Biota Environmental Sciences

Chichester Solar Biological Survey

Prepared for Alinta Energy Pilbara Holdings Pty Ltd

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Biota Environmental Sciences

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Chichester Solar Biological Survey

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1.0 Executive Summary

Alinta Energy Pilbara Holdings Pty Ltd (Alinta Energy) is planning an expansion of the Chichester Solar Gas Hybrid Project, in the Pilbara region of Western Australia. On behalf of Alinta Energy, Preston Consulting Pty Ltd commissioned Biota Environmental Sciences to complete a desktop study and biological survey of an 184.8 ha area bordering the existing solar array footprint.

A desktop study that consolidated all available and relevant existing data was carried out to identify known biological features and constraints near the survey area, and to inform the field survey. A detailed flora and vegetation survey was conducted from 18th May to 23rd May 2023, and a basic and targeted terrestrial fauna survey was conducted from 29th May to 31st May 2023.

No State or Federally listed Threatened Ecological Communities or Priority Ecological Communities were recorded in the survey area. Five vegetation types were mapped, associated with two broad landforms (drainage lines and floodplains).

A total of 62.6% of the vegetation in the survey area was rated as being in 'Very Good' condition, with 19.6% being 'Good' or 'Good to Poor'. The remaining 17.8% had been cleared and was considered 'Completely Degraded'. The entirety of the survey area was affected to some degree by weed invasion and minor degradation by livestock. The habitats that were most affected by weeds were associated with ephemeral drainage lines and lower-lying areas in the landscape.

A total of 140 native flora species from 76 genera and 30 families were recorded during the survey, none of which are listed as significant. The post-survey likelihood assessment indicates that no significant flora species are likely to occur in the survey area. A total of nine weed species were recorded across the survey area, none of which are Weeds of National Significance, or Declared Pests under the *Biosecurity and Agriculture Management Act 2007*.

Four distinct fauna habitats were identified for the survey area:

- *Acacia* woodlands;
- Major drainage lines;
- Minor drainage lines and low-lying floodplains; and
- Cleared areas.

Acacia woodlands were the dominant fauna habitat in the survey area, occupying more than half of the total area (66.9%), followed by cleared areas (17.8%) and minor drainage lines and low-lying floodplains (14.0%).

A total of 67 vertebrate fauna species were recorded from the survey area during the survey, comprising 15 mammals (four of which were introduced), 50 birds and two reptile species. No significant fauna were recorded during the survey, however the desktop study returned a total of 33 significant vertebrate fauna species with the potential to occur within the survey area. Nine of these species were deemed to have a high or moderate likelihood of occurrence within the survey area, as summarised below:

- Likely to occur:
  - Short-tailed Mouse, *Leggadina lakedownensis* (DBCA Priority 4).
- Likely to occur (only as foraging visitor):
  - Grey Falcon, *Falco hypoleucos (*Vulnerable under BC Act and EPBC Act),
  - Peregrine Falcon, *Falco peregrinus* (Other Specially Protected under BC Act), and
  - Pacific Swift, *Apus pacificus* (Migratory under EPBC Act).
- May occur:

  - Gane's Blind Snake, *Anilios ganei* (DBCA Priority 1), however the core habitat preferences of this species are not well understood.
- May occur (only as transient or foraging visitor):
  - Northern Quoll, *Dasyurus hallucatus* (Endangered under BC Act and EPBC Act),
  - Pilbara Leaf-nosed Bat, *Rhinonicteris aurantia* (Vulnerable under BC Act and EPBC Act),
  - Ghost Bat, *Macroderma gigas* (Vulnerable under BC Act and EPBC Act), and
  - Pilbara Olive Python, *Liasis olivaceus barroni (*Vulnerable under BC Act and EPBC Act).

2.0 Introduction

2.1 Project Background

Alinta Energy is planning an expansion of the Chichester Solar Gas Hybrid Project, which supplies low emission renewable energy to Fortescue Metal Group's (FMG) Chichester Hub iron ore operations in the Pilbara region of Western Australia. The proposed expansion around the existing solar array footprint (hereafter, the 'survey area'), covers a total area of 184.8 ha and is located approximately 103 km north of Newman.

2.2 Scope of the Study

On behalf of Alinta Energy, Preston Consulting commissioned Biota Environmental Sciences (Biota) to undertake a desktop study followed by a biological survey to assess the flora, vegetation and fauna values of the survey area. The results of this study will be used to support an application for a Native Vegetation Clearing Permit (NVCP).

The key elements of the current scope comprised:

- A desktop study within a 40 km buffer of the survey area, including database and literature searches, to consolidate all available and relevant existing data to identify known biological features and constraints near the survey area;
- A single-phase detailed flora and vegetation survey to characterise and map vegetation units and compile an inventory of flora species occurring in the survey area;
- A targeted survey for significant flora (Threatened and Priority species) identified in the desktop study as potentially occurring in the survey area;
- A single-phase basic and targeted vertebrate fauna survey to record fauna species observed, assess the occurrence of significant species likely to occur within the survey area, and map fauna habitats;
- Preparation of a technical report summarising the results of the desktop study and field surveys, and incorporating floristic analyses; and
- Preparation of an assessment against the 10 Clearing Principles as outlined in Schedule 5 of the WA *Environmental Protection Act 1986* (the EP Act).

This study was conducted in accordance with relevant Environmental Protection Authority (EPA) guidance:

- Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016); and
- Technical Guidance – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment (EPA 2020); as well as
- A guide to the assessment of applications to clear native vegetation under Part V Division 2 of the EP Act (Department of Environment Regulation 2014).

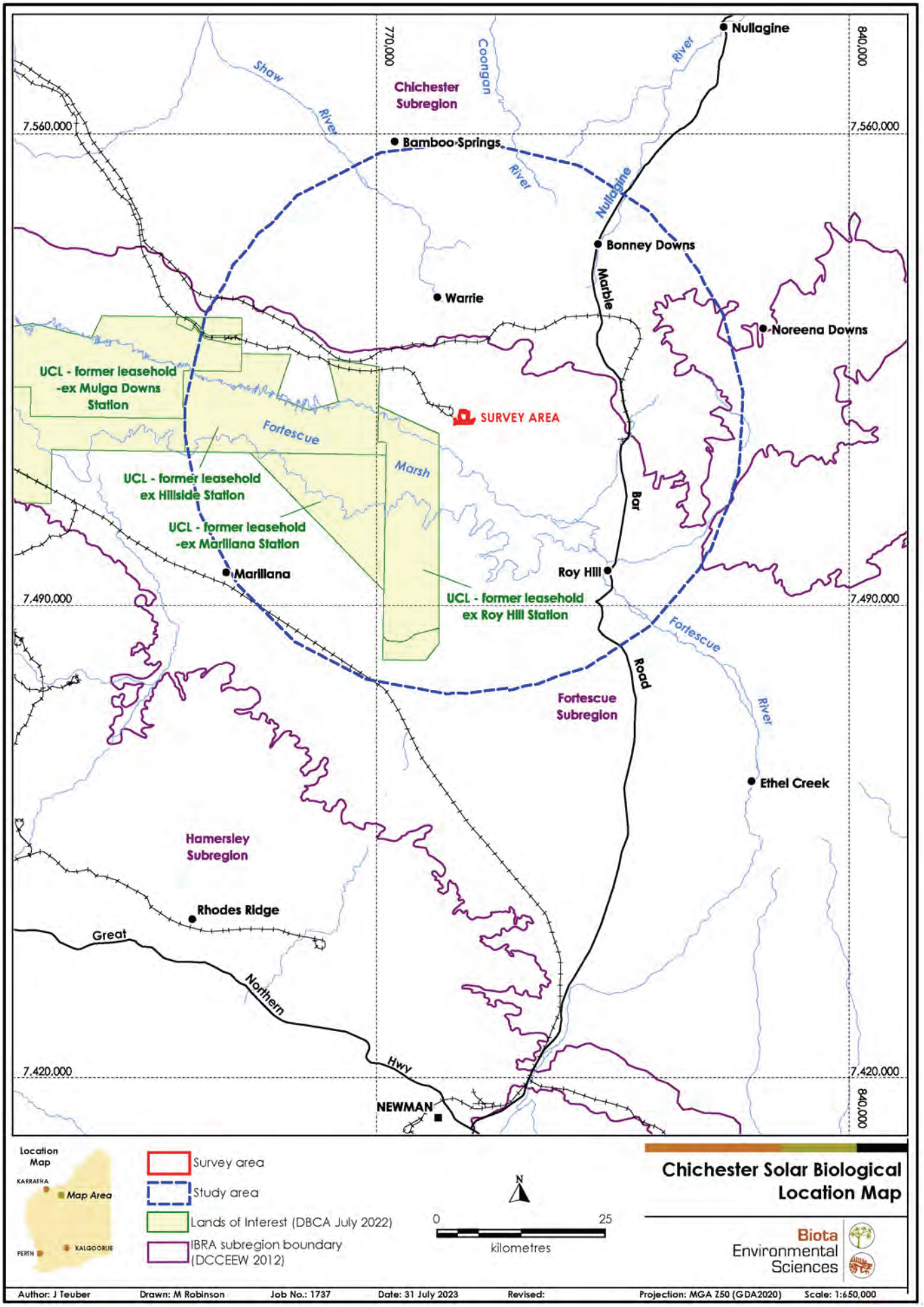

Figure 2.1: Location of the survey area and desktop study area.

3.0 Methodology

3.1 Desktop Study

A desktop study was carried out to identify biological features and constraints that may be present in the survey area, based on spatial and contextual information within a 40 km buffer ('the study area'). The desktop study included database searches, a review of available literature, compilation of biogeographical information relevant to the survey area, and an assessment of the likelihood of significant vegetation, flora and fauna occurring in the survey area. The results of the desktop study were used to inform the design of the field survey, including target species for the survey.

3.1.1 Database Searches

The following databases were searched as part of the desktop study:

- The Index of Biodiversity Surveys for Assessments (IBSA): a database consolidating data from land-based biodiversity surveys conducted to support assessments and compliance required under the EP Act, and providing a publicly available online platform for data sharing. The search was carried out using a 40 km buffer around the survey area.
- The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (the EPBC Act) Protected Matters Search Tool. The database search requested the return of records within a 40 km buffer around the survey area (Appendix 2).
- The Department of Biodiversity, Conservation and Attractions (DBCA) databases of Threatened Ecological Communities and Priority Ecological Communities (TECs and PECs), Threatened and Priority Flora, and Threatened and Priority Fauna. These searches returned spatial records from a 40 km buffer around the survey area, which are summarised in Appendices 3 and 4.
- The Atlas of Living Australia (ALA): a joint project between academic collecting institutions, private individual collectors and community groups. The atlas contains occurrence records, environmental data, images and the conservation status of species throughout Australia. The database search requested the return of flora and fauna records from a 40 km buffer around the survey area. Outputs from the ALA database search can be provided on request.

3.1.2 Literature Review

A review of publicly available desktop studies and reports of previous surveys conducted in the vicinity of the survey area was carried out, facilitated by the IBSA search and Biota's internal database of studies. The locality of the survey area has been surveyed extensively over the past two decades, given its proximity to FMG's Christmas Creek and Cloudbreak mine sites. A summary of the most relevant literature that was able to be sourced is presented in Table 4.5.

Other publicly available biogeographical information including soils, geology and land systems mapping, surface water values, conservation estate, environmentally sensitive areas and broad pre-European vegetation mapping, was also reviewed and collated for this study (Sections 4.1 to 4.10).

3.2 Assessment of Likelihood of Occurrence

To identify communities or species of significance potentially occurring in the survey area, the results of the database searches and previous surveys in the locality were compiled and then assessed considering the known habitat preferences for each community or species.

The likelihood that significant species or communities would occur in the survey area was assessed using a set of rankings and criteria (Table 3.1 presents those for species; a similar system was followed for communities). Throughout the remainder of this report, the term "proximity" has been defined as being within 20 km of the survey area, while the broader "locality" comprises the area up to 40 km

from the survey area. The criteria in Table 3.1 were used as guidance, and consideration was also given to:

- the documented distribution of the species;
- the proximity of the survey area to known populations;
- the species' ecology; and
- level of survey effort in the locality.

During the desktop study, habitats were defined according to the landforms apparent on aerial imagery, considering existing information regarding the environment and results from previous surveys (see Section 4.0). Following the field survey, the likelihood assessments were updated to include consideration of site-specific information and the sampling results. The likelihood assessments for flora and fauna are provided in Appendices 3 and 4 respectively.

Table 3.1: Ranking system used to assign the likelihood that a species would occur in the survey area.

Rank	Criteria
Recorded	1. The species has been recorded previously in the survey area.
Likely to occur (High likelihood of occurrence in the survey area)	1. There are existing records of the species in proximity to 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 (Moderate likelihood of occurrence in the survey area)	1. There are existing records of the species from the locality, 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 (Low likelihood of occurrence in the survey area)	1. The species is linked to a specific habitat, which is absent from the survey area; or 2. Suitable habitat is present, however there are no existing records of the species from the locality 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 (Negligible likelihood of occurrence in the survey area)	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 would not include the survey area.

3.3 Field Survey Team and Timing

A summary of the survey team members and their experience is provided in Table 3.2. The flora survey was undertaken from 18th to 23rd May 2023, comprising a total of six person days. The fauna survey was undertaken from 29th to 31st May 2023, comprising a total of three person days.

Table 3.2: Survey team, qualifications, and experience.

Name	Position at Biota	Survey Role	Qualification	Years of Experience	DBCA Licence #
Jason Teuber	Botanist	Flora (project manager and flora field leader)	BSc. (Bot. & Ag. Sc.)	3	FB62000286
Rob Hooper	Biologist	Flora and fauna (team member)	BSc. (Bot. & Mar. Sci.)	2	FB62000401 BA27000836 TFA2223-0221
John Graff	Senior Zoologist	Fauna (fauna field leader)	BSc. (Cons. Biol.), Hons.	12	BA27000836 TFA 2223-0221

3.4 Climate

Weather during a survey will influence the activity of terrestrial fauna, while longer term conditions, particularly rainfall, may influence productivity and thereby the overall abundance of individuals for both flora and fauna species. Additionally, the amount of rainfall preceding a botanical survey has a direct relationship with flora, influencing the presence of certain species that germinate after rainfall events, the condition of flora (dry or otherwise healthy), and the condition of vegetation to be sampled, particularly those susceptible to drought (e.g. clay communities).

Climate data were retrieved from the Bureau of Meteorology's Newman Airport weather station (#007176), located approximately 103 km south of the survey area. This station was selected because of the availability of both long-term and recent data.

The data show that rainfall in the year preceding the survey was lower than the long-term average (Figure 3.1). Although more than double the long-term average rainfall fell in the area in March 2023, annual grasses and herbs appeared dry during the survey. This could be attributed to the low rainfall immediately preceding the survey in May 2023.

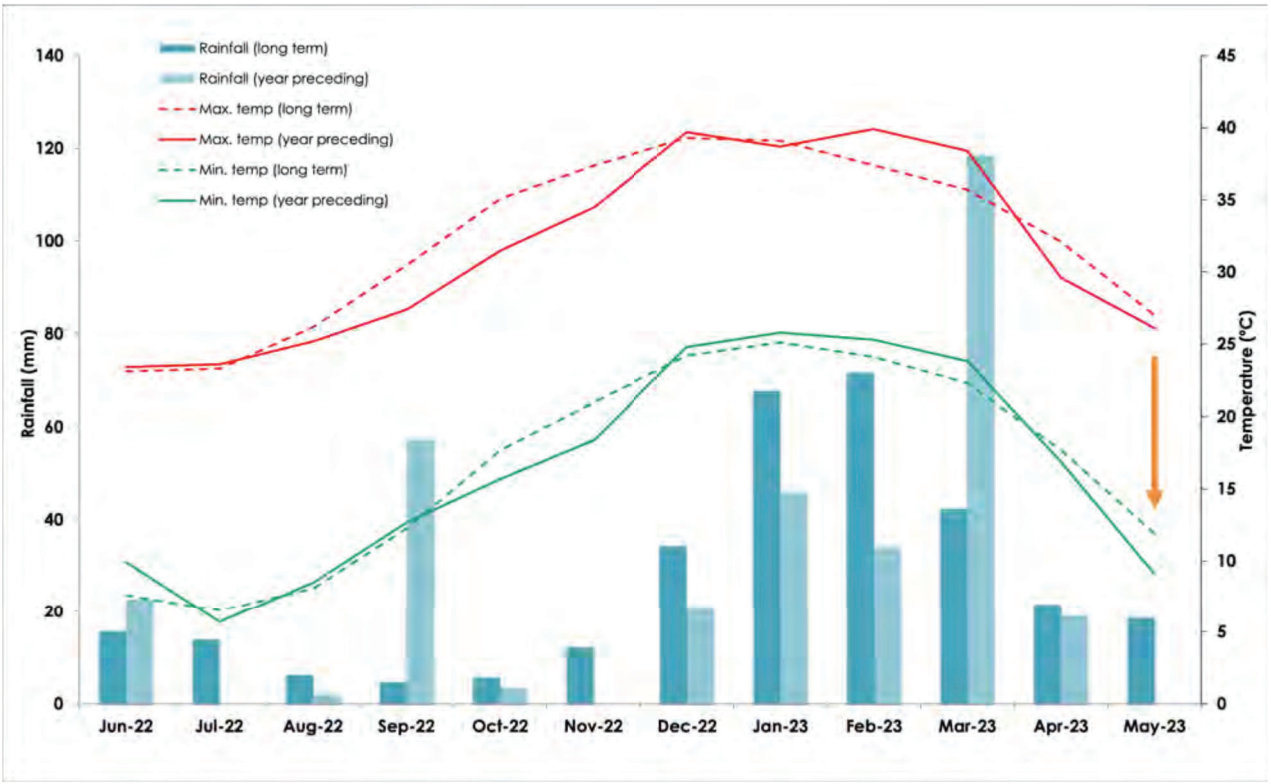

Figure 3.1: Climate graph depicting long-term averages and monthly data for the Newman Airport weather station.
Data from the Bureau of Meteorology weather station #007176. Arrow indicates survey timing.

3.5 Detailed and Targeted Flora and Vegetation Survey

3.5.1 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 on 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, to avoid recently burnt areas, etc.).

Sampling sites were established as either:

1. Quadrats: bounded floristic sampling sites. 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 optical squares and measuring tapes, but were not permanently marked; or
2. Relevés: unbounded floristic sampling sites with a similar search area to a quadrat. Relevés were typically used where the target vegetation was too small or too narrow to effectively establish a quadrat. The relevés during the current survey were thoroughly surveyed for flora but were not measured out.

The following parameters were recorded for all quadrats and relevés:

1. Location coordinates[1] (±2 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 the relevés, with a start and end point recorded for relevés that were undertaken in linear habitats such as creek lines;
2. Habitat: A description of the landform and habitat;
3. Soil: A broad description of the soil and any stony surface mantle or rocky outcropping;
4. Fire History: An estimate of time since last fire;
5. Disturbance Details: Vegetation condition was ranked according to the scale from EPA (2016), which was based on that developed by Trudgen (1988); this considered evidence of grazing, physical disturbance, weed invasion etc. (see Appendix 5);
6. Vegetation Description: A broad description based on the height and estimated cover of dominant species after Aplin's (1979) modification of the vegetation classification system of Specht (1970) (see Appendix 5);
7. Flora Species Cover: The estimated percentage foliar cover of each flora species present within the quadrat, or in the vicinity of the relevé; and
8. Photograph: Digital photographs of the vegetation were taken, typically from one or more corners of the quadrat or the central point of a relevé. Linear habitats were photographed at the start and end points.

A total of eight quadrats and four relevés were sampled in the survey area. A minimum of three sampling sites were established within each vegetation type, providing sufficient area was present within the survey area, consistent with EPA (2016) requirements for a detailed flora and vegetation survey. Some vegetation types were spatially restricted and had only minor representation within the survey area; as such, vegetation unit D2 (a major ephemeral drainage line) was assessed with only one relevé, and vegetation unit F3 (stony gibber snakewood floodplain) was assessed with two quadrats. Locations of the sampling sites and foot traverses are presented on the flora survey effort map in Figure 3.2, while a summary of raw data collected from the sites is presented in Appendix 6.

3.5.2 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)[2]. This level of detail would be considered fine-scale (intra-locality) delineation of vegetation types as per EPA (2016).

Vegetation mapping focused on the data retrieved from quadrats and relevés. Mapping notes were also utilised to mark the boundaries of vegetation types in the field and to allow for more accurate delineation of these boundaries following the survey.

[1] All coordinates presented in this report are in GDA94 datum and MGA50 projection.

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

Vegetation types and boundaries were subsequently verified using both the data collected in the field and digital imagery. Each vegetation type mapped for this assessment was given a unique alphanumeric code, comprising a character representing the broad landform group (i.e. 'D' for drainage areas and 'F' for floodplains), followed by a number sequence. The codes and a full description of each vegetation type are presented in Section 5.1.2, with the distribution of units mapped in Figure 5.1.

Vegetation condition mapping was also prepared using categories from EPA (2016), and is provided in Section 5.1.6.

Vegetation maps were drafted by Jason Teuber using Geographical Information System (GIS) software (QGIS). All figures in this report were produced by Melissa Robinson (Principal GIS Cartographer at Biota) using MapInfo Professional.

3.5.3 Searches for Significant Flora and Weeds

Targeted non-systematic searches were also conducted over the survey area, targeting areas considered to be potential habitat for significant flora. Locations of potential significant species or unknown taxa were recorded using a hand-held GPS unit, along with the number of individuals, the habitat and associated species.

Locations of introduced flora species (weeds) were also recorded during the foot traverses, along with an estimate of their population size (see Figure 5.2). These searches focused on weeds of management concern; i.e. Declared Plants under the *Biosecurity and Agriculture Management Act 2007* (BAM Act) and Weeds of National Significance (WoNS). Other weed species were recorded opportunistically, but no attempt was made to fully document their extent.

3.5.4 Specimen Identification, Nomenclature and Data Entry

Common taxa that were well known to the survey botanists were confirmed in the field. A voucher specimen was collected if the taxon was either difficult to determine without closer examination, belonged to a recognised species complex, was poorly collected in the past or otherwise unusual. Each voucher specimen was assigned a unique internal code to facilitate tracking of data. Specimens were pressed in the field and then returned to Perth for further examination and confirmation.

Voucher specimens were identified using all available flora keys, and comparison with reference collections of specimens at the WA Herbarium and in-house at Biota. Specimens were identified by Biota botanists with assistance from Pierre-Louis de Kock (consultant Specialist Taxonomist, and Director of DK Botanical). Mike Hislop (Identification Botanist at the WA Herbarium) is also gratefully acknowledged for his assistance to further resolve some specimen identifications.

A full vascular flora species list is provided in Appendix 7. Nomenclature and significance rankings used in this report are consistent with the current listing of WA flora recognised by the WA Herbarium on Florabase[3] at the time of writing.

All data were entered into a Microsoft Access database maintained at Biota, which was developed by Ted Griffin at the request of Malcolm Trudgen (M.E. Trudgen & Associates).

3.5.5 Analysis of Flora Data

3.5.5.1 Sampling Adequacy

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 asymptote. EstimateS (Colwell 2013) was used to calculate smoothed species

[3] http://florabase.dbca.wa.gov.au

accumulation curves based on 999 random permutations of the species data; only quadrat and relevé data were used (opportunistic records were excluded).

Species accumulation curves alone cannot be reliably used to extrapolate predicted species richness for future biological sampling. In order 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.

