; indeterminate taxon
Dolichocarpa crouchiana	Omitted; singleton
Calotropis procera	Omitted; weed
Carissa lanceolata	Omitted; singleton
Ehretia saligna var. saligna	Omitted; singleton

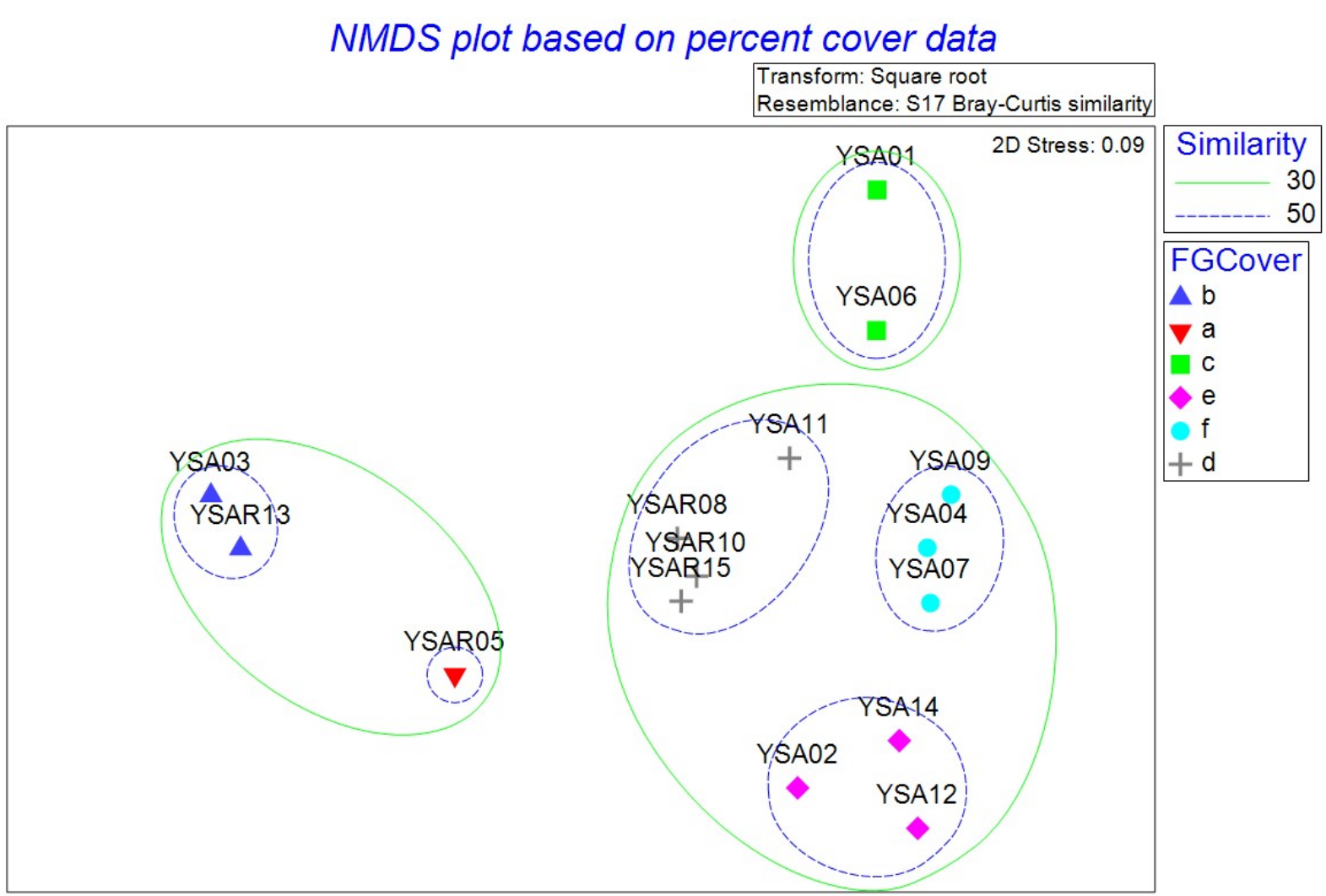
Original Taxon	Treated as Following for PRIMER
Euploca cunninghamii	Omitted; singleton
Bonamia alatisemina	Omitted; singleton
Bonamia erecta	Omitted; singleton
Bonamia pilbarensis (Port Hedland form; densely indumented)	*Bonamia pilbarensis*
Solanum lasiophyllum	Omitted; singleton
Solanum sp.	Omitted; indeterminate taxon
Jasminum didymum subsp. *lineare*	Omitted; singleton
Stemodia grossa	Omitted; singleton
Dampiera candicans	Omitted; singleton
Goodenia stobbsiana	Omitted; singleton
Pluchea dentex	Omitted; singleton