3.5.5.2 Floristic Analysis

To assist with defining the vegetation types from the survey area, hierarchical clustering analyses were conducted in PRIMER v6 (Clarke and Gorley 2006) to investigate the similarity of sampling sites based on their floristic composition.

A combined species list was generated from all sites in the data set from the current survey area. Taxon names and records were then rationalised as follows:

- Species that were present at only a single site were removed to reduce 'noise' in the data set.
- Taxa that could potentially refer to more than one entity (e.g. "*Euphorbia* sp.") were removed.
- Some taxa were merged, where considered appropriate (e.g. records of records of **Cenchrus ciliaris* and **Cenchrus setiger* were merged into **Cenchrus* spp.).
- All weeds were removed, except for **Cenchrus* spp. as these taxa were dominant in the majority of the sampling sites.

The rationalised table of species used in the analysis is shown in Appendix 9, Table 1.

The analysis was run using percent cover data (square-root transformed) (see Appendix 9, Table 2). 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.

Results were investigated through outputs including dendrograms (tree diagrams) of site similarity, and Non-metric Multi-Dimensional Scaling plots (NMDS plots). Selected inputs and outputs from the analyses are provided in Appendix 9.

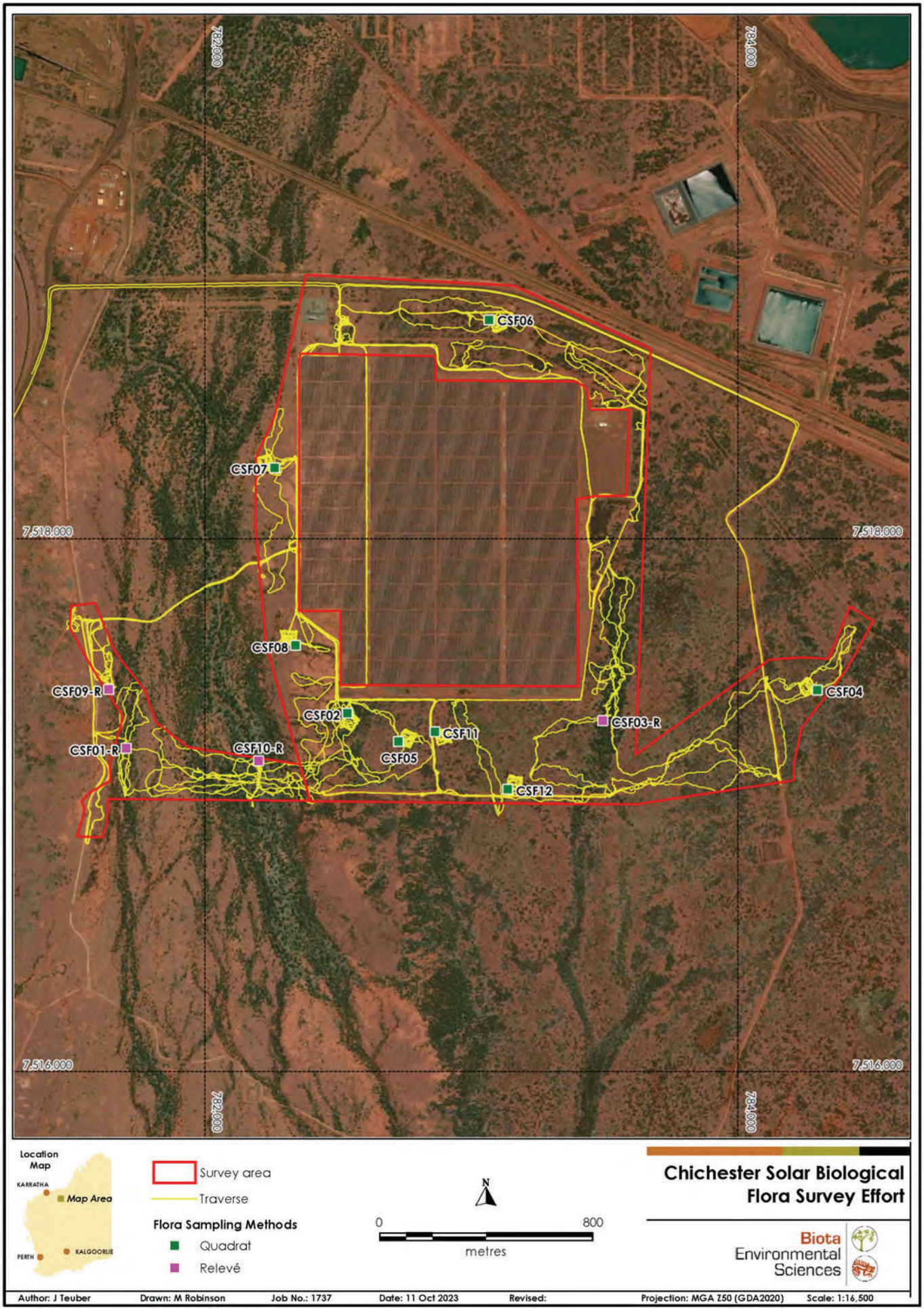

Figure 3.2: Flora survey locations and effort.

3.6 Targeted and Basic Fauna Survey

3.6.1 Targeted Species

The results of the desktop study and a preliminary assessment of likely habitat, based on aerial imagery, were used to identify significant fauna species to be targeted during the field survey. These species are outlined in Table 3.3, along with the techniques used to target them. Some techniques were suitable for targeting multiple significant species (e.g. targeted searches for Grey Falcons were also suitable for detecting Peregrine Falcons). Habitat assessments were also undertaken to identify habitat suitability for all significant fauna species identified as potentially occurring in the survey area.

Habitat was defined as "core" or "secondary", in line with the broad criteria used by the Commonwealth Department of Climate Change, Energy, the Environment and Water (DCCEEW) (Department of the Environment 2013, 2016). The definitions are as follows:

- "core", equivalent to "habitat critical to the survival of the species" as per Department of the Environment (2013) – habitat considered to potentially contain roosting, denning or breeding sites, primary foraging areas, or refugia during drought, fire or other stress; or
- "secondary" – the remaining habitats of the survey area, which may be used on a transitory, dispersing or occasional basis, but do not represent core habitat.

Table 3.3: Targeted species and survey methods employed.

Species	Common Name	Survey Methods
Mammals		
Dasyurus hallucatus	Northern Quoll	Motion cameras, secondary evidence searches, habitat assessment.
Leggadina lakedownensis	Lakeland Downs Mouse	
Pseudomys chapmani	Western Pebble-mound Mouse	
Rhinonicteris aurantia	Pilbara Leaf-nosed Bat	Ultrasonic recording units, habitat assessment.
Macroderma gigas	Ghost Bat	
Birds		
Apus pacificus	Pacific Swift	Targeted searches, habitat assessment.
Falco hypoleucos	Grey Falcon	
Falco peregrinus	Peregrine Falcon	
Pezoporus occidentalis	Night Parrot	Acoustic recording units, habitat assessment.
Reptiles		
Anilios ganei	Gane's Blind Snake	Targeted searches, habitat assessment.
Liasis olivaceus barroni	Pilbara Olive Python	

3.6.2 Habitat Assessments

Foot traverses were undertaken across the survey area to search for evidence of significant species and characterise fauna habitats. A total of 12.5 hours were spent searching, covering a total distance of approximately 12.7 km (Table 3.4; Figure 3.3).

Table 3.4: Habitat assessment, targeted search locations and effort.

Site Name	Date	Area	Search Effort (mins)	Search Distance (km)
CHI01TS	29/05/2023	South-west	328	5.3
CHI02TS	30/05/2023	South-east	242	4.3
CHI03TS	30/05/2023	South-central	72	1.2
CHI04TS	30/05/2023	North-east	104	1.9
		Total	**746**	**12.7**

3.6.3 Motion Cameras

Infrared motion-sensitive cameras (Reconyx Hyperfire 2) were deployed at five locations within the survey area, primarily targeting ground-dwelling mammals (Table 3.5; Figure 3.3). Cameras were deployed late in the flora survey and were retrieved the following week during the fauna survey, allowing seven to nine nights of recording at each location, for a total effort of 39 nights.

Table 3.5: Motion camera locations and effort.

Site Name	Latitude	Longitude	Date Deployed	Date Collected	Effort (nights)
CHI01MC	-22.4207	119.7541	22/05/2023	31/05/2023	9
CHI02MC	-22.4289	119.7544	22/05/2023	30/05/2023	8
CHI03MC	-22.4286	119.7596	22/05/2023	30/05/2023	8
CHI04MC	-22.4297	119.7412	23/05/2023	30/05/2023	7
CHI05MC	-22.4294	119.7376	23/05/2023	30/05/2023	7
				Total	**39**

3.6.4 Ultrasonic Sound Recorders

Song Meter SM4 automated ultrasonic sound recorders were deployed at four locations within the survey area to target significant bat species, particularly the Pilbara Leaf-nosed Bat and Ghost Bat (Table 3.6; Figure 3.3). Units were deployed with a focus on areas likely to attract aggregations of bats, such as flyway corridors (e.g. along major drainage lines fringed by tall vegetation) or near water sources. Survey effort totalled 16 nights (Table 3.6).

Bat call analysis was undertaken by Roxanne de Vos (Biologist at Biota) using Kaleidoscope Pro software (version 5.4.6), and following methods recommended by the Australasian Bat Society (2006) in conjunction with available reference data (Churchill 2008, McKenzie and Bullen 2009). Only sequences containing good quality search phase calls were considered for identification.

Table 3.6: Ultrasonic bat recorder locations and effort.

Site Name	Latitude	Longitude	Date Deployed	Date Collected	Effort (nights)
CHI01Bat	-22.4293	119.7416	23/05/2023	29/05/2023	6
CHI02Bat	-22.4282	119.7368	23/05/2023	29/05/2023	6
CHI03Bat	-22.4283	119.7545	29/05/2023	31/05/2023	2
CHI04Bat	-22.4143	119.7519	29/05/2023	31/05/2023	2
				Total	**16**

3.6.5 Acoustic Recording Units

Song Meter Mini automated recording units were deployed at four locations within the survey area to target the Night Parrot (Table 3.7; Figure 3.3). The in-field site assessment and detailed flora survey indicated no *Triodia* species were present within the survey area and therefore the likelihood of roosting sites or prospective habitat for the Night Parrot occurring within the survey area was negligible. Nonetheless, a precautionary approach was taken; song meters were set to record from dusk until dawn to detect Night Parrot calls for a total of 16 nights.

Audio files were analysed by John Graff (Senior Zoologist at Biota) using Kaleidoscope Pro software (version 5.4.6), with a recogniser built using Night Parrot calls recorded in Western Australia (available at https://nightparrot.com.au/index.php/resources/night-parrot-calls). Potential matches were then assessed manually by visually inspecting the spectra and listening to the recordings.

Table 3.7: Acoustic recorder locations and effort.

Site Name	Latitude	Longitude	Date Deployed	Date Collected	Effort (nights)
CHI01A	-22.4295	119.7420	23/05/2023	29/05/2023	6
CHI02A	-22.4298	119.7367	23/05/2023	29/05/2023	6

Site Name	Latitude	Longitude	Date Deployed	Date Collected	Effort (nights)
CHI03A	-22.4286	119.7566	29/05/2023	31/05/2023	2
CHI04A	-22.4198	119.7414	29/05/2023	31/05/2023	2
				Total	**16**

3.6.6 Fauna Habitat Mapping

Fauna habitat mapping was undertaken using a functional, ecological perspective on fauna use of the landscape (Biota 2013). Habitat mapping for the survey area was supported by the majority of the field sampling and extrapolation based on aerial imagery.

Fauna habitats were mapped in the field using a combination of foot traverses, and vehicle traverses along the existing road and tracks. Vegetation mapping completed for the current study was also used to support the fauna habitat descriptions.

Habitats were described and mapped based on areas that would be likely to offer a range of ecological niches for a suite of different species, with consideration of landform, substrate and vegetation. It is important to note that each broad habitat area defined here cannot be used to map the distribution of any one species, as many species utilise a range of ecological niches for specific activities such as foraging, commuting, breeding and nesting. The resultant habitat map may therefore be viewed as a guide to delineate areas that may be of differing ecological importance to the fauna species utilising the survey area.

Quality of fauna habitat was also considered according to the criteria defined in Table 3.8.

Table 3.8: Criteria used to assess fauna habitat quality.

Habitat Quality	Criteria
Excellent	Minimal to no modification of habitat from intense/frequent fires, trampling/grazing by introduced herbivores or weed invasion.
Good	Some habitat modification from intense/frequent fires, trampling/grazing by introduced herbivores and/or weed invasion.
Poor	Habitat mostly or completely modified by intense/frequent fires, trampling by introduced herbivores, invasion of weeds and/or clearing.

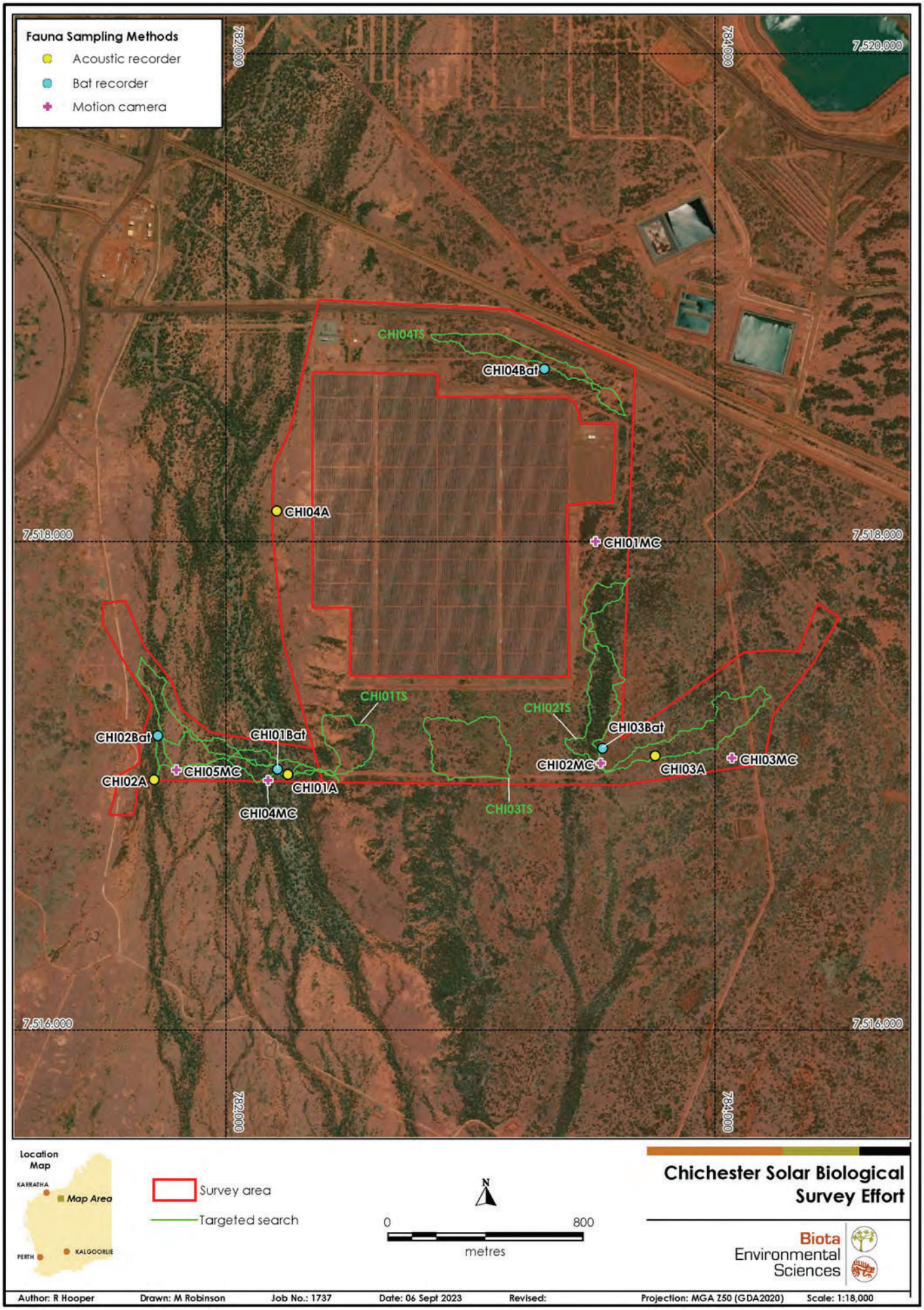

Figure 3.3: **Vertebrate fauna survey locations and effort.**

3.7 Survey Limitations

In accordance with the EPA Technical Guidance documents for 'Flora and Vegetation Surveys for Environmental Impact Assessment' (EPA 2016) and 'Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment' (EPA 2020), potential constraints and limitations of this biological survey are addressed in Table 3.9.

Table 3.9: Potential constraints and limitations of the biological survey.

Potential Constraint	Statement of Limitations
1. Availability of contextual information at a regional and local scale	• A large amount of survey work has been undertaken previously in the area, and the East Pilbara has been intensively surveyed. • Contextual information is not a limitation for this study.
2. Competency/ experience of the team carrying out the survey, including experience in the bioregion surveyed	• All field personnel were suitably qualified and experienced, and all persons involved have experience in the Pilbara. • Competency was not considered to be a limitation.
3. Proportion of species recorded and/or collected, any identification issues	• All vascular flora encountered in the survey area were recorded, with collections made of any taxa that were unusual, or difficult to identify without microscopic examination. The majority (94%) of the flora taxa were able to be identified to the lowest level possible within the current taxonomic framework. Specialist expertise was engaged as necessary to ensure determinations were as complete as possible. • The basic and targeted fauna survey recorded species via opportunistic methods verified habitats, and undertook targeted sampling for significant fauna species. An inventory survey of all fauna species was not required to meet the objectives of the current scope. • Overall, identifications and proportions of species recorded were not considered to be limitations, given the objectives of the scope.
4. Appropriate area fully surveyed (effort and extent)	• Flora sampling was completed through all representative habitats in the survey area. At least three replicate sites were set up in each vegetation type except for vegetation types D2 and F3, which had only limited representation in the survey area. • Targeted searches for significant flora were completed throughout the survey area in habitats considered to be prospective for such species. • The flora survey comprised a single phase of sampling only, and additional sampling would lead to additional taxa being recorded. • The basic and targeted fauna survey assessed the occurrence of habitat suitable for significant fauna species within the survey area. Survey effort was considered sufficient to meet the requirements for a basic and targeted survey. • Survey effort and extent were not considered to be limitations given the objectives of the scope.
5. Access restrictions within the survey and contextual areas	• The survey area was readily accessible, with the majority being located adjacent to an existing road, and the remainder being a short walk away from the road. • Access was not considered to be a limitation.

Potential Constraint	Statement of Limitations
6. Survey timing, rainfall, season of survey	• The flora survey was completed in late May 2023, and timing was considered adequate for recording most annual and cryptic perennial species. However, lower than usual rainfall in the two months preceding the survey may have affected the presence of some ephemeral species. • The fauna survey was undertaken when conditions were still relatively warm, which would be optimal for activity across most fauna groups. • Survey timing was not considered to be limitation given the objectives of the survey. • Rainfall is considered a minor limitation for the study.
7. Disturbance that may have affected the results of survey such as fire, flood or clearing	• Approximately 33% of the survey area has been cleared, however there was sufficient intact vegetation to adequately define the remaining vegetation. • The entirety of the survey area was affected to some degree by weed invasion, but this was expected, considering the historical land use (for pastoral and mining activities). • Vegetation in the survey area was largely in Very Good condition, therefore disturbance is not considered to have been a limitation.

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4.0 Desktop Study

4.1 IBRA Region and Subregion

The Interim Biogeographic Regionalisation for Australia (IBRA) recognises 89 bioregions and 419 biological subregions for Australia (Department of the Environment and Energy 2019). The survey area lies within the Fortescue Plains subregion of the Pilbara (PIL) bioregion (Figure 2.1). The Fortescue Plains (PIL2) subregion is 2,041,914 ha and is described as:

> "Alluvial plains and river frontage. Extensive salt marsh, mulga-bunch grass, and short grass communities on alluvial plains in the east. Deeply incised gorge systems in the western (lower) part of the drainage. River gum (*Eucalyptus camaldulensis*) woodlands fringe the drainage lines. Northern limit of Mulga (*Acacia aneura*). An extensive calcrete aquifer (originating within a palaeo-drainage valley) feeds numerous permanent springs in the central Fortescue, supporting large permanent wetlands with extensive stands of river gum and cadjeput (*Melaleuca argentea*) woodlands. Climatic conditions are semi desert tropical, with average rainfall of 300 mm, falling mainly in summer cyclonic events. Drainage occurs to the north-west" (Kendrick 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). The survey area lies within the Turee land system (Table 4.1; Figure 4.1).

Table 4.1: Description and extent of land systems in the survey area.
Data from Department of Agriculture WA (van Vreeswyk et al. 2004).

Land System	Description	Extent in PIL Bioregion (ha)	Extent in Survey Area		Extent in Survey Area as a Proportion of the Bioregion (%)
			Area (ha)	Proportion (%)	
Turee (RGETUR)	Stony alluvial plains with gilgaied and non-gilgaied surfaces supporting tussock grasslands and grassy shrublands of mulga and snakewood.	62,032.4	184.8	100.0	0.3

4.3 Geology

Surface geology of the region was mapped at a scale of 1:250,000 by the Geological Survey of Western Australia (1996). Mapping of the surface geological units in the locality was prepared based on data from Stewart et al. (2008). The survey area intersects two geological units, with the dominant unit being Qw, alluvium and colluvium (Table 4.2; Figure 4.2).

Table 4.2: Description and extent of geological units in the survey area.

Geological Unit	Description	Extent in Survey Area	
		Area (ha)	Proportion (%)
Qa	Alluvium unconsolidated silt, sand, and gravel; in drainage channels and on adjacent floodplains	20.9	11.3
Qw	Alluvium and colluvium-red-brown sandy and clayey soil; on low slopes and sheetwash areas	163.9	88.7
	Total	**184.8**	**100.0**

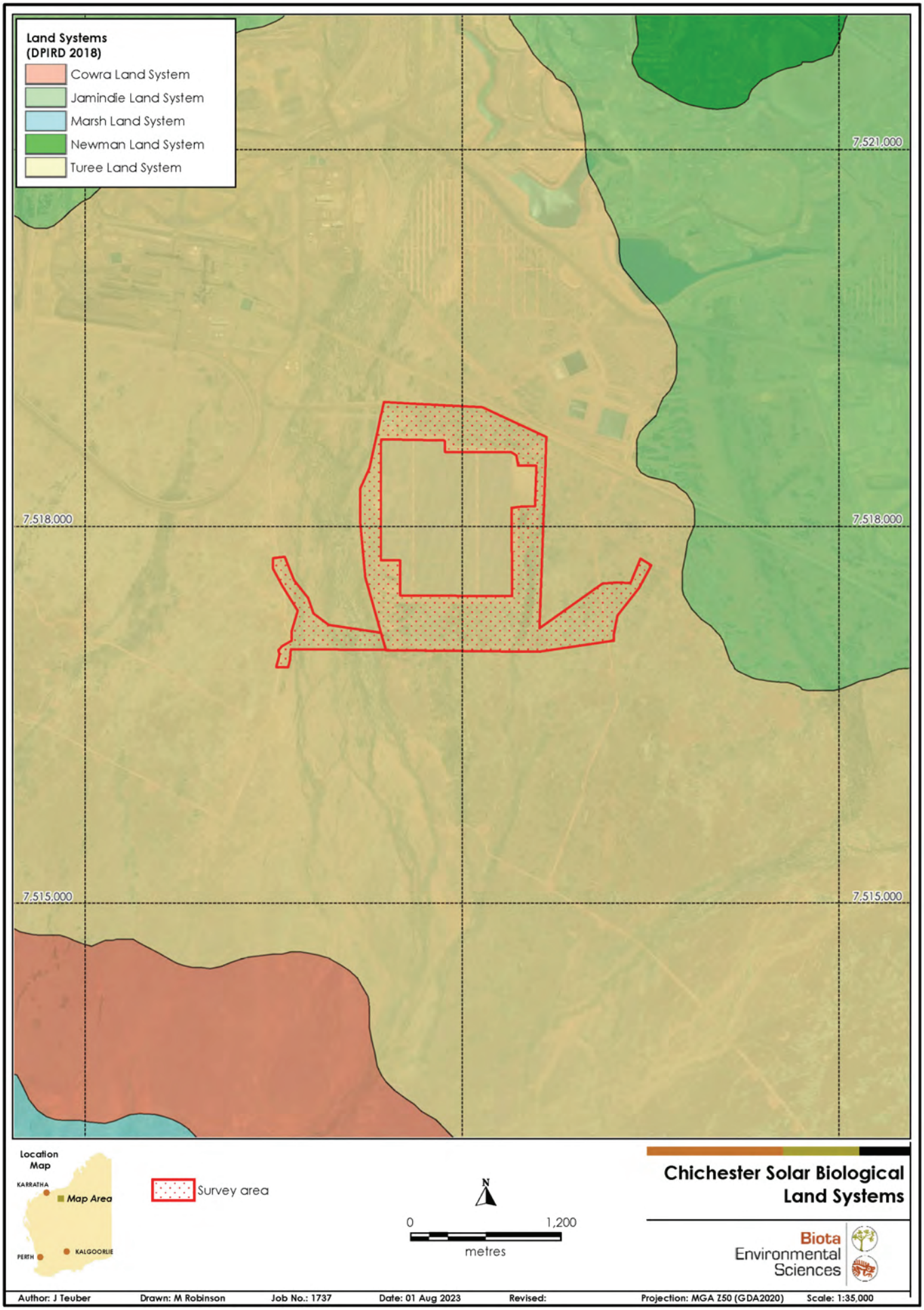

Figure 4.1: Land systems of the survey area.

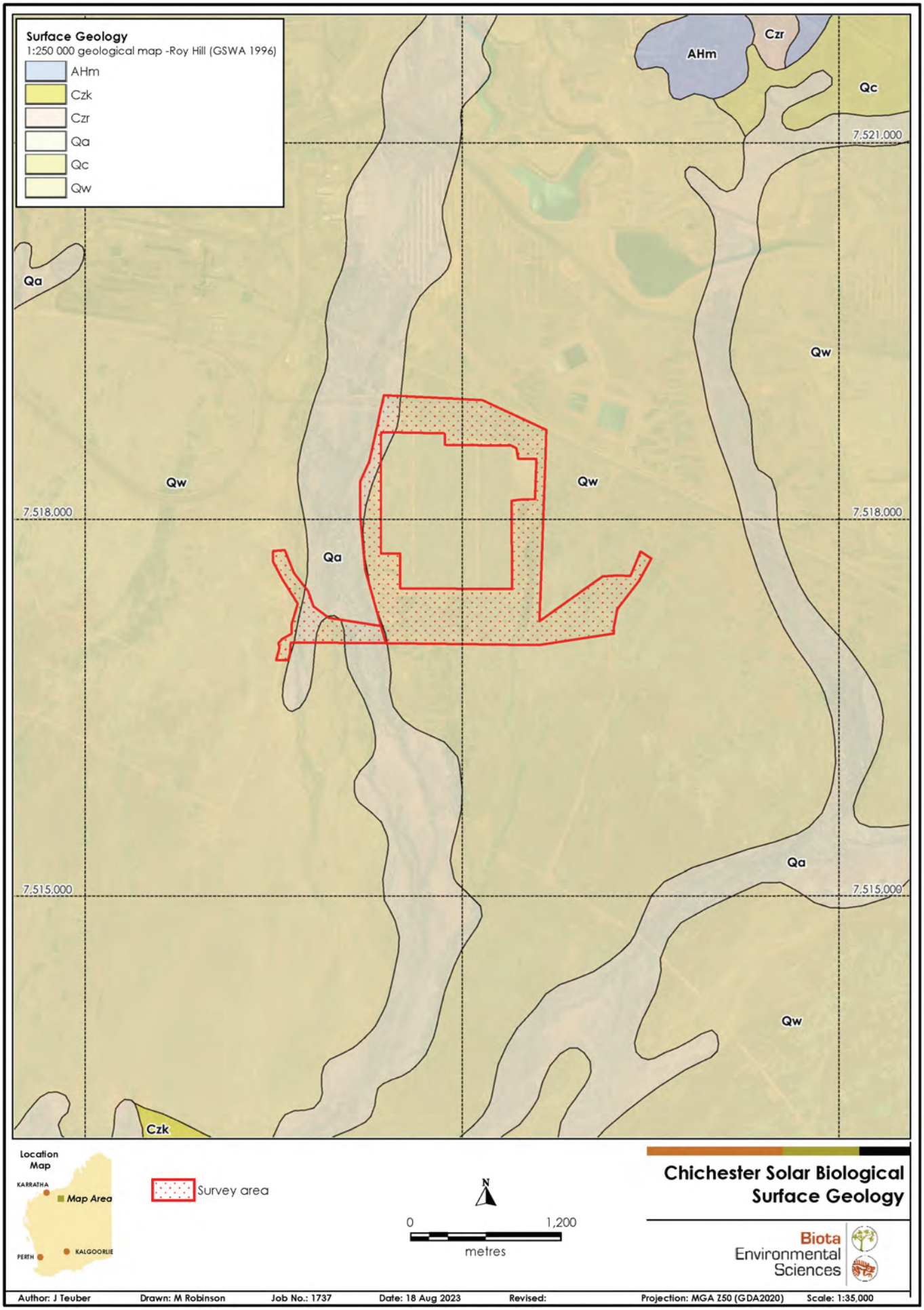

Figure 4.2: Surface geology of the survey area.

4.4 Soils

Two broad soil types have been mapped within the survey area by Northcote et al. (1960) (Table 4.3; Figure 4.3). The survey area is primarily underlain by soil unit Mz25 (72.3%).

Table 4.3: Description and extent of soil units within the survey area.

Soil Unit	Description	Extent in Survey Area	
		Area (ha)	Proportion (%)
Mz25	Plains associated with the Fortescue valley; there is a surface cover of stony gravels close to the ranges and hills: chief soils are acid red earths (Gn2.11) with some neutral red earths (Gn2.12); red-brown hardpan is absent. Associated are areas of calcareous earths (Gc) and loams (Um1) on calcrete (kunkar) and some hard red (Dr) soils around creek lines.	133.7	72.3
Oc71	Outwash plains with much coarse surface gravel: chief soils are hard alkaline red soils (Dr2.33) but (Uf6.71), (Ug5.38), and (Gn2.12) soils also occur. There are areas of (Gc) soils in proximity to unit Lb12.	51.2	27.7
	Total	**184.8**	**100.0**

4.5 Pre-European Vegetation Mapping

The survey area occurs in a single vegetation system association defined by Beard (1975a) within the Fortescue Valley physiographic region (Figure 4.4), described as:

- Fortescue Valley 29 - Mulga (*Acacia aneura*) low woodland, open woodland or sparse woodland and associated species.

From 2007 to 2018, the DBCA and Department of Water and Environment Regulation (DWER) published regular updates regarding the pre-European extent and current year's extent of each of Beard's vegetation units in WA. Based on the most recent data from 2018 (Government of Western Australia 2019), the extent of the Fortescue Valley vegetation system association in the survey area remained at above 99% of its pre-European extent in the Pilbara bioregion at that time (Table 4.4).

Table 4.4: Description and extent of Beard's vegetation system association in the survey area.
Data from Government of Western Australia (2019).

Beard's Vegetation System Association	Extent in 2018 (ha)	Extent in the Survey Area (ha)	Extent in Survey Area as Proportion of the 2018 Extent (%).
Fortescue Valley 29	877,652.9	184.8	<0.1

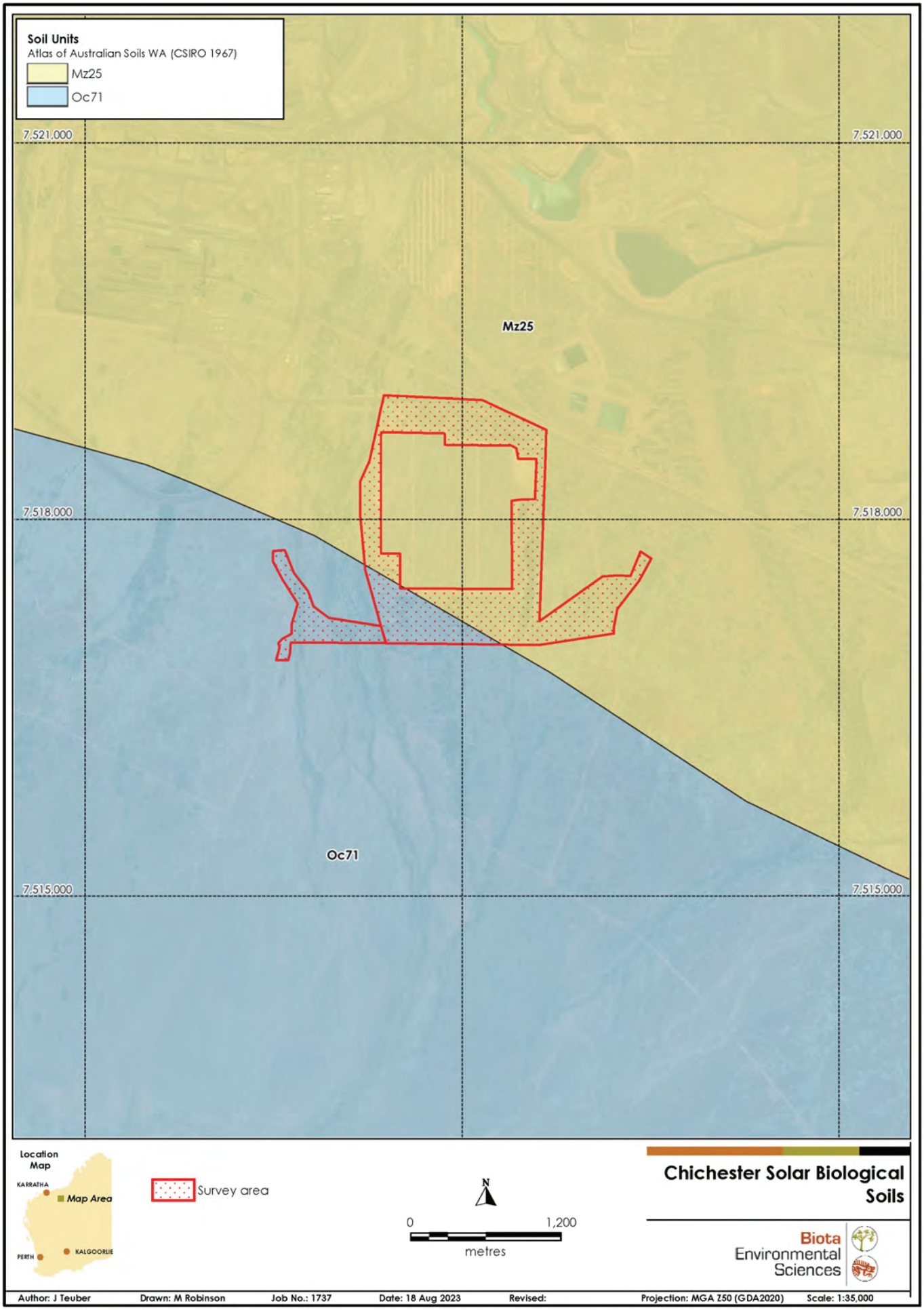

Figure 4.3: Soil units within the survey area.

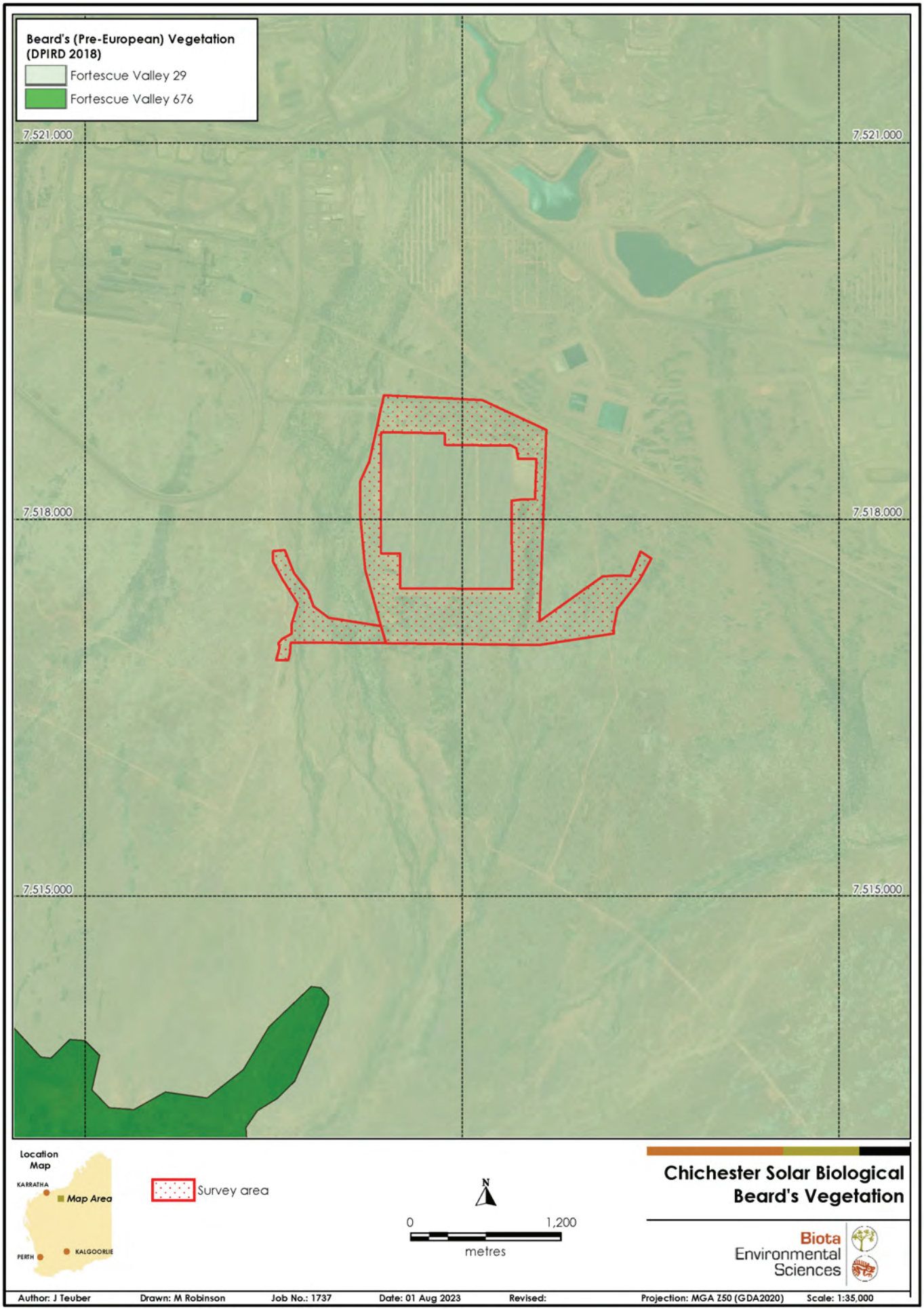

Figure 4.4: Beard's vegetation mapping units within the survey area.

4.6 Surface Hydrology

While the survey area does not intersect any major rivers or permanent watercourses, the Fortescue Marsh is located approximately 3.5 km southwest of the southern boundary. This significant wetland system is described further in Section 4.7. In addition, three minor tributaries of the Fortescue River intersect the western and eastern sections of the survey area (Figure 4.5).

4.7 Conservation Estate and other Significant Areas

There is no formally gazetted conservation estate within 100 km of the survey area. A large area 2.7 km southwest of the survey area was excised from the Roy Hill pastoral station in 2015, and redesignated as Unallocated Crown Land (Figure 4.6). This area was noted as a 'Land of Interest' to DBCA and was proposed to be added to the conservation estate, however this does not appear to have been enacted.

The Directory of Important Wetlands in Australia (DIWA; DAWE 2020) not only identifies nationally important wetlands but provides a substantial knowledge base of what defines wetlands, their variety, the species that depend on them, the ecosystem services they provide, and information about their social and cultural values. The Fortescue Marsh is described as a nationally important wetland that comprises a contiguous floodplain (lakes, marshes, pools) in the middle of the Fortescue River (Figure 4.6). The wetlands are a major breeding area for Australian Pelican (*Pelecanus conspicillatus*) and Black Swan (*Cygnus atratus*), with typical vegetation consisting of low samphire shrublands and occasional low open woodlands of *Eucalyptus victrix*, *E. camaldulensis*, and *Melaleuca* spp. along creeks entering the site. The survey area lies in the "North East Alluvial Flanks" management zone 3a designated EPA (2013), which is an extensive area of gently sloping alluvial plains fringing the northeastern edge of the marsh (Figure 4.6).

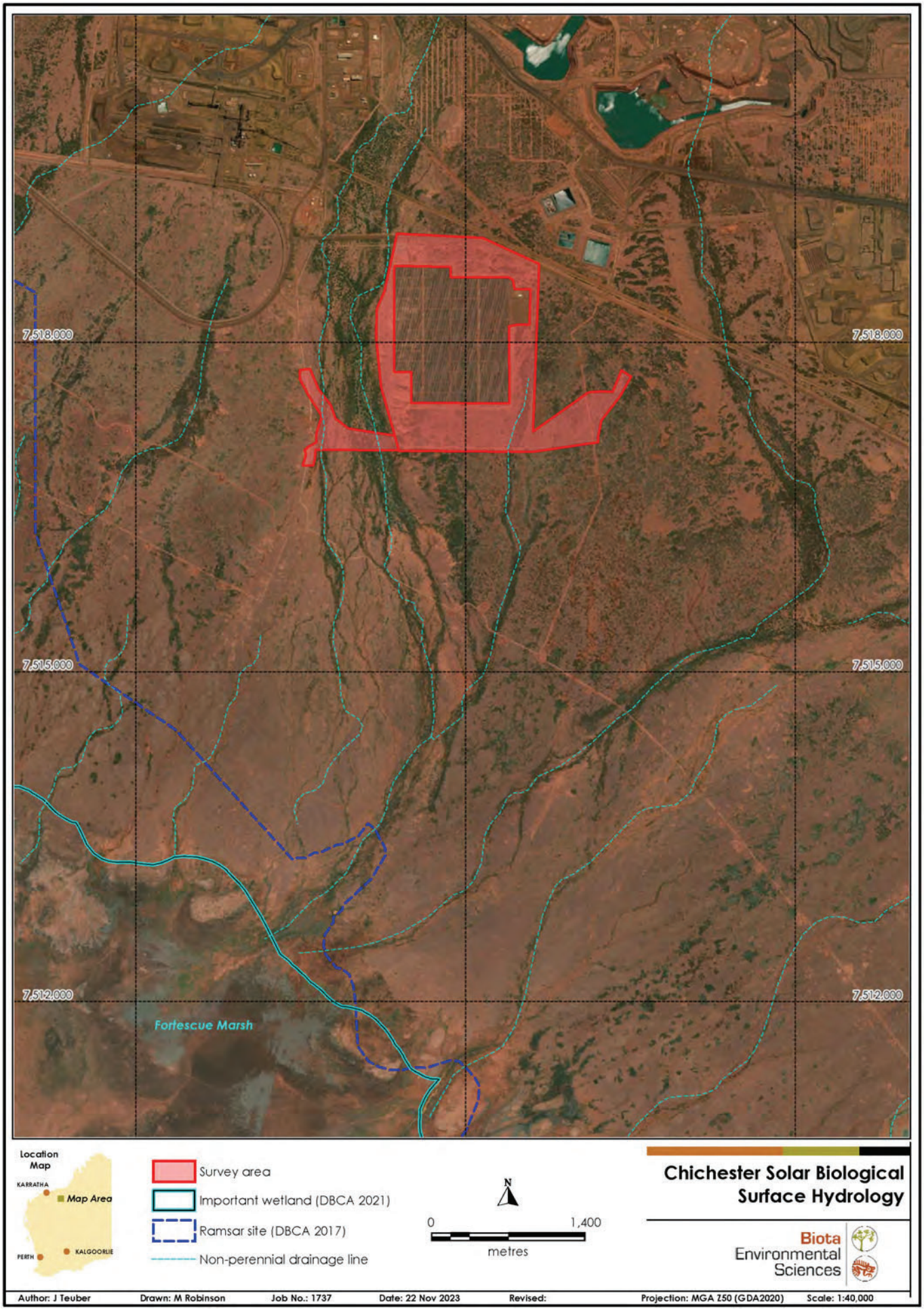

Figure 4.5: Location of the Fortescue Marsh and its tributaries in relation to the survey area.