Site x Species Matrix

Species	YSA-01	YSA-02	YSA-03	YSA-04	YSA-06	YSA-07	YSA-09	YSA-11	YSA-12	YSA-14	YSAR-05	YSAR-08	YSAR-10	YSAR-13	YSAR-15
Cassytha capillaris				0.1											
Cyperus vaginatus			0.1								0.5			6	
Cenchrus spp.		0.1	40		0.1									4	
Chrysopogon fallax		0.1	0.1									1		0.1	
Dactyloctenium radulans		0.1												0.1	
Eragrostis eriopoda					0.1			0.1				0.1			
Eriachne obtusa		0.1		0.1					0.1				0.1		
Paraneurachne muelleri		0.1										0.1			
Paspalidium clementii			0.1											0.1	
Paspalidium rarum											0.1				
Sporobolus australasicus		0.1												0.1	
Triodia epactia		15		18	2	15	20	50	5	15	4	35	15		50
Triodia wiseana	20			12	55	1	14								
Grevillea pyramidalis subsp. *leucadendron*	0.5				0.1	0.1		0.1				0.1			
Grevillea wickhamii				0.5	0.1		0.1	0.1		0.1			0.1	0.1	
Acacia ancistrocarpa				0.1	0.1			51		0.1					
Acacia colei var. colei			0.1					0.1			5	0.1	0.1	0.1	
Acacia inaequilatera	0.1			1	1	0.1	1	0.1							
Acacia ptychophylla	0.1				0.1	0.1	1.5	0.1	0.1	1			0.1		
Acacia sphaerostachya		0.1				0.1			0.1						
Acacia stellaticeps		60		4	0.1	2		1	55	40					
Acacia synchronicia				0.1		0.1				0.1					
Acacia tumida var. *pilbarensis*		0.1	9								15	1	3	2	2
Indigofera monophylla					0.1			0.1		0.1		0.1	0.1		0.1
Rhynchosia minima					0.1						0.1	0.1			
Senna glutinosa subsp. *glutinosa*				0.1	0.1										0.1
Senna glutinosa subsp. *pruinosa*				0.1						0.1					
Senna glutinosa subsp. x *luerssenii*				0.1		0.1	0.1			0.1					
Senna notabilis	0.1	0.1	0.1	0.1				0.1			0.1			0.1	0.1
Cucumis variabilis			0.1								0.1			0.1	
Euphorbia trigonosperma				0.1										0.1	
Afrohybanthus aurantiacus		0.1									0.1	0.1	0.1		0.1
Corymbia flavescens		0.1	11								1	0.1		8	
Corymbia hamersleyana	1				2			1				4	3		1
Corchorus elachocarpus	0.1	0.1		0.1								0.1			

Species	YSA-01	YSA-02	YSA-03	YSA-04	YSA-06	YSA-07	YSA-09	YSA-11	YSA-12	YSA-14	YSAR-05	YSAR-08	YSAR-10	YSAR-13	YSAR-15
Hibiscus leptocladus	0.1							0.1							
Sida rohlenae subsp. *rohlenae*			0.1		0.1									0.1	
Sida sp. Pilbara (A.A. Mitchell PRP 1543)											0.1			0.1	
Triumfetta chaetocarpa				0.1										0.1	0.1
Arivela viscosa	0.1	0.1												0.1	
Ptilotus exaltatus	0.1			0.1											
Boerhavia coccinea					0.1									0.1	
Trigastrotheca molluginea	0.1				0.1			0.1				0.1	0.1		
Portulaca oleracea			0.1											0.1	
Bonamia pilbarensis				0.1			0.1								
Evolvulus alsinoides var. *villosicalyx*		0.1			0.1										
Ipomoea muelleri		0.1												0.1	
Solanum diversiflorum	0.1													0.1	
Goodenia microptera	0.1											0.1			
Goodenia muelleriana	0.1	0.1			0.1										
Pluchea rubelliflora			0.1											0.1	
Pluchea tetranthera	0.1	0.1		0.1	0.1	0.1							0.1		0.1
Pterocaulon sphacelatum		0.1										0.1			
Trachymene oleracea subsp. *oleracea*				0.1							0.1		0.1		0.1


Dendrogram of site similarity based on percent cover (group average method)
Transform: Square root
Resemblance: S17 Bray-Curtis similarity
FGCover
b
a
c
e
f
d
Similarity
0
20
40
60
80
100
YSAR05
YSA03
YSAR13
YSA01
YSA06
YSA11
YSAR08
YSAR10
YSAR15
YSA02
YSA12
YSA14
YSA07
YSA04
YSA09
Sites


NMDS plot based on percent cover data
Transform: Square root
Resemblance: S17 Bray-Curtis similarity
2D Stress: 0.09
Similarity
30
50
FGCover
b
a
c
e
f
d
YSA01
YSA06
YSA11
YSA03
YSA09
YSAR13
YSAR08
YSA04
YSAR10
YSAR15
YSA07
YSAR05
YSA14
YSA02
YSA12