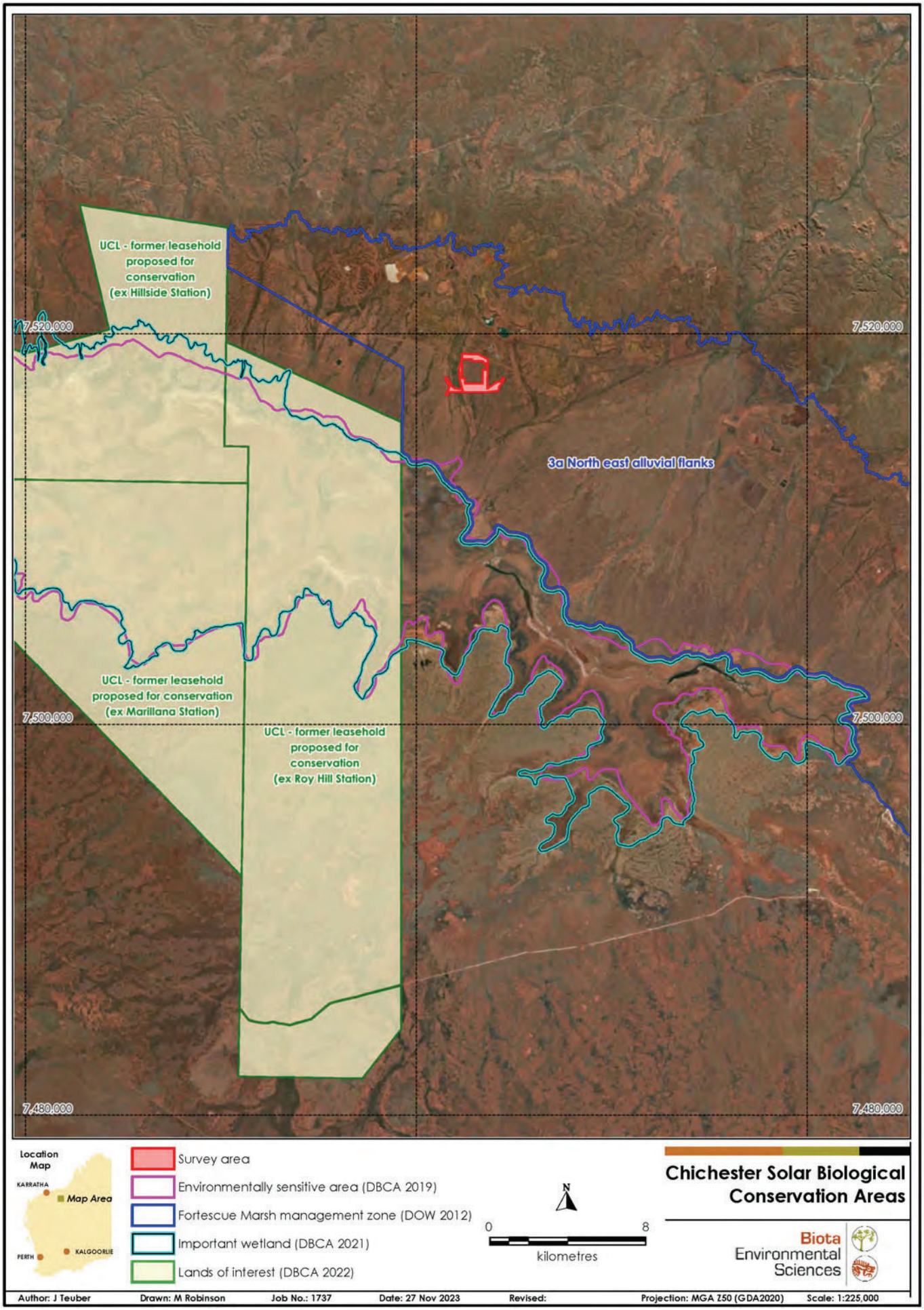

Figure 4.6: **Fortescue Marsh management zones in the vicinity of the survey area.**

4.8 Previous Biological Surveys in the Locality

A literature review was carried out for previous biological surveys conducted in the locality of the survey area. Table 4.5 below presents the results of the literature review.

Table 4.5: Summary of the literature review.

† Significance rankings: MI = Migratory; MA = Marine; OS = Other specially protected fauna; P = Priority.

Project / Survey (Reference)	Survey Type / Date	Size of Area / Location in Relation to Current Survey Area	No. of Species	Features of Conservation Significance: TECs and PECs / Threatened and Priority Species †	Stated Limitations
Flora					
Roy Hill Southern Borefield Study Area (L47/642 and L47/735) Detailed (Level 2) Flora and Vegetation Assessment (Maia 2018)	• Detailed flora and vegetation survey. • October 2017. • April 2018.	• Two survey areas totalling 48,267 ha. • Occurs within the study area; tenement is 40 km S of the survey area.	• 253 vascular flora species. • Nine weed species.	• No TECs or PECs. • No significant flora species. • Locally significant sheet flow dependant mulga communities and small drainage foci.	• Limited accessibility.

Remote MAR Borefield Reconnaissance Flora and Vegetation Survey (Biologic 2018)	• Reconnaissance flora and vegetation survey
	• 10–15 July 2018.
		• 20,000 ha.
		• Occurs within the study area; 32 km SE of the survey area.
			• 199 vascular flora species.
			• 11 weed species.
				• One PEC:
				  ○ Narbung Land System (P3)
				• Three significant flora species:
				  ○ *Eremophila pilosa* (P1)
				  ○ *Eucalyptus rowleyi* (P3)
				  ○ *Eremophila youngii* subsp. *lepidota* (P4)
				• 13 locally significant vegetation types.
					• Survey intensity (Reconnaissance) not designed to capture all flora within study area.
					• Survey timing outside the EPA recommended primary survey period.
					• Weather conditions preceding the survey were a minor limitation.

Newman-Roy Hill Transmission Line Survey (Ecoscape 2013)	• Level 2 (now Detailed) flora and vegetation survey.
	• 4–9 August 2012.
	• 15–25 May 2013.
		• 2,460 ha corridor (123 km long and 200 m wide).
		• Occurs within the study area; most northern point of the corridor is 31 km SE of the survey area.
			• 264 vascular flora species.
			• Nine weed species.
				• No TECs or PECs.
				• Four significant flora species:
				  ○ *Eremophila pilosa* (P1)
				  ○ *Rhagodia* sp. Hamersley (M. Trudgen 17794) (P3)
				  ○ *Themeda* sp. Hamersley Station (M.E. Trudgen 11431) (P3)
				  ○ *Eremophila youngii* subsp. *lepidota* (P4)
				• Locally significant groundwater dependant vegetation and vegetation supporting *Eremophila pilosa* populations.
					• Timing of the 2012 survey was outside the recommended primary survey period.
					• Rainfall preceding the surveys were a minor limitation.

Project / Survey (Reference)	Survey Type / Date	Size of Area / Location in Relation to Current Survey Area	No. of Species	Features of Conservation Significance: TECs and PECs / Threatened and Priority Species †	Stated Limitations

Christmas Creek Life of Mine Flora and Vegetation Assessment (ENV 2013)	• Single season Level 2 (now Detailed) flora and vegetation survey.
	• 16–24 March 2011, 28 April – 6 May 2011.
	• 26 April – 6 May 2012, 5–10 June 2012.
	• 7–9 May 2013.
		• 70,144 ha
		• Overlaps the survey area.
			• 485 vascular flora species.
			• 18 weed species.
				• One PEC:
				  ○ Fortescue Marsh (P1)
				• 10 significant flora species:
				  ○ *Calotis squamigera* (P1)
				  ○ *Tecticornia globulifera* (P1)
				  ○ *Tecticornia* sp. Christmas Creek (K.A Shepherd & T. Colmer et al. KS 1063) (P1)
				  ○ *Atriplex flabelliformis* (P3)
				  ○ *Eleocharis papillosa* (P3)
				  ○ *Eremophila spongiocarpa* (P3)
				  ○ *Rhagodia* sp. Hamersley (M. Trudgen 17794) (P3)
				  ○ *Rostellularia adscendens* var. *latifolia* (P3)
				  ○ *Tecticornia medusa* (P3)
				  ○ *Eremophila youngii* subsp. *lepidota* (P4)
				• Two locally significant vegetation types:
				  ○ Potential Groundwater-Dependent Ecosystem characterised by *Eucalyptus camaldulensis* and *E. victrix*.
				  ○ Sheet Flow Dependant mulga community.
					• None stated.

Vegetation and Flora Survey of the Proposed FMG Stage B Rail Corridor and Mindy Mindy, Christmas Creek, Mt Lewin and Mt Nicholas Mine Areas (Biota 2004)	• Single season Level 2 (now Detailed) flora and vegetation survey.
	• 23 June – 11 July 2004, 20–23 July 2004, 14–17 Sept 2004, 25–28 October 2004.
		• 33,248 ha railway corridor linking Christmas Creek, Mindy Mindy, Mt. Lewin and Mt Nicholas mines to Stage A rail corridor.
		• Quadrats sampled within 1 km of the survey area.
			• 599 vascular flora species.
			• 13 weed species.
				• No TECs or PECs.
				• Two significant flora species:
				  ○ *Eremophila pilosa* (P1)
				  ○ *Themeda* sp. Hamersley Station (M.E. Trudgen 11431) (P3)
					• Some parts of the survey area difficult to access due to lack of vehicle tracks and time constraints of the study.

Project / Survey (Reference)	Survey Type / Date	Size of Area / Location in Relation to Current Survey Area	No. of Species	Features of Conservation Significance: TECs and PECs / Threatened and Priority Species †	Stated Limitations
Fauna					
Bonney Downs Camp and Workshop Basic and Targeted Fauna Survey (Biota 2023)	• Basic and targeted vertebrate fauna survey. • 27-28 February 2023	• 40 km S of Nullagine. • 60 ha • 30 km NE of the survey area.	• 39 vertebrate fauna species.	• 11 significant vertebrate species have the potential to occur.	• Disturbance such as fire, flooding or clearing, however, these areas were extensively mapped.
Roy Hill Mine and Southern Borefields Targeted Fauna Survey (Biologic 2020)	• Targeted Greater Bilby and Northern Quoll Survey. • 3–6 December 2019 and 4–8 February 2020.	• 110 km N of Newman.	• N/A (targeted only).	• No evidence of Greater Bilby. • No evidence of Northern Quoll. • One active Brush-tailed Mulgara burrow recorded during the survey.	• Evidence of species potentially displaced or habitat degraded by cyclones in January and February 2020.
Fortescue Marsh Tenement E46/684 Level 1 Targeted Vertebrate Fauna Survey (Biologic 2014)	• Targeted vertebrate fauna survey and fauna habitat assessment. • 25 August – 1 September 2014.	• 90 km N of Newman, covering an area of 221 km^2. • 20 km SW of the survey area.	• 40 vertebrate fauna species.	• No significant fauna species recorded during the survey. • 29 significant species have the potential to occur in the vicinity of the survey area.	• Low number of species recorded could possibly be due to limited access to parts of the survey area.

Newman-Roy Hill Transmission Line Survey (Ecoscape 2013)	• Level 1 reconnaissance (Basic) survey and habitat assessment.
	• 3–6 August 2012.
		• 2,460 ha corridor (123 km long and 200 m wide).
		• Occurs within the study area; most northern point of the corridor is 31 km SE of the survey area.
			• 223 vertebrate fauna species.	• Two significant fauna species:
				  ○ Mulgara *(Dasycercus cristicauda,* P4)
				  ○ Western Pebble-mound Mouse *(Pseudomys chapmani,* P4).
					• Reconnaissance (Basic) level survey, so only easily detectable species likely to be recorded.

Project / Survey (Reference)	Survey Type / Date	Size of Area / Location in Relation to Current Survey Area	No. of Species	Features of Conservation Significance: TECs and PECs / Threatened and Priority Species †	Stated Limitations
Christmas Creek Terrestrial Vertebrate Fauna and Fauna Habitat Assessment (ENV 2012)	• Level 2 (Detailed) vertebrate fauna survey. • 16–27 March 2011.	• 667.4 km^2. • Intersects current survey area.	• 275 vertebrate fauna species.	• One significant fauna species: ○ Pilbara Olive Python *(Liasis olivaceus barroni,* VU) • 23 significant species have been previously recorded in the vicinity of the survey area.	• None stated.

Fauna Habitats and Fauna Assemblage of the Proposed FMG Stage B Rail Corridor and Mindy Mindy, Christmas Creek, Mt Lewin and Mt Nicholas Mine Areas (Biota 2005)	• Detailed fauna survey.
	• March and June/July 2004.
		• 33,248 ha railway corridor linking Christmas Creek, Mindy Mindy, Mt. Lewin and Mt Nicholas mines to Stage A rail corridor.
		• Unbounded search areas intersect the current survey area.
			• 175 vertebrate fauna species.	• Five significant fauna species:
				  ○ Mulgara *(Dasycercus cristicauda,* P4)
				  ○ Peregrine falcon *(Falco peregrinus,* OS)
				  ○ Long-tailed Dunnart *(Antechinomys longicaudata,* P4)
				  ○ Short-tailed Mouse *(Leggadina lakedownensis,* P4)
				  ○ Western Pebble-mound Mouse *(Pseudomys chapmani,* P4)
					• Traps were closed early during the Mindy Mindy survey due to high rainfall.

4.9 Significant Ecological Communities in the Locality

4.9.1 Threatened and Priority Ecological Communities

TECs are described by the DBCA as biological assemblages occurring in a particular habitat, which are under threat of modification or destruction from various processes. TECs are significant at State level, being protected under the WA *Biodiversity Conservation Act 2016* (the BC Act), as well as having protection as Environmentally Sensitive Areas (ESAs) under the EP Act. Some TECs are also protected at Commonwealth level under the EPBC Act. Further information regarding the classification of TECs is provided in Appendix 1.

No TECs occur within the study area, and none would be expected to occur, based on their distribution and composition.

PECs are ecological communities that are recognised to be of significance, but do not meet the criteria for listing as a TEC. There are five categories of PECs, none of which are currently protected under legislation (see Appendix 1). A total of 43 PECs are listed for the Pilbara (DBCA 2023), four of which occur within the study area (Figure 4.7):

- Fortescue Marsh (Priority 1): "an extensive, episodically inundated samphire marsh at the upper terminus of the Fortescue River and the western end of Goodiadarrie Hills; regarded as the largest ephemeral wetland in the Pilbara. It is a highly diverse ecosystem with fringing mulga woodlands (on the northern side), samphire shrublands and groundwater dependent riparian ecosystems". It should be noted that the mapped occurrence of this PEC, provided by the DBCA, typically includes a 5 km management buffer around the actual community. The edge of the buffer zone overlaps the southwest section of the survey area.
- Wona Land System (Priority 1): previously known as 'Cracking clays of the Chichester and Mungaroona Range. "This shrubless plain of stony gibber community occurs on the tablelands with very little vegetative cover during the dry season, however during the wet a suite of ephemerals/annuals and short-lived perennials emerge". There are 27 occurrences of this PEC in the study area, with the closest being 14.3 km north of the survey area.
- Freshwater claypans of the Fortescue Valley (Priority 1): "Freshwater claypans downstream of the Fortescue Marsh – Goodiadarrie Hills on Mulga Downs Station. Larger claypans contain the highest number of invertebrate species and most of the restricted elements of the Pilbara riparian flora. *Eriachne* spp., *Eragrostis* spp. grasslands; unique community, has few Coolibah (*Eucalyptus victrix*)". The single occurrence of this PEC in the study area is 20.5 km south of the survey area.
- Narbung Land System (Priority 3): "alluvial washplains with prominent internal drainage foci supporting snakewood and mulga shrublands with halophytic low shrubs". There are two mapped occurrences of this PEC in the study area, with the closest being 24.6 km southeast of the survey area.

4.10 Significant Species in the Locality

4.10.1 Significant Flora

Native flora and fauna species that are rare, threatened with extinction, or have high conservation value, are specially protected by law as Threatened species under the BC Act and/or the EPBC Act. In addition, the DBCA maintains a list of Priority species; these are species which have not been assigned statutory protection under the BC Act but are still considered to be of conservation priority, or are considered to be rare but not threatened, and require monitoring (see Appendix 1 for details of significance categories recognised under the above frameworks).

4.10.1.1 Threatened Flora

Four flora species are listed as Threatened for the Pilbara bioregion (Table 4.6). Based on their known distribution and habitat preferences, none of these species would occur within the survey area; they all have restricted distributions and occur in habitats that are not present in the survey area.

Table 4.6: Threatened flora species listed for the Pilbara bioregion.

Species (Common Name)	Significance †		Distribution Overlaps Survey Area?
	State	Commonwealth	
Aluta quadrata	EN	–	No – restricted to southern Pilbara / northern Gascoyne (>200 km southeast).
Quoya zonalis (Pilbara Foxglove)	EN	EN	No – restricted to ranges of hills west of Marble Bar.
Synostemon hamersleyensis	EN	–	No – restricted to hillslopes of the Hamersley subregion near Koodaideri (55 km southwest).
Thryptomene wittweri (Mountain Thryptomene)	VU	VU	No – known from a few widely separated locations on mountain tops in the southern Pilbara, western Gascoyne, and western Little Sandy Desert (127 km southeast).

† CR = Critically Endangered, EN = Endangered, VU = Vulnerable.

4.10.1.2 Priority Flora

A total of 30 Priority flora species were identified from the desktop study as having been previously recorded within the study area. No historical records of Priority flora were recorded within the survey area (see Figure 4.8). An assessment of their likelihood to occur in the survey area is presented in Appendix 3 and summarised below.

Two Priority 3 species were ranked as "likely to occur" in the survey area prior to the field survey:

- *Rhagodia* sp. Hamersley (M. Trudgen 17794) had been recorded from 11 locations within the study area. The nearest record was 6 km east of the survey area, on floodplains associated with the Christmas Creek mining tenement. This species was considered likely to occur within mulga woodlands, particularly at the base of trees.
- *Themeda* sp. Hamersley Station (M.E. Trudgen 11431) had been previously recorded from two locations, with the nearest record being 3 km south of the survey area. This species was considered likely to occur in tributaries of the Fortescue River that intersect the survey area.

It was considered that five other Priority species "may occur":

- The Priority 1 annual herb *Calotis squamigera* occurs on stony floodplains and had been previously recorded from four locations close to the survey area.
- The Priority 3 small annual grass *Eragrostis crateriformis* was considered to have some potential to occur in the same areas as *Rhagodia* sp. Hamersley (M. Trudgen 17794).
- The Priority 3 herb *Rostellularia adscendens* var. *latifolia* had been previously recorded from two locations in the broader locality and grows near creeks in ironstone soils.
- The Priority 3 prostrate herb *Swainsona thompsoniana* had been previously recorded from five locations in the broader locality and grows in clay slopes or flats.
- The Priority 4 shrub *Eremophila youngii* subsp. *lepidota* had been recorded in numerous locations south of the survey area, within a broad range of habitat preferences.

The species listed above formed the key significant species targeted during the survey. The remaining species were still searched for but were considered "unlikely to occur".

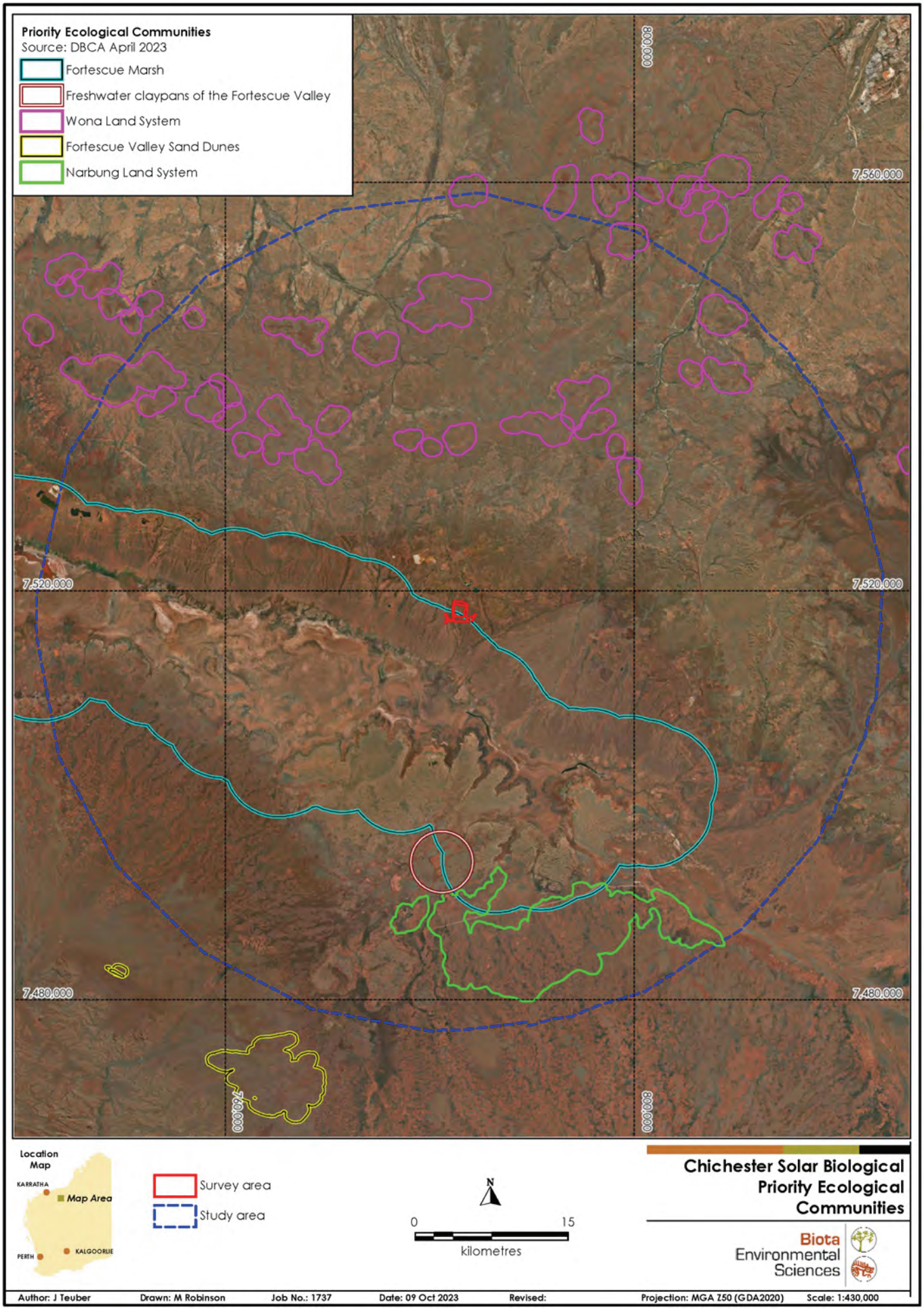

Figure 4.7: PECs known from the study area.

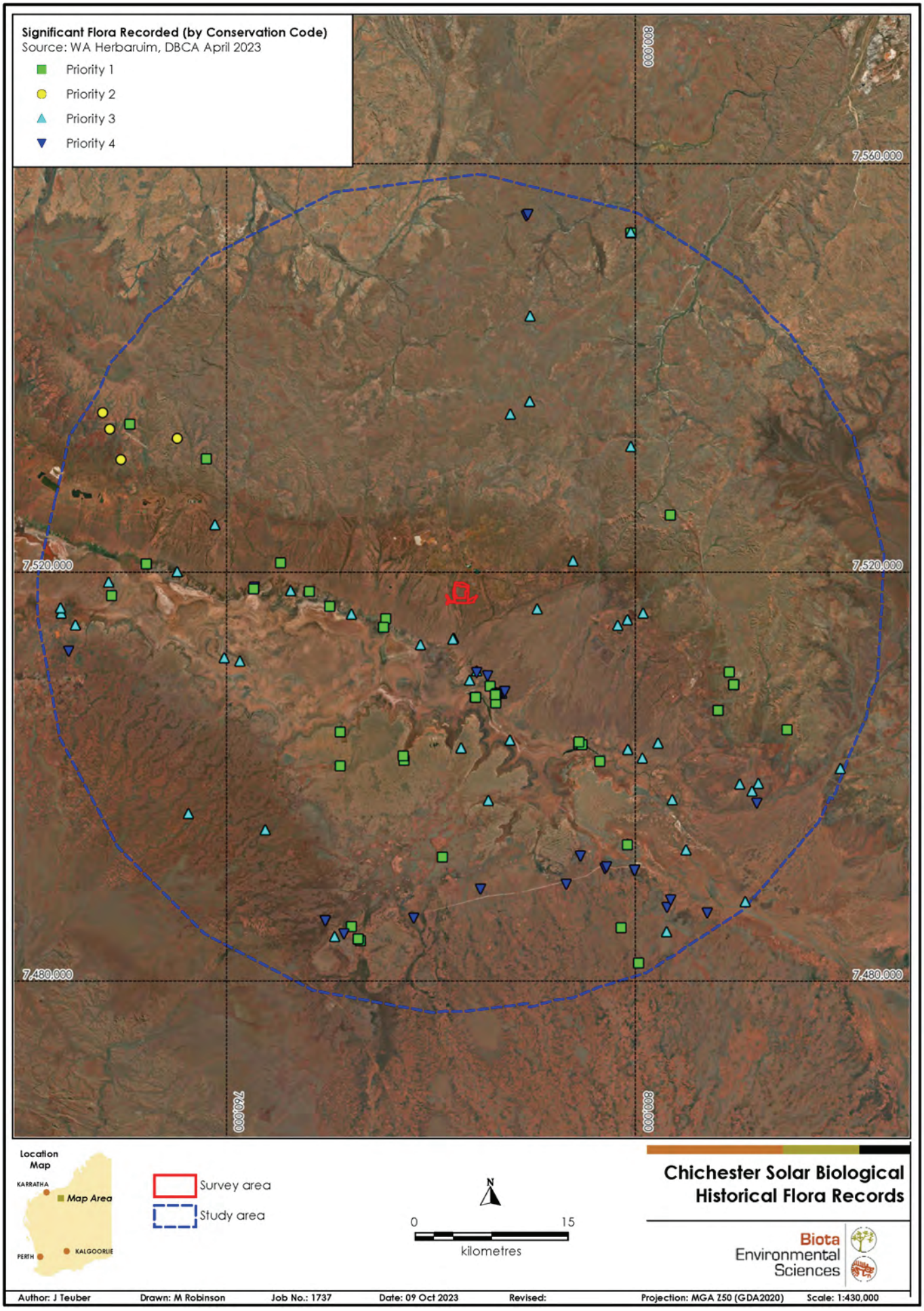

Figure 4.8: **Previous records of significant flora within 40 km of the survey area.**

4.10.2 Significant Vertebrate Fauna

A total of 33 vertebrate fauna species listed as significant under State or Federal legislation were identified during the desktop study as having some potential to occur within the survey area. (Note that 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, 22 bird species and three reptile species (see Appendix 4 for a complete list). For those species which have previously been recorded within 40 km of the survey area, locations are presented in Figure 4.9 (this does not include species identified only from the EPBC Act search, which do not have associated records).

A likelihood of occurrence assessment was conducted for each of the potentially occurring significant species using the criteria outlined in Section 3.2. This assessment included both a preliminary assessment undertaken prior to the field survey, and a final assessment that incorporated the findings of the field survey (see Appendix 4).

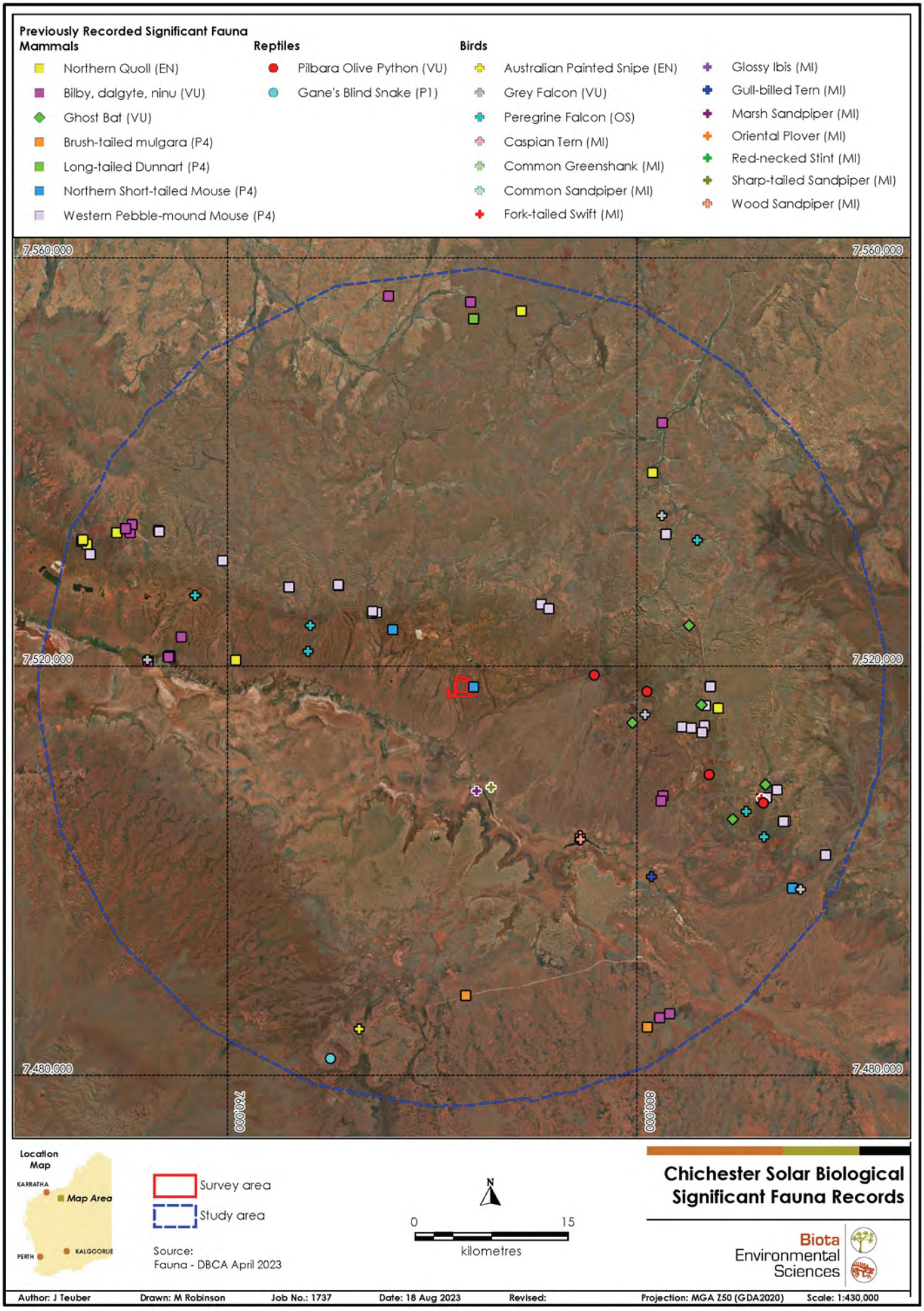

Figure 4.9: Previous significant vertebrate fauna records within 40 km of the survey area.

5.0 Flora and Vegetation Results

5.1 Vegetation

5.1.1 Overview

The primary landforms found throughout the survey area comprised:

- Major to moderate ephemeral drainage lines (Plate 5.1); and
- Floodplains with discrete areas of minor clay depressions or snakewood (Plate 5.2).

Plate 5.1: Vegetation of drainage lines (D2: CSF10-R and D1: CSF03-R).

Plate 5.2: Vegetation of floodplains (F1: CSF04 and F3: CSF11).

5.1.2 Vegetation Units

Five vegetation units were mapped across the survey area and cleared areas were mapped separately. The extent of each mapping unit is presented in Table 5.1 and a map is provided in Figure 5.1. Each vegetation unit is further described in Section 5.1.3.

Table 5.1: Extent of vegetation types and other mapping units in the survey area.

Code	Mapping Unit	Extent in Survey Area	
		Area (ha)	Proportion of Survey Area (%)
Vegetation of Drainages			
D1	Low open forest of *Acacia aptaneura* over mixed *Acacia* spp. and **Malvastrum americanum* shrubs over mixed tussock grassland dominated by **Cenchrus* spp. and *Aristida* spp.	29.7	16.1
D2	Low riparian woodland of *Eucalyptus victrix*, *Acacia coriacea* subsp. *pendens*, *Atalaya hemiglauca* and *A. aptaneura* with occasional *Ehretia saligna* var. *saligna* over **Cenchrus* spp. tussock grassland.	1.1	0.6
Vegetation of Floodplains			
F1	Low open woodland of *Acacia aptaneura* over mixed *Acacia* spp., *Senna* spp. and *Eremophila cuneifolia* shrubs over mixed tussock grasses dominated by *Aristida* spp.	85.8	46.4
F2	Scattered low trees of *Acacia aptaneura* over scattered shrubs of mixed *Acacia* spp. over scattered tussock grasses dominated by *Aristida contorta*, *Enneapogon polyphyllus* and *Eragrostis xerophila*, with scattered herbs of *Sclerolaena* spp.	30.7	16.6
F3	Low open woodland of *Acacia xiphophylla* over scattered shrubs of *Senna artemisioides* subsp. *oligophylla* and *Eremophila cuneifolia* over scattered tussock grasses of *Enteropogon ramosus* and *Aristida contorta*, with scattered herbs of *Sclerolaena cornishiana*.	4.5	2.4
Other Mapping Units			
C1	Cleared.	33.0	17.9
	Total	**184.8**	**100.0**

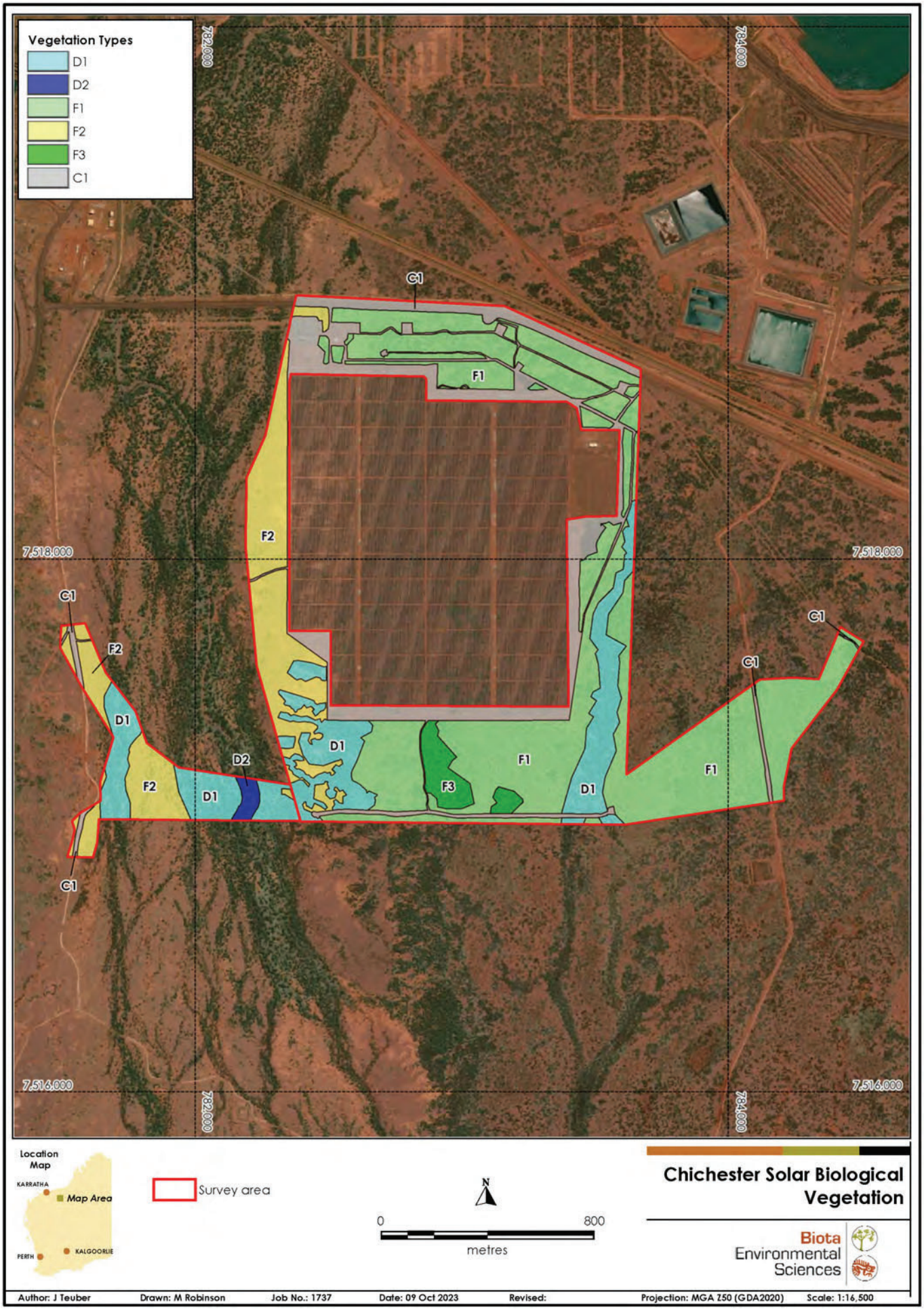

Figure 5.1: Vegetation units of the survey area.

5.1.3 Description of Vegetation Types

5.1.3.1 Vegetation of Drainage Lines

D1	**Low open forest of *Acacia aptaneura* over mixed *Acacia* spp. and **Malvastrum americanum* shrubs over mixed tussock grassland dominated by **Cenchrus* spp. and *Aristida* spp.**
Typical vegetation association description	*Acacia aptaneura* low open forest over *A. tetragonophylla* scattered tall shrubs over **Malvastrum americanum* low open shrubland over **Cenchrus ciliaris, *C. setiger, Aristida contorta, A. latifolia, Enneapogon polyphyllus* tussock grassland.
Vegetation Association (NVIS Level V)	U1+^Acacia aptaneura\Acacia\^tree\6\c; M1^Acacia tetragonophylla\Acacia\^shrub\4\bc; M2^*Malvastrum americanum*Malvastrum\^shrub\1\bc; G1^*Cenchrus ciliaris,*Cenchrus setiger,Aristida contorta,Aristida latifolia,Enneapogon polyphyllus*Cenchrus\^tussock grass\2\c
Distribution and habitat	This vegetation type occurred in moderate ephemeral drainage lines in the landscape (tributaries of the Fortescue River) with predominantly clay loam soils. This vegetation made up 29.7 ha within the survey area.
Other associated species	Trees: *Acacia coriacea* subsp. *pendens, Atalaya hemiglauca* and *Ehretia saligna* var. *saligna.* Shrubs: *Abutilon lepidum, Acacia pruinocarpa, A. pyrifolia* var. *pyrifolia, A. synchronicia, Enchylaena tomentosa* var. *tomentosa, Eremophila latrobei* subsp. *filiformis, Rhagodia eremaea, Senna artemisioides* subsp. *oligophylla* and *Sida* sp. L (A.M. Ashby 4202). Grasses: *Chloris pectinata, Chrysopogon fallax, Dactyloctenium radulans, Dichanthium sericeum* subsp. *humilius, Digitaria brownii, Eragrostis leptocarpa, E. tenellula, E. xerophila, Iseilema membranaceum, Panicum decompositum, Sporobolus australasicus* and *Themeda triandra.* Herbs: *Abutilon macrum, Achyranthes aspera, Alternanthera denticulata, Amyema fitzgeraldii, Commelina ensifolia, Corchorus tridens, Cucumis variabilis, Evolvulus alsinoides* var. *villosicalyx, Glycine canescens, Gomphrena kanisii, Ipomoea muelleri, Marsilea exarata, Nellica maderaspatensis, Pterocaulon sphacelatum, Ptilotus gomphrenoides, Rhynchosia minima* and *Rostellularia adscendens* var. *clementii.*
Vegetation condition	Good: weed infestations with many weed species present; cattle tracks, scats and evidence of grazing.
Sampling sites	CSF01-R, CSF02, and CSF03-R.

Plate 5.3: Vegetation type D1 (CSF01-R).

Plate 5.4: Vegetation type D1 (CSF02).

D2	**Low riparian woodland of *Eucalyptus victrix*, *Acacia coriacea* subsp. *pendens*, *Atalaya hemiglauca* and *A. aptaneura* with occasional *Ehretia saligna* var. *saligna* over **Cenchrus* spp. tussock grassland.**
Typical vegetation association description	*Eucalyptus victrix, Acacia coriacea* subsp. *pendens, Atalaya hemiglauca, A. aptaneura, Ehretia saligna* var. *saligna* low woodland over *A. tetragonophylla* scattered low shrubs over **Cenchrus ciliaris, *C. setiger* tussock grassland.
Vegetation Association (NVIS Level V)	U1+^Acacia aptaneura,Acacia coriacea subsp. pendens,Atalaya hemiglauca,Acacia aptaneura,Ehretia saligna var. saligna\Acacia\^tree\6\i; M1^Acacia tetragonophylla\Acacia\^shrub\2\bc; G1^*Cenchrus ciliaris,*Cenchrus setiger*Cenchrus\^tussock grass\1\c
Distribution and habitat	This vegetation type occurred in a major drainage line with predominantly sandy clay loam soils. This vegetation made up 1.1 ha within the survey area.
Other associated species	Shrubs: *Abutilon lepidum, Acacia pyrifolia* var. *pyrifolia, Jasminum didymum* subsp. *lineare*. Grasses: *Dactyloctenium radulans, Enneapogon caerulescens, E. polyphyllus* and *Sporobolus australasicus*. Herbs: *Achyranthes aspera, Alternanthera denticulata, A. nana, Amaranthus undulatus, Cucumis variabilis, Ipomoea muelleri, *Malvastrum americanum, Nellica maderaspatensis* and *Rostellularia adscendens* var. *clementii*.
Vegetation condition	Good: high weed infestation along the banks; cattle tracks, scats and grazing.
Sampling sites	CSF10-R.

Plate 5.5: Vegetation type D2 (CSF10-R).

5.1.3.2 Vegetation of Floodplains

F1	**Low open woodland of *Acacia aptaneura* over mixed *Acacia* spp., *Senna* spp. and *Eremophila cuneifolia* shrubs over mixed tussock grasses dominated by *Aristida* spp.**
Typical vegetation association description	*Acacia aptaneura* low open woodland over *A. synchronicia, Senna glutinosa* subsp. *x luerssenii* tall open shrubland over *Senna artemisioides* subsp. *oligophylla* (thinly sericeous form MET 15,035), *Eremophila cuneifolia*, *Acacia tetragonophylla* open shrubland over *Senna artemisioides* subsp. *helmsii, Sida* aff. *fibulifera* (glabrous mericarps) low open shrubland over *Aristida latifolia, A. contorta, *Cenchrus ciliaris, *C. setiger, Eragrostis xerophila* very open to open tussock grassland, with *Sclerolaena cornishiana* scattered herbs.
Vegetation Association (NVIS Level V)	U1+^Acacia aptaneura\Acacia\^tree\6\r; M1^A. synchronicia,Senna glutinosa subsp. x luerssenii\A.\^shrub\4\r; M2^Senna artemisioides subsp. oligophylla (thinly sericeous form MET 15,035),Eremophila cuneifolia,Acacia tetragonophylla\Senna\^shrub\3\r; M3^Senna artemisioides subsp. helmsii,Sida aff. fibulifera (glabrous mericarps)\Senna\^shrub\2\r; G1^Aristida latifolia,A. contorta,*Cenchrus ciliaris,*C. setiger,Eragrostis xerophila\Aristida\^tussock grass\2\i; G2^Sclerolaena cornishiana\Sclerolaena\^chenopod shrub\1\bc
Distribution and habitat	This vegetation type occurred on stony floodplains with discrete areas of minor clay depressions. Soils were predominantly composed of clay loam to sandy clay. This vegetation made up 85.8 ha within the survey area.
Other associated species	Shrubs: *Abutilon lepidum, Eremophila latrobei* subsp. *filiformis, Hibiscus sturtii* var. *grandiflorus, Indigofera georgei, *Malvastrum americanum, Psydrax latifolia, Rhagodia eremaea* and *Solanum lasiophyllum.* Grasses: *Chrysopogon fallax, Dactyloctenium radulans, Dichanthium sericeum* subsp. *humilius, Digitaria brownii, Enneapogon polyphyllus, Iseilema vaginiflorum, Panicum decompositum, Sporobolus australasicus* and *Urochloa occidentalis* var. *ciliata.* Herbs: *Abutilon macrum, Alternanthera denticulata, Commelina ensifolia, Corchorus tridens, Evolvulus alsinoides* var. *villosicalyx, Gomphrena kanisii, Goodenia prostrata, Neptunia scutata, Portulaca oleracea/intraterranea, Salsola australis* and *Sclerolaena densiflora.*
Vegetation condition	Good to Very Good: Cattle and rabbit scats. Low weed density at CSF04 and CSF06; more aggressive weeds (*Cenchrus* spp. and *Malvastrum americanum*) present at CSF05.
Sampling sites	CSF04, CSF05 and CSF06

Plate 5.6: Vegetation type F1 (CSF04).

Plate 5.7: Vegetation type F1 (CSF05).

F2	**Scattered low trees of *Acacia aptaneura* over scattered shrubs of mixed *Acacia* spp. over scattered tussock grasses dominated by *Aristida contorta*, *Enneapogon polyphyllus* and *Eragrostis xerophila*, with scattered herbs of *Sclerolaena* spp.**
Typical vegetation association description	*Acacia aptaneura* scattered low trees over *Acacia synchronicia*, *A. pruinocarpa* scattered tall shrubs over *A. tetragonophylla* scattered shrubs over *Aristida contorta*, *Enneapogon polyphyllus, Eragrostis xerophila* scattered tussock grasses, with *Sclerolaena cornishiana* and *S. costata* scattered herbs.
Vegetation Association (NVIS Level V)	U1+^Acacia aptaneura\Acacia\^tree\6\bc; M1^Acacia synchronicia,Acacia pruinocarpa\Acacia\^shrub\4\bc; M2^Acacia tetragonophylla\Acacia\^shrub\3\bc; G1^Aristida contorta,Enneapogon polyphyllus,Eragrostis xerophila\Aristida\^tussock grass\1\bc; G2^Sclerolaena cornishiana,Sclerolaena costata\Sclerolaena\^chenopod shrub\1\bc
Distribution and habitat	This vegetation type occurred on stony floodplains with minor areas of shallow flowlines and depressions, with predominantly sandy clay soils. This vegetation made up 30.7 ha within the survey area.
Other associated species	Shrubs: *Enchylaena tomentosa* var. *tomentosa, Eremophila cuneifolia, E. lanceolata, Senna artemisioides* subsp. *helmsii, S. artemisioides* subsp. *oligophylla* and *Sida fibulifera.* Grasses: *Aristida latifolia*, **Cenchrus ciliaris*, *Chloris pectinata*, *Dactyloctenium radulans, Enneapogon caerulescens*, *Eragrostis leptocarpa* and *Sporobolus australasicus.* Herbs: *Evolvulus alsinoides* var. *villosicalyx*, *Gomphrena kanisii*, *Maireana planifolia*, *Portulaca conspicua*, *Ptilotus aervoides*, *P. gomphrenoides*, *Salsola australis, Sclerolaena densiflora* and *Trianthema triquetrum.*
Vegetation condition	Very Good: cattle scats and tracks; weeds at low density.
Sampling sites	CSF07, CSF08 and CSF09-R.

Plate 5.8: Vegetation type F2 (CSF08).

Plate 5.9: Vegetation type F2 (CSF09-R).

F3	**Low open woodland of *Acacia xiphophylla* over scattered shrubs of *Senna artemisioides* subsp. *oligophylla* and *Eremophila cuneifolia* over scattered tussock grasses of *Enteropogon ramosus* and *Aristida contorta*, with scattered herbs of *Sclerolaena cornishiana*.**
Typical vegetation association description	*Acacia xiphophylla* low open woodland over *Senna artemisioides* subsp. *oligophylla* (thinly sericeous form MET 15,035), *Eremophila cuneifolia* scattered low shrubs over *Enteropogon ramosus, Aristida contorta* scattered tussock grassland, with *Sclerolaena cornishiana* scattered herbs.
Vegetation Association (NVIS Level V)	U1+^Acacia xiphophylla\Acacia\^tree\6\r; M1^Senna artemisioides subsp. oligophylla (thinly sericeous form MET 15,035),Eremophila cuneifolia\Senna\^shrub\3\bc; G1^Enteropogon ramosus,Aristida contorta\Enteropogon\^tussock grass\1\bc; G2^Sclerolaena cornishiana\Sclerolaena\^chenopod shrub\1\bc
Distribution and habitat	This vegetation type occurred on undulating ironstone and quartz stony gibber plains, with soils predominantly composed of clay loam. This vegetation made up 4.5 ha within the survey area.
Other associated species	Shrubs: *Acacia synchronicia*, *A. tetragonophylla*, *Enchylaena tomentosa* var. *tomentosa, Eremophila latrobei* subsp. *filiformis, Hibiscus sturtii* var. *grandiflorus, Rhagodia eremaea* and *Senna glutinosa* subsp. x *luerssenii*. Grasses: *Aristida latifolia, *Cenchrus ciliaris, Enneapogon polyphyllus* and *Eragrostis xerophila.* Herbs: *Commelina ensifolia, Evolvulus alsinoides* var. *villosicalyx*, *Gomphrena kanisii, Ptilotus exaltatus, P. obovatus* var. *obovatus, Salsola australis* and *Sclerolaena costata.*
Vegetation condition	Very Good: low weed density; some cattle tracks, but no other obvious signs of disturbance.
Sampling sites	CSF11 and CSF12.

Plate 5.10: Vegetation type F3 (CSF11).

Plate 5.11: Vegetation type F3 (CSF12).

5.1.4 Results of the Floristic Analysis

At the 50% level of similarity, the sampling sites were divided into four groups (Table 5.2; Appendix 9). These showed relatively clear associations of the vegetation units with particular habitat types and could be broadly discriminated based on the presence and abundance of various *Acacia* and *Aristida* species. On a practical mapping level however, some adjustments to groupings were made to account for anomalies, such as instances where there were too few sample sites per floristic group and mapping relied heavily on field observations; or where field observations and aerial imagery were found to be more representative of the differences in vegetation than the analysis groupings.

The four floristic groups (FG_a to FG_d) are briefly described below:

- FG_a contained all three sites from vegetation type D1 and the single site from D2. High cover of *Acacia aptaneura* and **Cenchrus* spp. within each of these sites were the primary characteristics of this floristic group. They were mapped differently based on their respective dominant overstorey species observed in the field (*Acacia aptaneura* at D1 and *Eucalyptus victrix* at D2) and landform type (moderate ephemeral drainage lines vs major ephemeral drainage lines).
- FG_b contained the two sites mapped as vegetation type F3. This group was characterised by the dominant tree species *Acacia xiphophylla* and the herb *Sclerolaena cornishiana*. Low shrubs of *Senna artemisioides* subsp. *oligophylla* and *Eremophila cuneifolia* also occurred with *Enteropogon ramosus* grasses on these undulating plains.
- FG_c contained all three sites mapped as vegetation type F2, comprising sparsely vegetated floodplains dominated by low trees of *Acacia aptaneura* and tall shrubs of *A. synchronicia*, together with the grasses *Aristida contorta*, *Enneapogon polyphyllus* and *Eragrostis xerophila*.
- FG_d contained all three sites mapped as vegetation type F1. This group was characterised by an *Acacia aptaneura* low open woodland, shrubs of *A. synchronicia* and *Senna artemisioides* subsp. *oligophylla*, with *Aristida latifolia* and *A. contorta* grasses occurring on stony floodplains with discrete areas of clay depressions.

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

Floristic Group	Average Similarity	Top 5 Species Contributing to Similarity (Cumulative Similarity)	Vegetation Types
a	48.6%	*Acacia aptaneura, Cenchrus* spp., *Acacia tetragonophylla, Aristida contorta, *Malvastrum americanum* (67.8%)	D1, D2
b	82.8%	*Acacia xiphophylla, Sclerolaena cornishiana, Senna artemisioides* subsp. *oligophylla, Enteropogon ramosus, Eremophila cuneifolia* (62.8%)	F3
c	68.0%	*Acacia aptaneura, Acacia synchronicia, Aristida contorta, Enneapogon polyphyllus, Eragrostis xerophila* (43.1%)	F2
d	58.8%	*Acacia aptaneura, Aristida latifolia, Acacia synchronicia, Aristida contorta, Senna artemisioides* subsp. *oligophylla* (50.2%)	F1

5.1.5 Significant Vegetation

No TECs were mapped in the survey area, and none are expected to occur.

The mapped occurrence of the Fortescue Marsh (Priority 1) PEC in the southwest section of the survey area comprises a 5 km management buffer around the actual community. On ground assessment of the buffer zone overlapping the survey area confirmed that the vegetation is not representative of this PEC.

5.1.6 Vegetation Condition

Vegetation condition mapping using the categories from EPA (2016) is provided in Figure 5.2. Approximately 33.0 ha (17.8%) of the survey area was mapped as cleared and assigned a condition rating of 'Completely Degraded'; these areas represented roads and vehicle access tracks.

The condition of the remaining vegetation in the survey area ranged from 'Very Good' to 'Good to Poor', with most areas ranked as 'Very Good' (62.6%) or 'Good' (14.5%) condition (Table 5.3). The main disturbance factors in the survey area comprised weed invasion, and cattle grazing and trampling. Several aggressive weed species, often in high densities, occurred over the majority of the survey area. The most poorly rated areas ('Good to Poor' condition) were associated with drainage lines and patches of remnant vegetation isolated by previously modified areas. These areas typically supported high densities of weeds, which were often a dominant feature of the

vegetation (e.g. *Cenchrus ciliaris* tussock grasslands and *Malvastrum americanum* shrublands in drainages). Although some areas rated as 'Very Good' did contain weeds, these were generally in low densities and were not impacting vegetation structure. These areas were typically located further from the existing footprint of the solar farm.

Table 5.3: Extent of vegetation condition categories in the survey area.

Condition Rating	Area (ha)	Proportion of Survey Area (%)
Very Good	115.6	62.6
Good	26.7	14.5
Good to Poor	9.5	5.1
Completely Degraded (cleared)	33.0	17.8
Total	**184.8**	**100.0**

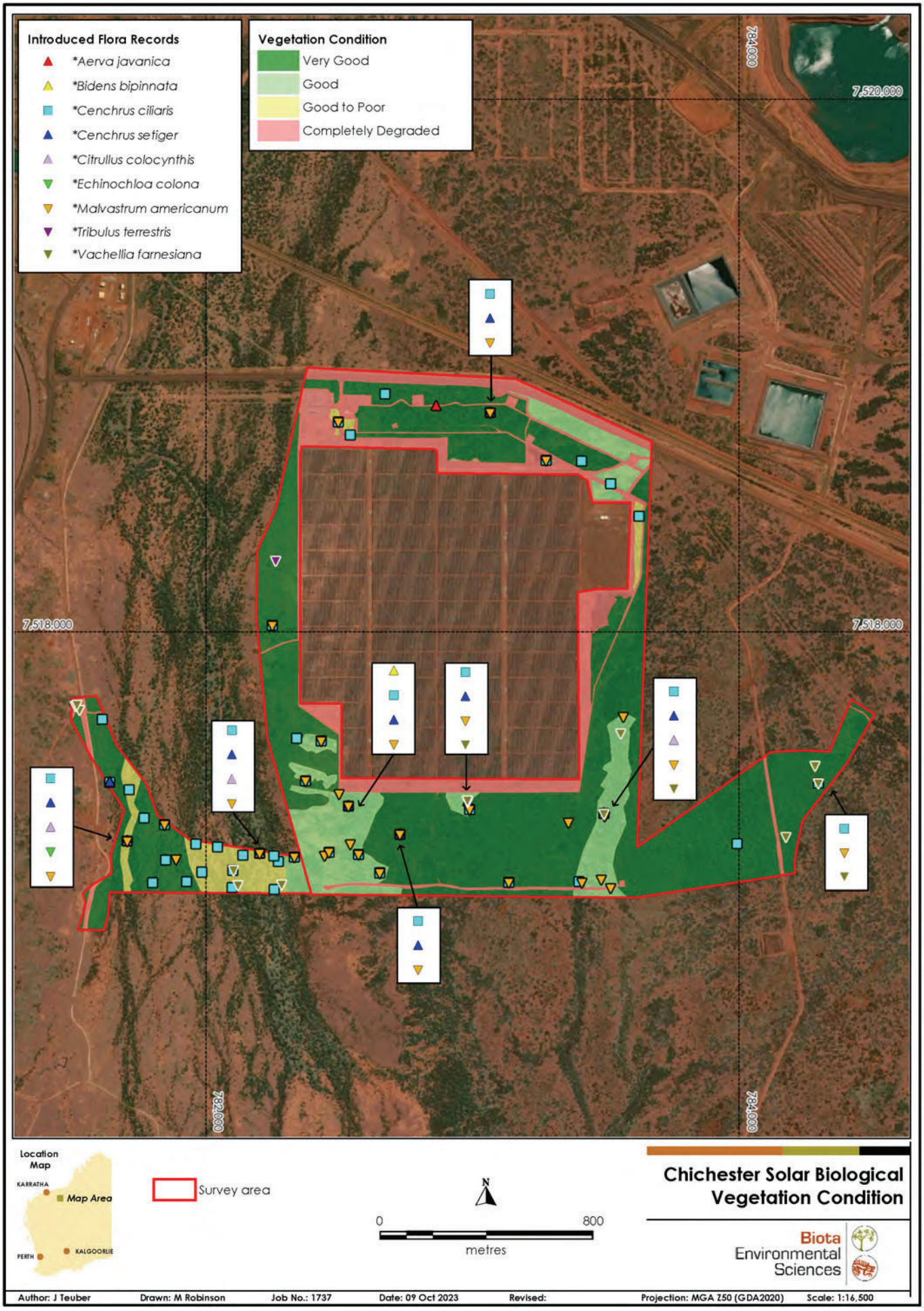

Figure 5.2: **Vegetation condition and Introduced flora records in the survey area.**

5.2 Flora

5.2.1 Overview

A total of 140 native flora species from 76 genera and 30 families were recorded during the survey (Appendix 7). The dominant native plant families and genera recorded are presented in Table 5.4. These families and genera are typically well represented in species lists from this region. A total of nine introduced flora were also recorded (see Section 5.2.3).

Table 5.4: Dominant families and genera recorded from the survey area.

Family	No. of Native Species	Genus	No. of Native Taxa
Poaceae (grasses)	29	*Acacia*	9
Fabaceae (wattles, peas, senna)	27	*Ptilotus*	6
Malvaceae (lantern-flowers, hibiscus)	14	*Senna*	6
Amaranthaceae (mulla-mullas, amaranths)	11	*Abutilon*	5
Chenopodiaceae (chenopods, bluebush, bindii)	10		

5.2.1.1 Sampling Adequacy

The species accumulation curve generated from the quadrat and relevé survey data is approaching a plateau, indicating that sampling of the survey area was relatively thorough (Figure 5.3). However, the two estimates of species richness (ICE and Chao 2) suggest that the actual number of species present in the sampled area was 194 to 195, which would indicate that approximately 70% of the total flora (native and introduced species) was recorded during sampling in the survey area (see Table 5.5). This proportion is similar to those reported for other surveys of a similar nature (e.g. 69% (Maia 2018) and 87% (ENV 2013)). It should be noted that an additional nine taxa were recorded through opportunistic sampling in the survey area; with the inclusion of these taxa, the current survey work has recorded 75% of the predicted total number of taxa.

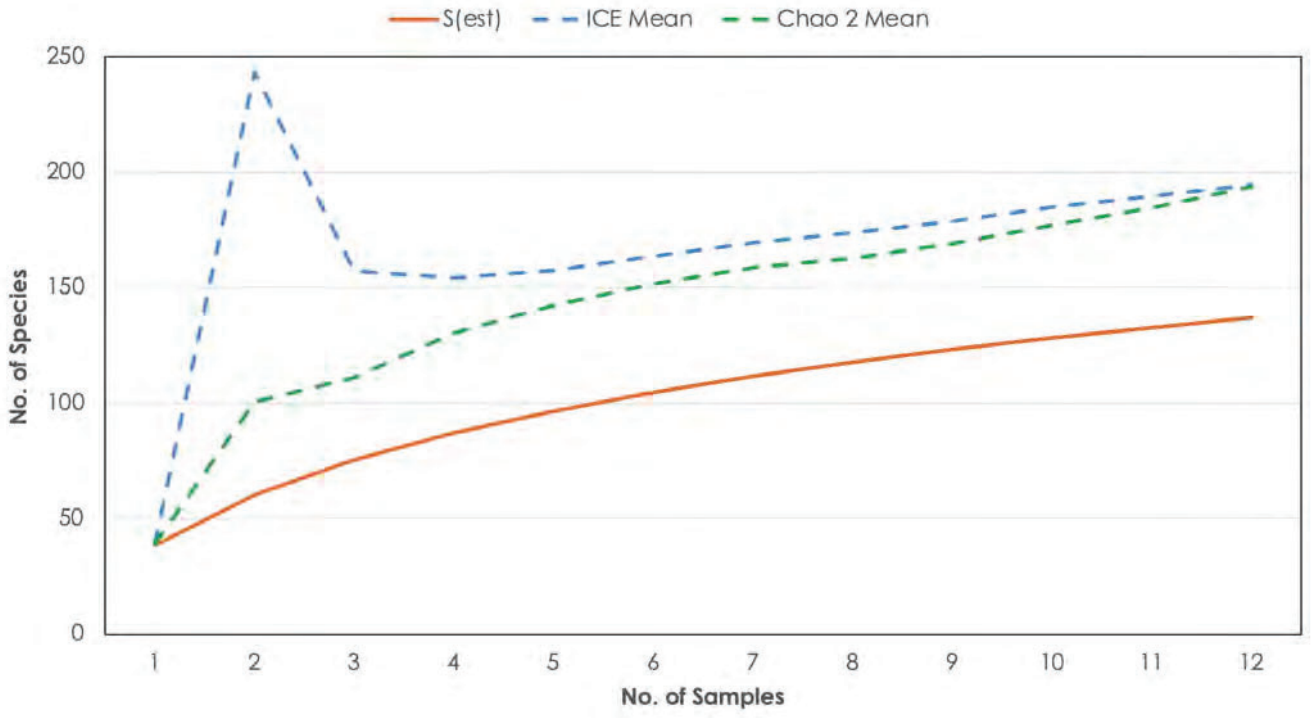

Figure 5.3 Randomised species accumulation curves for sites sampled in the survey area.

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

Parameter		Number of Species	Percent of Estimated Richness Recorded
Number of species recorded (from quadrats and relevés only)		137	
Estimated number of species	Chao 2 Mean	194	70.6%
	ICE Mean	195	70.3%

5.2.1.2 Unresolved Taxa

The majority (94%) of the flora taxa were able to be identified to the lowest level possible within the current taxonomic framework. One specimen, *Sida* aff. *fibulifera* (glabrous mericarps), did not fit the typical taxonomic description for the species. Specialist taxonomist Pierre-Louis de Kock noted that the mericarps lacked verrucose veins, some cymose inflorescences were present, and adaxial leaf stellate hairs were sessile, with rays horizontal to ascending. *Sida fibulifera* is common throughout the Pilbara and known to hybridise. The collected specimen may represent a hybridisation between *Sida fibulifera* and *Sida* sp. L. 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 species are thought to represent significant species.

5.2.1.3 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 to various other surveys in the wider locality for which these values could be sourced: Christmas Creek Life of Mine (ENV 2013), FMG Stage B Rail Corridor (Biota 2004), Remote MAR Borefield (Biologic 2018), Roy Hill Transmission Line (Ecoscape 2013) and Roy Hill Southern Borefield (Maia 2018). Species richness from the current study was lower than other surveys in the locality however, this was expected, given the significantly smaller size of the survey area. Additionally, the survey areas from some other studies (e.g. FMG Stage B (Biota 2004) and Christmas Creek (ENV 2013)) comprised long linear corridors that intersected a large number of landforms. Due to the nature of the current project (solar farm expansion), the survey area was relatively small, thereby limiting the number of habitats and vegetation types to be sampled.

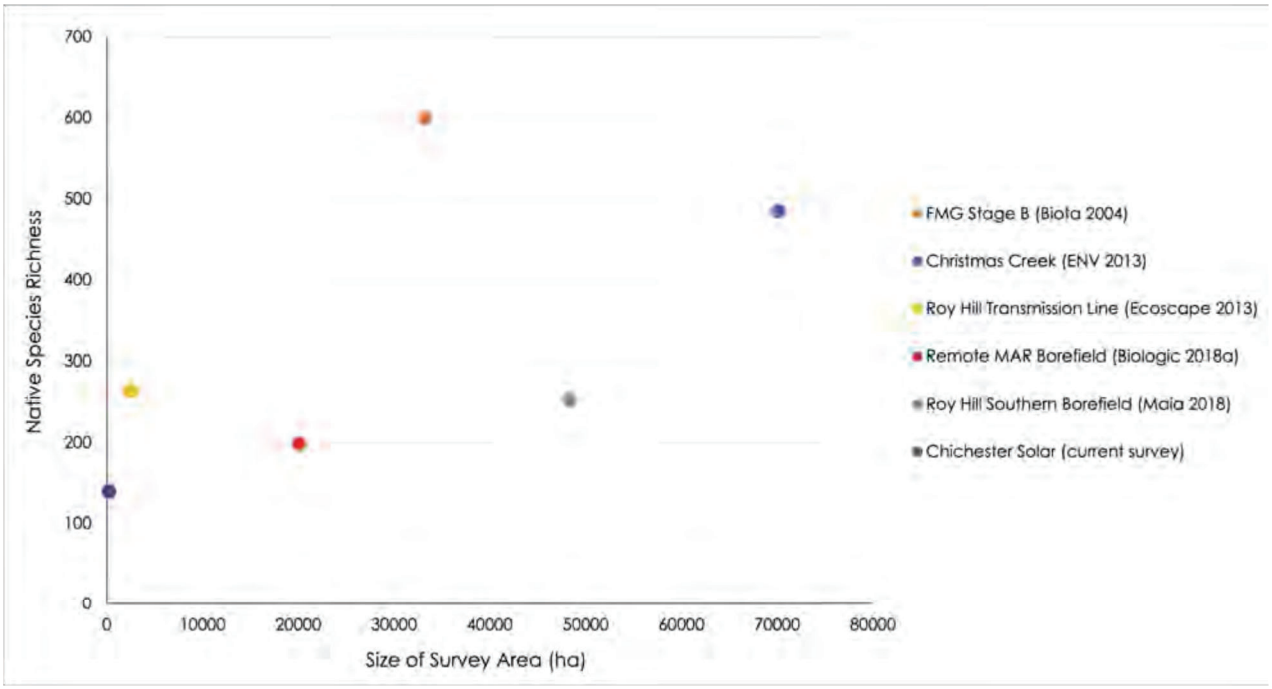

Figure 5.4: Species richness for the current survey area, compared with other surveys in the region.

5.2.2 Significant Flora

No Threatened or Priority flora species were recorded in the survey area during the survey. Prospective habitat was searched for the species ranked during the desktop study as having some potential to occur in the survey area (particularly *Rhagodia* sp. Hamersley (M. Trudgen 17794) and *Themeda* sp. Hamersley Station (M.E. Trudgen 11431)). Where potentially suitable habitat was present, none of the species were recorded, and in some cases suitable habitat was found to be very limited or absent from the survey area. The likelihood of occurrence of these species was subsequently revised to 'unlikely to occur' following the field survey (see Appendix 3).

5.2.3 Introduced Species

Nine weed species were recorded from the survey area (Table 5.6; Figure 5.2; Appendix 8). None of these species are listed as WoNS (Thorp and Lynch 2000) or are Declared Pests under the BAM Act (DPIRD 2023).

The then Department of Parks and Wildlife's Weed Species Ranking, which was derived from the Department's Weed Prioritisation Process (WPP) (Department of Parks and Wildlife 2013a), took into account the potential distribution, current distribution, ecological impact, invasiveness and feasibility of control to derive a broad qualitative weed species ranking corresponding to specific management actions (see Department of Parks and Wildlife 2013b). According to this methodology, five of the weed species recorded have a 'High' ranking for ecological impact: **Cenchrus ciliaris, *C. setiger, *Echinochloa colona, *Malvastrum americanum* and **Vachellia farnesiana* (Table 5.6). Seven of the species have a 'Rapid' ranking for invasiveness: **Bidens bipinnata, *Cenchrus ciliaris, *C. setiger, *Citrullus colocynthis, *Echinochloa colona, *Malvastrum americanum* and **Vachellia farnesiana*.

High weed density reflects the historical pastoral use of the area, as well as the location of the survey area along the main access road to Christmas Creek and Cloudbreak mine sites. The survey area intersected a few ephemeral drainage lines, which are particularly susceptible to weed invasion. **Cenchrus* spp. (e.g. **C. ciliaris* and **C. setiger*) and Mimosa Bush (**Vachellia farnesiana*) are considered to be serious environmental weeds in WA (CALM 1999). The significant threat posed by **Cenchrus* spp. in particular has also been recognised by the Commonwealth, with ecosystem degradation, habitat loss and species decline in arid and semi-arid Australia caused by the invasion of these spp. nominated for inclusion as a key threatening process under the EPBC Act. Although this was ultimately considered to be recognised in the overarching key threatening process 'Novel biota and their impact on biodiversity', a specific threat abatement advice was prepared (see Department of the Environment 2015).

Table 5.6: Summary of Introduced taxa recorded within the survey area, including WPP rankings.

Species	Description (WA Herbarium (2023) unless otherwise cited)	WPP – Weed Species Ranking †		Distribution in Survey Area (Sites)
		Impact	Invasiveness	
**Aerva javanica* (Kapok Bush)	Erect, perennial herb, often occurs on sandy soils. Originally introduced to assist with the revegetation of disturbed bushland; now widespread from the Kimberley to Carnarvon (Hussey et al. 2007).	L	M	Recorded once opportunistically in the north of the survey area, next to an access track.
**Bidens bipinnata* (Bipinnate Beggartick)	Annual daisy growing to 90 cm tall, with yellow flowers between March and September. Commonly observed in association with Mulga vegetation and creeklines in the Pilbara. May occur in high densities within suitable habitats and given appropriate conditions, but on its own does not appear to cause exclusion of native flora species.	U	R	Recorded at one site in vegetation type D1 (CSF02).
**Cenchrus ciliaris* (Buffel Grass)	Perennial tussock grass growing to 1 m tall and flowering for most of the year. Introduced by pastoralists as a fodder species and 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 primarily by wind and water, but can also be spread through the movement of mammals, birds and vehicles.	H	R	Recorded at 10 sites and 33 opportunistic locations throughout the survey area. This was a dominant species in the understorey at seven sites, most notably at CSF01-R, CSF02 and CSF12. Recorded at 22% cover at one location (CSF01-R).
**Cenchrus setiger* (Birdwood Grass)	Erect tussocky perennial grass; grows in the same habitats as Buffel Grass but is usually less common. 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 at eight locations in a variety of vegetation types throughout the survey area. Recorded at 22% cover at one location (CSF01-R).
**Citrullus colocynthis* (Colocynth)	Trailing, perennial herb or climber, which has yellow flowers between January and October. Widespread throughout the state and is commonly found in association with floodplains, drainage lines and sites of disturbance.	L	R	Recorded at three locations in the drainage vegetation types D1 and D2 (CSF01-R, CSF03-R and CSF10-R).
**Echinochloa colona* (Awnless Barnyard Grass)	Tufted annual grass growing to 60 cm, and flowering from February to July. It is a common weed of creeklines 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	Recorded at one site in vegetation type D1 (CSF01-R).
**Malvastrum americanum* (Spiked Malvastrum)	Erect, perennial herb or shrub to 1.3 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 bioregions.	H	R	Recorded at eight sites and 23 opportunistic locations in drainages and floodplains throughout the survey area (CSF01-R, CSF02, CSF03-R, CSF04, CSF05, CSF06, CSF10-R and CSF12). It was a dominant species in the understorey at two sites, CSF02 and CSF03-R.

Species	Description (WA Herbarium (2023) unless otherwise cited)	WPP – Weed Species Ranking †		Distribution in Survey Area (Sites)
		Impact	Invasiveness	
**Tribulus terrestris* (Caltrop)	Prostrate vine with greyish pinnate leaves and small yellow flowers. Widespread in the Eremaean and Northern botanical provinces, often growing on sandy soils and waste places.	U	M	Recorded at one location in vegetation type F2 (CSF07).
**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 at two sites (CSF03-R and CSF04) and 11 opportunistic locations in a variety of vegetation types throughout the survey area.

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

5.3 Fauna Habitats

The following four fauna habitats were identified within the survey area:

- *Acacia* woodland;
- Minor drainage lines and low lying floodplains;
- Major drainage lines; and
- Cleared areas/tracks.

The majority of the survey area was represented by plains supporting mixed *Acacia* woodland. While not containing much, if any, vegetation, cleared areas would still be utilised by some fauna (particularly feral animals such as cats). The fauna habitats recorded in the survey area were typical of the region and widespread in the surrounding locality.

Fauna habitats are described further below in Table 5.7 and mapped in Figure 5.5.

Table 5.7: Fauna habitats of the survey area.

Habitat	Area (ha) / Proportion (%)	Description	Photo
Acacia woodland	123.6 (66.9%)	Plains with mixed *Acacia* woodland, predominantly mulga with some smaller areas of snakewood. Scattered to open tussock grassland with variable overstorey of shrubs and low trees including *Acacia*, *Eremophila*, *Psydrax* and *Senna*. Flora quadrats: CSF04, CSF05, CSF06, CSF07, CSF08, CSF09-R, CSF11, CSF12. Vegetation units: F1, F2, F3. Condition: Variable, but overall Good.	
Minor drainage lines and low-lying floodplains	25.9 (14.0%)	Low lying floodplains and minor drainage lines vegetated primarily with open mixed *Acacia* over tussock grassland. Variable midstory of low to tall shrubs, including *Atalaya, Rhagodia, Acacia* and *Senna*. Flora quadrats: CSF-R01, CSF-02, CSF-R03. Vegetation unit: D1. Condition: Good to Poor: tussock grasslands dominated by weeds; cattle tracks and scats abundant.	

Habitat	Area (ha) / Proportion (%)	Description	Photo
Major drainage lines	2.3 (1.3%)	One major drainage line, with a sandy bed fringed with riparian vegetation including Smooth-barked Coolibah (*Eucalyptus victrix*), *Acacia* (*A. coriacea, A. aptaneura, A. pyrifolia*) and *Atalaya hemiglauca*. Flora quadrat: CSF-R10. Vegetation unit: D2. Condition: Good. High weed cover along banks.	
Cleared areas	33.0 (17.8%)	Cleared dirt tracks, fence lines and areas of infrastructure linked to the solar farm. Man-made depressions often resulting in large weed concentrations. Condition: Completely degraded.	No image.

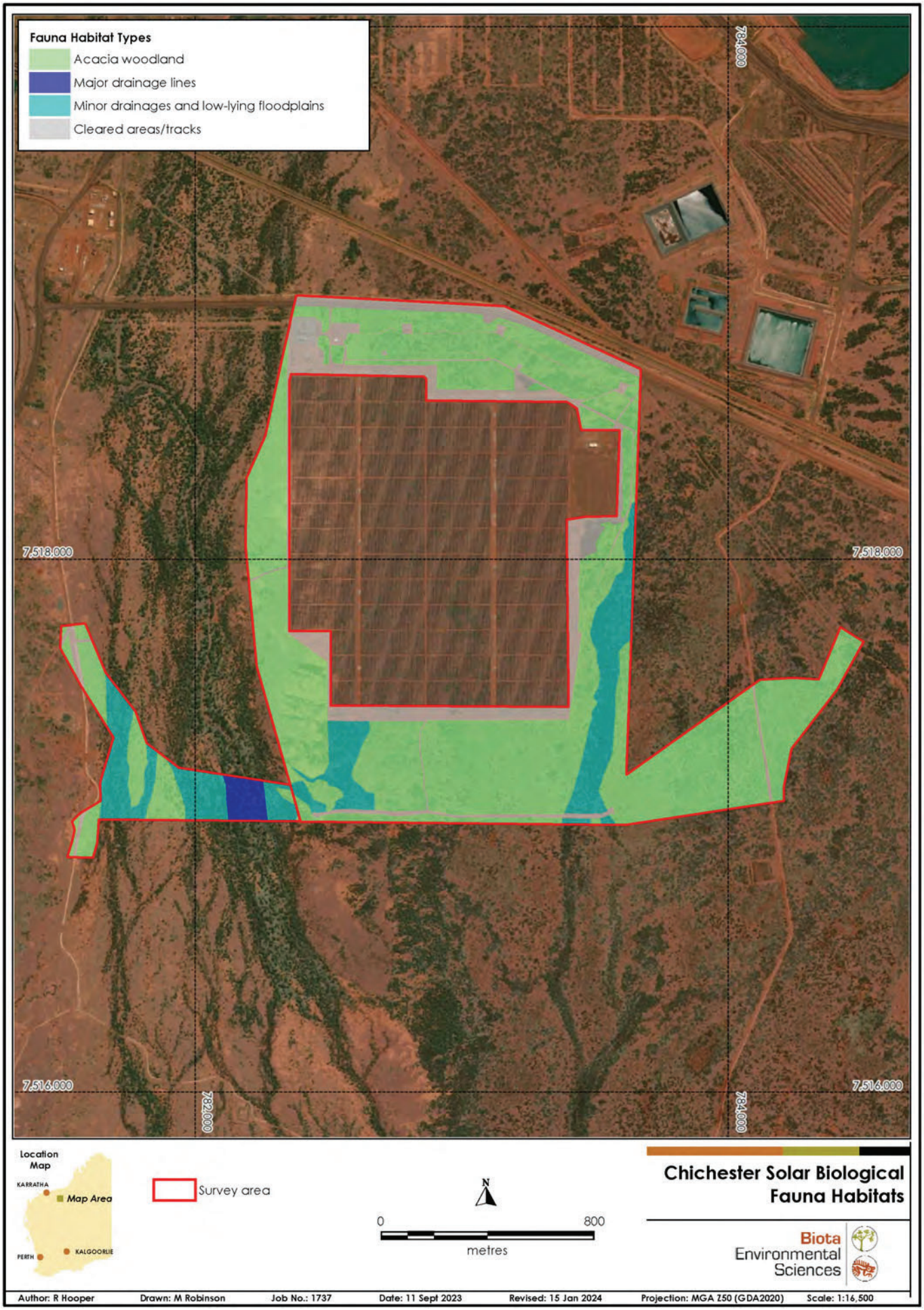

Figure 5.5 **Fauna habitats of the survey area.**

5.4 Vertebrate Fauna

Sixty-seven (67) vertebrate species were recorded during the current survey, comprising 15 mammal species, 50 bird species and two reptile species (Table 5.8). The 15 mammal species comprised 11 species of bat from three families, and four introduced mammal species (rabbit, cat, dog and cattle). The avifauna recorded represented 27 families, and 52% of the species recorded were passerines (perching birds). The reptiles were represented by two families, comprising one species of varanid and one dragon species. No significant fauna were recorded during the survey.

Table 5.8: Vertebrate fauna species recorded during the survey.

Group Family	Species	Common Name †
Mammals		
Leporidae	*Oryctolagus cuniculus*	European Rabbit*
Emballonuridae	*Saccolaimus flaviventris*	Yellow-bellied Sheath-tailed Bat
	Taphozous georgianus	Common Sheath-tailed Bat
Molossidae	*Austronomus australis*	White-striped Free-tailed Bat
	Chaerephon jobensis	Greater Northern Free-tailed Bat
	Ozimops lumsdenae	Northern Free-tailed Bat
Vespertilionidae	*Chalinolobus gouldii*	Gould's Wattled Bat
	Chalinolobus morio	Chocolate Wattled Bat
	Nyctophilus daedalus	Pallid Long-eared Bat
	Nyctophilus geoffroyi	Lesser Long-eared Bat
	Scotorepens greyii	Little Broad-nosed Bat
	Vespadelus finlaysoni	Finlayson's Cave-bat
Canidae	*Canis familiaris*	Dog*
Felidae	*Felis catus*	Cat*
Bovidae	*Bos taurus*	European Cattle*
Birds		
Anatidae	*Cygnus atratus*	Black Swan
Aegothelidae	*Aegotheles cristatus*	Australian Owlet-nightjar
Cuculidae	*Chrysococcyx basalis*	Horsfield's Bronze Cuckoo
	Chrysococcyx osculans	Black-eared Cuckoo
	Cacomantis pallidus	Pallid Cuckoo
Columbidae	*Ocyphaps lophotes*	Crested Pigeon
Turnicidae	*Turnix velox*	Little Buttonquail
Accipitridae	*Hamirostra melanosternon*	Black-breasted Buzzard
	Aquila audax	Wedge-tailed Eagle
	Milvus migrans	Black Kite
	Haliastur sphenurus	Whistling Kite
Tytonidae	*Tyto javanica*	Eastern Barn Owl
Strigidae	*Ninox boobook*	Australian Boobook
Alcedinidae	*Dacelo leachii*	Blue-winged Kookaburra
	Todiramphus pyrrhopygius	Red-backed Kingfisher
Falconidae	*Falco cenchroides*	Nankeen Kestrel
	Falco longipennis	Australian Hobby
	Falco berigora	Brown Falcon
Cacatuidae	*Nymphicus hollandicus*	Cockatiel
	Eolophus roseicapilla	Galah
	Cacatua sanguinea	Little Corella
Psittaculidae	*Barnardius zonarius*	Australian Ringneck
	Neopsephotus bourkii	Bourke's Parrot
	Melopsittacus undulatus	Budgerigar

Group Family	Species	Common Name †
Maluridae	*Malurus assimilis*	Purple-backed Fairywren
	Malurus leucopterus	White-winged Fairywren
Meliphagidae	*Gavicalis virescens*	Singing Honeyeater
	Ptilotula penicillata	White-plumed Honeyeater
	Acanthagenys rufogularis	Spiny-cheeked Honeyeater
	Manorina flavigula	Yellow-throated Miner
Acanthizidae	*Pyrrholaemus brunneus*	Redthroat
	Gerygone fusca	Western Gerygone
	Acanthiza uropygialis	Chestnut-rumped Thornbill
	Acanthiza robustirostris	Slaty-backed Thornbill
Pomatostomidae	*Pomatostomus temporalis*	Grey-crowned Babbler
	Pomatostomus superciliosus	White-browed Babbler
Cinclosomatidae	*Cinclosoma marginatum*	Western Quail-thrush
Artamidae	*Artamus cinereus*	Black-faced Woodswallow
	Cracticus torquatus	Grey Butcherbird
	Cracticus nigrogularis	Pied Butcherbird
Campephagidae	*Coracina novaehollandiae*	Black-faced Cuckooshrike
	Lalage tricolor	White-winged Triller
Oreoicidae	*Oreoica gutturalis*	Crested Bellbird
Pachycephalidae	*Pachycephala rufiventris*	Rufous Whistler
Rhipiduridae	*Rhipidura leucophrys*	Willie Wagtail
Monarchidae	*Grallina cyanoleuca*	Magpie-lark
Corvidae	*Corvus orru*	Torresian Crow
Petroicidae	*Petroica goodenovii*	Red-capped Robin
Dicaeidae	*Dicaeum hirundinaceum*	Mistletoebird
Estrildidae	*Taeniopygia castanotis*	Australian Zebra Finch
Reptiles		
Agamidae	*Ctenophorus caudicinctus*	Ring-tailed Dragon
Varanidae	*Varanus gouldii*	Sand Goanna

† NB. * denotes introduced species.

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6.0 Discussion and Conclusions

A flora and vegetation survey was conducted from 18th May to 23rd May 2023, and a terrestrial fauna survey was conducted from 29th to 31st May 2023. The surveys were undertaken post-wet season, and conditions were adequate for the collection of flora and observations of fauna activity.

6.1 Vegetation

Neither the desktop study nor the field survey identified any TECs in the survey area or within 40 km.

None of the four PECs from the desktop study area were recorded in the survey area and none are expected to occur based on the habitats and species present. The management buffer of the Fortescue Marsh (Priority 1) PEC intersects the southwest portion of the survey area, however an on-ground assessment confirmed that the vegetation present was not representative of this PEC.

A total of five vegetation types were mapped in the survey area (Section 5.1.3), comprising:

- Two units in moderate to major ephemeral drainages:
  - D1 – Low open forest of *Acacia aptaneura* over mixed *Acacia* spp. and **Malvastrum americanum* shrubs over mixed tussock grassland dominated by **Cenchrus* spp. and *Aristida* spp.
  - D2 – Low riparian woodland of *Eucalyptus victrix*, *Acacia coriacea* subsp. *pendens*, *Atalaya hemiglauca* and *Acacia aptaneura* with occasional *Ehretia saligna* var. *saligna* over **Cenchrus* spp. tussock grassland.
- Three units on floodplains:
  - F1 – Low open woodland of *Acacia aptaneura* over mixed *Acacia* spp., *Senna* spp. and *Eremophila cuneifolia* shrubs over mixed tussock grasses dominated by *Aristida* spp.
  - F2 – Scattered low trees of *Acacia aptaneura* over scattered shrubs of mixed *Acacia* spp. over scattered tussock grasses dominated by *Aristida contorta*, *Enneapogon polyphyllus* and *Eragrostis xerophila*, with scattered herbs of *Sclerolaena* spp.
  - F3 – Open woodland of *Acacia xiphophylla* over scattered shrubs of *Senna artemisioides* subsp. *oligophylla* and *Eremophila cuneifolia* over scattered tussock grasses of *Enteropogon ramosus* and *Aristida contorta*, with scattered herbs of *Sclerolaena cornishiana*.

The most widespread vegetation type in the survey area was F1, which accounted for 85.8 ha (46.4%). Over 62% of the vegetation in the survey area was rated as being in 'Very Good' condition, with only 33.0 ha (17.8%) having been cleared and considered 'Completely Degraded'. The entirety of the survey area was affected to some degree by weed invasion and minor degradation by livestock, which is unsurprising given the former pastoral land use prior to 2015, as well as the proximity to a main access road to active mine sites, and vehicle tracks that are regularly accessed for maintenance of the solar farm. The habitats in the poorest condition were associated with ephemeral drainages and lower-lying areas in the landscape.

6.2 Flora

A total of 140 native flora species from 76 genera and 30 families were recorded during the survey, none of which were significant species. Nine weed species were recorded across the survey area, none of which are listed as WoNS (Thorp and Lynch 2000) or Declared Pests under the BAM Act (DPIRD 2023). The post-survey likelihood assessment indicates that no significant flora species are likely to occur in the survey area (Appendix 3).

Analysis indicated that approximately 70-75% of the flora species present in the survey area were recorded; this result is comparable with other surveys in the area. Species richness from the current study was lower than other surveys in the locality, however this was expected given the small size of the survey area.

6.3 Vertebrate Fauna

No significant vertebrate fauna species were recorded during the field survey. The desktop study returned a total of 33 significant species with potential to occur within the survey area. Nine of these species were deemed through the likelihood of occurrence assessment to have either a high or moderate likelihood to occur within the survey area (i.e. were either "Likely to occur" or "May occur"; see Appendix 4). Those species deemed "Unlikely to occur" or "Would not occur" are not discussed further, however additional detail is provided in Appendix 4.

Of the eight potentially occurring significant mammal species, one was assessed as "Likely to occur"; the Short-tailed Mouse, *Leggadina lakedownensis* (DBCA Priority 4). This species has been recorded within 500 m of the survey area. Bioregional records suggest that primary or core habitat comprises areas of cracking clay and adjacent habitats. However, other sources provide a more diverse picture of habitat utilisation that includes areas of open tussock and hummock grassland, *Acacia* shrubland and savannah woodland, sandy soils, cracking clays (Aplin et al. 2016), hilltops (Dr Peter Kendrick, pers. comm.) and sandy coastal areas (Biota, pers. obs.). Areas of *Acacia* woodland occurring within the mapped fauna habitats (see Table 5.7; Figure 5.5) may provide habitat for the species within the survey area, particularly where tussock grasslands occur. However given the small footprint of the project, its proximity to existing disturbed areas, and no evidence of cracking clay found, the study area is not considered likely to represent significant habitat for this species.

A further three significant mammal species were assessed as having a moderate likelihood to occur within the survey area ("May occur"), but only as transient or foraging visitors:

- Northern Quoll, *Dasyurus hallucatus* (Endangered under BC Act and EPBC Act);
- Pilbara Leaf-nosed Bat, *Rhinonicteris aurantia* (Vulnerable under BC Act and EPBC Act);
- Ghost Bat, *Macroderma gigas* (Vulnerable under BC Act and EPBC Act).

Northern Quolls would be most likely to occur within the major drainage lines habitat, which would represent suitable dispersal and foraging habitat. They may also occur in adjacent habitats while foraging. Pilbara Leaf-nosed Bats and Ghost Bats forage over a wide range of habitats and may occur over all habitats of the survey area.

Of the 22 potentially occurring significant bird species, three were assessed as "Likely to occur" but only as foraging visitors:

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

Both falcon species may forage over all habitat types within the survey area, with the major drainage line habitat and other areas attracting aggregations of birds (e.g. temporary patches of surface water) likely to be most attractive. Pacific Swifts are non-breeding migrants to WA and would be most likely to occur over the survey area between September and April, particularly in association with the passage of low pressure systems and unsettled weather (Johnstone and Storr 1998).

Of the three potentially occurring reptile species, two were deemed moderately likely to occur within the survey area ("May occur"):

- Pilbara Olive Python, *Liasis olivaceus barroni* (Vulnerable under BC Act and EPBC Act); and

- Gane's Blind Snake, *Anilios ganei* (DBCA Priority 1).

The Pilbara Olive Python would be most likely to occur within the major drainage lines habitat, which would represent suitable dispersal and foraging habitat, but may also occasionally occur in adjacent habitats while foraging. Habitat preferences for Gane's Blind Snake are not well known, so potential habitat usage within the survey area is uncertain. It has been suggested that the species probably prefers "moist microhabitats which exist in many of the deeper, better shaded gorges throughout the Pilbara region" (Aplin 1998), but more recent records have been obtained from a wider range of habitats. Precautionarily, we consider that the species may occur in either of the major intact habitat types within the survey area.

In summary, apart from the Short-tailed Mouse and potentially Gane's Blind Snake, all of the significant fauna species listed above that were identified as having moderate or high likelihood of occurrence within the survey area would only be expected to utilise the habitats of the survey area on a transitory basis while foraging or dispersing. The habitats within the survey area would therefore represent only secondary habitat for these species.

6.4 Assessment Against the 10 Clearing Principles

A general assessment of the proposal to clear land within the survey area against each of the 10 clearing principles, as outlined in Schedule 5 of the EP Act, is provided in Table 6.1.

Table 6.1: Assessment of vegetation within the survey area against the ten clearing principles.

Clearing Principle	Background Information (Justification of Assessment)	Assessment
A	**Native vegetation should not be cleared if it comprises a high level of biological diversity.**	
	Flora The survey area is not located within a known biodiversity hotspot for WA (Department of the Agriculture, Water and the Environment 2020). Vascular flora species diversity recorded within the survey area was considered to be moderate to low; a total of 140 native flora species from 30 families were recorded within the 184.8 ha survey area. No significant flora species were recorded during the survey and none were deemed likely to occur following the field survey. **Fauna** A total of 67 vertebrate species were recorded during the current survey, comprising 15 mammal species, two reptile species and 50 bird species. No significant fauna were recorded during the survey, however the desktop study identified that 33 significant fauna species could potentially occur in the survey area. Following the field survey, an assessment of the habitat available identified nine of these species as having a moderate to high likelihood of occurrence in the survey area. With the exception of the Short-tailed Mouse, these species are only likely to be occasional visitors. The clearing footprint for the project is small (184.8 ha); neither the vascular flora species diversity nor the fauna species diversity would be expected to be affected by clearing at this scale.	Not at Variance (flora) Unlikely to be at Variance (fauna)
B	**Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to Western Australia.**	
	Four fauna habitats (one of which comprised cleared areas) were described for the survey area. All are typical of the region and widespread in the surrounding locality. None of the fauna habitats were considered to represent core habitat for any of the potentially occurring significant fauna species. The *Acacia* woodland habitat is likely to support the Short-tailed Mouse, however given its proximity to existing disturbed areas and the fact	Unlikely to be at Variance

	that it is contiguous with other very extensive areas of similar habitat, it is not considered to represent significant habitat for the species.	
C	**Native vegetation should not be cleared if it includes, or is necessary for the continued existence of, rare flora.**	
	The desktop study did not identify any records of Threatened flora species within 40 km of the survey area, and none were recorded during the survey. Based on the habitat preferences and currently known distributions of Threatened species in the Pilbara, none would occur in the survey area.	Not at Variance
D	**Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of, a threatened ecological community.**	
	None of the vegetation within the survey area comprises any TECs defined at State or Commonwealth level.	Not at Variance
E	**Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared.**	
	The survey area contains one broad-scale regional vegetation unit described as Fortescue Valley 29 (Mulga low woodland, open woodland or sparse woodland and associated species (1975a, 1975b)). When last assessed in 2018, the extent of this vegetation unit in the Fortescue Plains subregion was 877,652.9 ha (or 99.9 % of the pre-European extent; see Section 4.5). The proposed clearing is not within a significantly cleared landscape and does not represent an ecological linkage. Clearing of up to 184.8 ha would represent a small increment on historical clearing in the area.	Not at Variance
F	**Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland.**	
	The Fortescue Marsh is located approximately 3.5 km southwest of the southern boundary. Given the small scale of the survey area, the proposal is not expected to have an impact on the Fortescue Marsh. While there are no major rivers or any permanent watercourses intersecting the survey area, three ephemeral tributaries intersect the western and eastern regions of the survey area.	Unlikely to be at Variance
G	**Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.**	
	Given the small scale of the proposed development, it is considered unlikely that the proposal would contribute significantly to land degradation in the locality.	Unlikely to be at Variance
H	**Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area.**	
	There are currently no conservation reserves in the locality of the survey area. Land fringing the Fortescue Marsh was excised from the Roy Hill pastoral station in 2015, with the intent of addition to the conservation estate, however this was never enacted.	Not at Variance
I	**Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water.**	
	The proposed clearing does not intersect any major waterbodies or wetlands, however the Fortescue Marsh is located approximately 3.5 km southwest of the southern boundary, and three ephemeral tributaries intersect the western and eastern parts of the survey area. Provided that the construction avoids any excavations below the water table, there is no reason to expect that the clearing would affect the quality of surface or underground water.	Unlikely to be at Variance
J	**Native vegetation should not be cleared if clearing the vegetation is likely to cause, or exacerbate, the incidence of flooding.**	
	No permanent surface water sources or wetlands occur in the survey area. Given the small scale of clearing required, it would not be expected to affect the intensity or incidence of flooding.	Not at Variance

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Appendix 1

Framework for Significance Ranking of Species and Communities in WA

A. Categories for Threatened and Priority Ecological Communities

A1. Categories and Criteria for Threatened Ecological Communities under the BC Act

Division 2

Subdivision 1 — Threatened ecological communities

27. Listing of threatened ecological communities

(1) The Minister may, by order, list an ecological community as a threatened ecological community in one of the following categories —

(a) critically endangered ecological community;

(b) endangered ecological community;

(c) vulnerable ecological community.

(2) An ecological community is not eligible for listing as a threatened ecological community if it is a collapsed ecological community.

(3) When deciding whether or not to list an ecological community as a threatened ecological community or to amend or repeal such a listing, the Minister must have regard only to matters relating to the survival of the ecological community.

(4) An order made under subsection (1) may describe or identify an ecological community by reference to a map or plan held in the Department.

(5) Section 258 applies to an order made under subsection (1).

28. Criteria for categorisation as critically endangered ecological community

An ecological community is eligible for listing in the category of critically endangered ecological community at a particular time if, at that time —

(a) it is facing an extremely high risk of becoming eligible for listing as a collapsed ecological community in the immediate future, as determined in accordance with criteria set out in the ministerial guidelines; and

(b) listing in that category is otherwise in accordance with the ministerial guidelines.

29. Criteria for categorisation as endangered ecological community

An ecological community is eligible for listing in the category of endangered ecological community at a particular time if, at that time —

(a) it is not a critically endangered ecological community; and

(b) it is facing a very high risk of becoming eligible for listing as a collapsed ecological community in the near future, as determined in accordance with criteria set out in the ministerial guidelines; and

(c) listing in that category is otherwise in accordance with the ministerial guidelines.

30. Criteria for categorisation as vulnerable ecological community

An ecological community is eligible for listing in the category of vulnerable ecological community at a particular time if, at that time —

(a) it is not a critically endangered ecological community or an endangered ecological community; and

(b) it is facing a high risk of becoming eligible for listing as a collapsed ecological community in the medium-term future, as determined in accordance with criteria set out in the ministerial guidelines; and

(c) listing in that category is otherwise in accordance with the ministerial guidelines.

Subdivision 2 — Collapsed ecological communities

31. Listing of collapsed ecological communities

(1) The Minister may, by order, list an ecological community as a collapsed ecological community.

(2) Section 258 applies to an order made under subsection (1).

32. Criteria for listing as collapsed ecological community

An ecological community is eligible for listing as a collapsed ecological community at a particular time if, at that time —

(a) there is no reasonable doubt that the last occurrence of the ecological community has collapsed; or

(b) the ecological community has been so extensively modified throughout its range that no occurrence of it is likely to recover —

(i) its species composition or structure; or

(ii) its species composition and structure.

33. Rediscovered ecological communities

If a collapsed ecological community is discovered in a state that no longer makes it eligible for listing as a collapsed ecological community, it is to be regarded as a threatened ecological community for the purposes of this Act until —

(a) it is listed as a threatened ecological community; or

(b) the Minister declares, by instrument published in the Gazette, that it is not to be so listed.

A2. Categories and Criteria for Priority Ecological Communities (DEC 2010)

Possible threatened ecological communities that do not meet survey criteria or that are not adequately defined are added to the DBCA Priority Ecological Community Lists under Priorities 1, 2 and 3. These three categories are ranked in order of priority for survey and/or definition of the community, and evaluation of conservation status, so that consideration can be given to their declaration as threatened ecological communities. Ecological Communities that are adequately known, and are rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list, are placed in Priority 4. These ecological communities require regular monitoring. Conservation Dependent ecological communities are placed in Priority 5.

Priority One: Poorly-known ecological communities
Ecological communities with apparently few, small occurrences, all or most not actively managed for conservation (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) and for which current threats exist. Communities may be included if they are comparatively well-known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range.

Priority Two: Poorly-known ecological communities
Communities that are known from few small occurrences, all or most of which are actively managed for conservation (e.g. within national parks, conservation parks, nature reserves, State forest, unallocated Crown land, water reserves, etc.) and not under imminent threat of destruction or degradation. Communities may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under threat from known threatening processes.

Priority Three: Poorly known ecological communities

(i) Communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation or:

(ii) communities known from a few widespread occurrences, which are either large or within significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat, or;

(iii) communities made up of large, and/or widespread occurrences, that may or not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, and inappropriate fire regimes.

Communities may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and/or are not well defined, and known threatening processes exist that could affect them.

Priority Four: Ecological communities that are adequately known, rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list. These communities require regular monitoring.

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

(b) Near Threatened. Ecological communities that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable.

(c) Ecological communities that have been removed from the list of threatened communities during the past five years.

Priority Five: Conservation Dependent ecological communities
Ecological communities that are not threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming threatened within five years.

B. Categories for Flora and Fauna Species

B1. Western Australian BC Act, and Priority Species Classification

In Western Australia, 'Threatened', 'Extinct' and 'Specially Protected' fauna and flora species are protected under the *Biodiversity Conservation Act 2016* (the BC Act), making it an offence to take or disturb these species without Ministerial approval. The definition of 'take' is broad, and includes killing, injuring, harvesting or capturing fauna, and gathering, cutting, destroying, harvesting or damaging flora.

Such species are classified within a framework of several categories.

Species of the highest significance are designated as Threatened species and are protected under sections 19(1)(a), 19(1)(b) and 19(1)(c) of the BC Act. Species are listed within one of three categories:

- Critically endangered (CR), Endangered (EN), or Vulnerable (V), representing those species listed in Schedules 1 to 3 respectively of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* or the *Wildlife Conservation (Rare Flora) Notice 2018*.

Presumed extinct species are protected under sections 24 and 25 of the BC Act and are listed in one of two categories:

- Extinct (EX), representing those species listed in Schedule 4 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* or the *Wildlife Conservation (Rare Flora) Notice 2018*; or
- Extinct in the wild (EW); there are currently no listed species under this category.

Specially protected species are protected under section 13(1) of the BC Act, and include species of special conservation interest, migratory species, cetaceans, species subject to international agreement, or species otherwise in need of special protection. Of these:

- Migratory species (MI) are those listed under schedule 5 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018*;
- Species of special conservation interest (conservation dependent fauna) (CD) are those listed under schedule 6 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018*; and
- Other specially protected fauna (OS) are those listed under schedule 7 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018*;

In addition to the species formally designated as protected under the BC Act, the WA Department of Biodiversity, Conservation and Attractions (DBCA) also maintains a list of 'Priority species'.

Species that appear to be rare or threatened, but for which there is insufficient information to properly evaluate their significance, are assigned to one of three Priority categories (Priority 1 to Priority 3), while species that are adequately known but require regular monitoring are assigned to Priority 4.

Note that of the above classifications, only 'Threatened', 'Extinct' and 'Specially Protected' species have statutory standing. The Priority flora and fauna classifications are employed by the WA DBCA to manage and classify their database of species considered potentially rare or at risk, but these categories have no legislative status.

Further explanations of the categories is provided in more detail in the following pages.

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.

B2. 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 Federal 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

Results of EPBC PMST Database Search

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: 02-Aug-2023

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	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	12
Listed Migratory Species:	9

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:	14
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:	17
Key Ecological Features (Marine):	None
Biologically Important Areas:	None
Bioregional Assessments:	None
Geological and Bioregional Assessments:	None

Details

Matters of National Environmental Significance

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 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 buffer area only
Polytelis alexandrae Princess Parrot, Alexandra's Parrot [758]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area	In feature area
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	Species or species habitat known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Macrotis lagotis			
Greater Bilby [282]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Rhinonicteris aurantia (Pilbara form)			
Pilbara Leaf-nosed Bat [82790]	Vulnerable	Species or species habitat likely to occur within area	In buffer area only
REPTILE			
Liasis olivaceus barroni			
Olive Python (Pilbara subspecies) [66699]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Liopholis kintorei			
Great Desert Skink, Tjakura, Warrarna, Mulyamiji [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
Motacilla flava			
Yellow Wagtail [644]		Species or species habitat may occur within area	In feature area
Migratory Wetlands Species			
Actitis hypoleucos			
Common Sandpiper [59309]		Species or species habitat may occur within area	In feature area
Calidris acuminata			
Sharp-tailed Sandpiper [874]		Species or species habitat likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
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

Other Matters Protected by the EPBC Act

Listed Marine Species			[Resource Information]
Scientific Name	Threatened Category	Presence Text	Buffer Status
Bird			
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may 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]		Species or species habitat likely 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

Scientific Name	Threatened Category	Presence Text	Buffer Status
Chalcites osculans as Chrysococcyx osculans			
Black-eared Cuckoo [83425]		Species or species habitat likely to 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
Haliaeetus leucogaster			
White-bellied Sea-Eagle [943]		Species or species habitat may occur within area	In buffer area only
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 may occur within area overfly marine area	In feature area
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

Extra Information

Nationally Important Wetlands		[Resource Information]
Wetland Name	State	Buffer Status
Fortescue Marshes	WA	In buffer area only

EPBC Act Referrals				[Resource Information]
Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Roy Hill Iron Ore Mine expansion, Pilbara Region, WA	2018/8330		Approval	In buffer area only
Controlled action				
Additional Rail Infrastructure between Herb Elliott Port Facility and Cloudbreak Mine Site	2010/5513	Controlled Action	Post-Approval	In feature area
Bonney Downs Rail Alignment	2011/5867	Controlled Action	Post-Approval	In buffer area only
Christmas Creek Iron Ore Mine Expansion Project, East Pilbara, WA	2013/7055	Controlled Action	Post-Approval	In feature area
Christmas Creek Water Management Scheme	2010/5706	Controlled Action	Post-Approval	In feature area
Cloud Break Open Pit Iron Ore Mine	2005/2205	Controlled Action	Post-Approval	In buffer area only
construction of iron ore mine & associated infrastructure	2013/6945	Controlled Action	Completed	In buffer area only
Expansion of Cloudbreak iron ore mine	2010/5696	Controlled Action	Post-Approval	In buffer area only
FerrAus Pilbara Project - mine & Rail Pilbara Region WA	2011/6036	Controlled Action	Post-Approval	In buffer area only
Nullagine Iron Ore Extension Project, Pilbara region, WA	2013/6887	Controlled Action	Post-Approval	In buffer area only
Nullagine Iron Ore Project	2009/4930	Controlled Action	Post-Approval	In buffer area only
Roy Hill to Port Hedland Rail Line and Associated Infrastructure	2010/5424	Controlled Action	Post-Approval	In feature area
Not controlled action				
Improving rabbit biocontrol: releasing another strain of RHDV, sthrn two thirds of Australia	2015/7522	Not Controlled Action	Completed	In feature area
Pilbara Transmission Project, Pilbara, WA	2018/8349	Not Controlled Action	Completed	In buffer area only
Roy Hill Iron Ore Project	2008/4624	Not Controlled Action	Completed	In buffer area only
Stage B of Pilbara Iron Ore and Infrastructure Project	2004/1897	Not Controlled Action	Completed	In feature area
Not controlled action (particular manner)				
Additional Rail Infrastructure	2012/6314	Not Controlled Action	Post-Approval	In feature area

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Not controlled action (particular manner)				
		(Particular Manner)		

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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Appendix 3

Likelihood of Significant Flora Occurring in the Survey Area

Taxon	Habit and Habitat †	Source				Likelihood of Occurrence in Survey Area Based on Desktop Study (NR = nearest record)	Post-Survey Likelihood of Occurrence
		DBCA TPFL	WAH	ALA	Previous Surveys		
Priority 1							
Calotis squamigera	Annual herb to 0.1 m tall. Occurs on stony floodplains in red-brown loams.	–	✓	✓	✓	**May occur:** suitable habitat may be present, with four records in the locality (NR 8 km SE).	**Unlikely to occur:** some suitable habitat was present, but species was not recorded during current survey.
Eremophila pilosa	Shrub to 0.8 m, growing on or near seasonally inundated sandy flats.	–	✓	✓	✓	**Unlikely to occur:** suitable habitat unlikely to be present, and only two records in the locality from two locations (NR 34 km SE).	**Would not occur:** no suitable habitat.
Helichrysum oligochaetum	Annual herb to 0.3 m, growing on floodplains and clay pans.	–	✓	✓	–	**Unlikely to occur:** suitable habitat may be present in survey area, but only one WAH record in the locality (NR 24 km S).	**Unlikely to occur:** some suitable habitat present, but species was not recorded during current survey.
Lindernia sp. Pilbara (M.N. Lyons & L. Lewis FV 1069)	Annual herb, growing on riparian slopes.	–	✓	✓	–	**Unlikely to occur**: suitable habitat may be present in survey area, but only one WAH record in the locality (NR 33 km SW).	**Unlikely to occur:** some suitable habitat present, but species not recorded during current survey.
Myriocephalus scalpellus	Herb to 0.8 m, growing on floodplains, clay depressions and riparian slopes.	✓	✓	–	–	**Unlikely to occur:** suitable habitat present in survey area, but infrequent records of species in the locality (NR 32 km SW).	**Unlikely to occur:** some suitable habitat present, but species not recorded during current survey.
Rorippa sp. Fortescue Valley (M.N. Lyons & R.A. Coppen FV 0760)	Annual herb, growing on riparian slopes.	–	✓	✓	–	**Unlikely to occur**: suitable habitat may be present in survey area, but only two records in the locality from one location (NR 33 km SW).	**Unlikely to occur:** some suitable habitat present, but species not recorded during current survey.
Samolus sp. Fortescue Marsh (A. Markey & R. Coppen FM 9702)	Erect herb to 1.2 m, growing in marsh areas.	–	✓	✓	–	**Unlikely to occur:** existing records in proximity, but species is linked to a specific habitat that is absent from the survey area (NR 9 km S).	**Unlikely to occur:** no suitable habitat.
Stemodia sp. Battle Hill (A.L. Payne 1006)	Erect herb to low shrub growing on cracking clay.	–	✓	✓	–	**Unlikely to occur:** suitable habitat may be present in survey area, but species is infrequently recorded in the locality (NR 38 km NE).	**Unlikely to occur:** no suitable habitat.
Tecticornia globulifera	Shrub to 0.5 m, endemic to ephemeral salt lakes and marsh fringes.	✓	✓	✓	✓	**Unlikely to occur:** species is linked to a specific habitat that is absent from survey area (NR 15 km SW).	**Would not occur:** no suitable habitat.
Tecticornia sp. Christmas Creek (K.A. Shepherd & T. Colmer et al. KS 1063)	Shrub to 0.7 m, endemic to ephemeral salt lakes and marsh fringes.	–	✓	✓	✓	**Unlikely to occur:** existing records in proximity, but species is linked to a specific habitat that is absent from the survey area (NR 6 km SW).	**Would not occur:** no suitable habitat.

Taxon	Habit and Habitat †	Source				Likelihood of Occurrence in Survey Area Based on Desktop Study (NR = nearest record)	Post-Survey Likelihood of Occurrence
		DBCA TPFL	WAH	ALA	Previous Surveys		
Triodia veniciae	Hummock grass with inflorescences to 1.3 m, growing on shale slopes and rocky hills.	–	✓	✓	–	**Unlikely to occur:** species is linked to a specific habitat that is absent from the survey area. (NR 20 km NE).	**Would not occur:** no suitable habitat.
Priority 2							
Gompholobium karijini	Shrub to 0.4 m, growing on hilltops and hillslopes.	–	✓	✓	–	**Unlikely to occur:** species is linked to a specific habitat that is absent from survey area. (NR 30 km NW).	**Would not occur:** no suitable habitat.
Priority 3							
Atriplex flabelliformis	Erect perennial herb to 0.4 m, growing on saline flats or marshes in loam or clay-loam.	–	✓	✓	✓	**Unlikely to occur:** species is linked to a specific habitat that is absent from the survey area. (NR 15 km W).	**Would not occur:** no suitable habitat.
Dolichocarpa sp. Hamersley Station (A.A. Mitchell PRP 1479)	Annual to perennial herb, growing on plateaus on clay over dolerite.	–	✓	–	–	**Unlikely to occur:** species is infrequently recorded in the locality (NR 18 km NE).	**Unlikely to occur:** no particularly suitable habitat.
Eleocharis papillosa	Annual herb to 0.2 m, growing in clay over granite, on open clay flats and claypans fringing marsh areas.	–	✓	✓	✓	**Unlikely to occur:** existing records in proximity, but species is linked to a specific habitat that is absent from the survey area (NR 4 km SW).	**Unlikely to occur:** no suitable habitat.
Eragrostis crateriformis	Annual grass, to 0.5 m, growing in clay or clay-loam on creek banks and depressions.	–	✓	✓	–	**May occur:** suitable habitat may be present in the survey area, with two existing records in proximity (NR 9 km SE).	**Unlikely to occur:** some suitable habitat present, but species not recorded during current survey.
Eragrostis sp. Erect spikelets (P.K. Latz 2122)	Tufted perennial grass to 0.3 m, growing on low calcrete rises.	–	✓	✓	–	**Unlikely to occur:** species is linked to a specific habitat that is absent from the survey area, and is infrequently recorded in the locality (NR 22 km SE).	**Would not occur:** no suitable habitat.
Eremophila spongiocarpa	Compact, succulent-leaved shrub to 1 m, growing on alluvial plains on margins of marshes.	✓	✓	✓	✓	**Unlikely to occur:** numerous records in proximity, but species is linked to a specific habitat that is absent from the survey area (NR 3 km S).	**Unlikely to occur:** no suitable habitat present, and species not recorded during current survey.
Eucalyptus rowleyi	Mallee to 4 m with smooth bark and dull light green leaves, growing on hard red soil.	–	✓	✓	✓	**Unlikely to occur:** suitable habitat may be present in survey area, but species is infrequently recorded in the locality (NR 37 km SE).	**Unlikely to occur:** no particularly suitable habitat present, and species not recorded during current survey.

Taxon	Habit and Habitat †	Source				Likelihood of Occurrence in Survey Area Based on Desktop Study (NR = nearest record)	Post-Survey Likelihood of Occurrence
		DBCA TPFL	WAH	ALA	Previous Surveys		
Euphorbia australis var. *glabra*	Prostrate annual herb 1 cm high x 10-25 cm wide, growing in red clay loam.	–	✓	✓	–	**Unlikely to occur:** suitable habitat may be present in survey area, but species infrequently recorded in the locality (NR 37 km NW).	**Unlikely to occur:** some suitable habitat present, but species not recorded during current survey.
Iotasperma sessilifolium	Erect herb, growing in black loam and cracking clay on plains and waterhole edges.	–	✓	✓	–	**Unlikely to occur:** suitable habitat unlikely to be present in survey area, and species is infrequently recorded in the locality (NR 20 km NE).	**Unlikely to occur:** some suitable habitat present, but species not recorded during current survey.
Isotropis parviflora	Shrub to 0.1 m, growing on valley slopes and low rocky hills.	–	✓	–	–	**Unlikely to occur:** species is linked to a specific habitat that is absent from the survey area, and is infrequently recorded in the locality (NR 34 km SW).	**Would not occur:** no suitable habitat.
Rhagodia sp. Hamersley (M. Trudgen 17794)	Shrub to 1.2 m, growing on flats and floodplains in a variety of soil types.	–	✓	✓	✓	**Likely to occur:** species has more general habitat preferences, with suitable habitat present in survey area; numerous existing records in proximity to the survey area (NR 6 km E).	**Unlikely to occur:** while suitable habitat was present, species was not recorded during current survey.
Rostellularia adscendens var. *latifolia*	Herb or shrub to 0.3 m, growing near creeks and on rocky hills in ironstone soils.	–	✓	✓	✓	**May occur:** suitable habitat may be present in the survey area, but species is infrequently recorded in the locality (NR 31 km SE).	**Unlikely to occur:** some potentially suitable habitat present, but species was not recorded during current survey.
Streptoglossa sp. Cracking clays (S. van Leeuwen et al. PBS 7353)	Annual herb, growing in clay loam in sub-saline flats.	–	✓	✓	–	**Unlikely to occur:** suitable habitat unlikely to be present in the survey area, and species infrequently recorded in the locality (NR 37 km NW).	**Unlikely to occur:** no suitable habitat.
Swainsona thompsoniana	Prostrate herb to 10 cm, growing in clay on slopes and flats.	–	✓	✓	–	**May occur:** suitable habitat may be present in the survey area, but species is infrequently recorded in the locality (NR 17 km NE).	**Unlikely to occur:** some potentially suitable habitat present, but species was not recorded during current survey.
Tecticornia medusa	Shrub to 1.2 m, endemic to ephemeral salt lakes and saline flats.	–	✓	✓	✓	**Unlikely to occur:** species is linked to a specific habitat that is absent from survey area and is infrequently recorded in the locality (NR 13 km SE).	**Would not occur:** no suitable habitat.
Themeda sp. Hamersley Station (M.E. Trudgen 11431)	Perennial grass to 1.1 m, growing on in a range of habitats including red clay, clay pans and grass plains.	–	✓	✓	✓	**Likely to occur:** suitable habitat may be present in the survey area and there are existing records in proximity to the survey area (NR 3 km S).	**Unlikely to occur:** some potentially suitable habitat was present, but species was not recorded during current survey.

Taxon	Habit and Habitat †	Source				Likelihood of Occurrence in Survey Area Based on Desktop Study (NR = nearest record)	Post-Survey Likelihood of Occurrence
		DBCA TPFL	WAH	ALA	Previous Surveys		
Priority 4							
Eremophila youngii subsp. *lepidota*	Shrub to 3 m high, growing in stony red sandy loam on flats, floodplains and sometimes semi-saline clay flats.	–	✓	✓	✓	**May occur:** numerous existing records in proximity to survey area; suitable habitat may be present in the survey area (NR 6 km S).	**Unlikely to occur:** no particularly suitable habitat present, and species not recorded during current survey.
Ptilotus mollis	Shrub, to 0.5 m, growing on stony hills and screes.	–	✓	–	–	**Unlikely to occur:** species is linked to a specific habitat that is absent from the survey area (NR 36 km NE).	**Would not occur:** no suitable habitat.

† Based on information from WA Herbarium (2023) unless otherwise referenced.

Appendix 4

Likelihood of Significant Fauna Occurring in the Survey Area

Species Name	Common Name	Status †		Preferred Habitat	Habitat Available	Records and Comments	Likelihood of Occurrence in Survey Area
		State	Federal				
MAMMALS							
Anthechinomys longicaudata[4]	Long-tailed Dunnart	P4	-	Arid and rugged, rocky scree areas, including scree slopes, boulder and stony plateaus and adjacent stony plains with shrubs over spinifex hummock grassland	No	2 records, closest 35 km north.	Unlikely to occur.
Dasycercus blythi	Brush-tailed Mulgara	P4	-	Sandy soils covered with spinifex grassland, with an overstorey of low shrubs.	No	3 records, closest 29 km south.	Unlikely to occur.
Dasyurus hallucatus	Northern Quoll	EN	EN	Core habitat: gorges, gullies, free faces, breakaways, boulder piles, incised hills. Secondary habitat: permanent and semi-permanent water, drainage systems.	Yes (secondary)	9 records, closest 21 km north-west.	May occur (transient).
Macrotis lagotis	Bilby	VU	VU	Sandy soils covered with spinifex grassland, with an overstorey of low shrubs dominated by *Acacia* species.	No	21 records within 40 km, closest record 21 km south-east.	Unlikely to occur.
Leggadina lakedownensis	Short-tailed Mouse, Lakeland Downs Mouse, kerakenga	P4	-	Open tussock and hummock grassland, *Acacia* shrubland and savannah woodland; on sandy soils and particularly on cracking clays.	Yes	4 records, two records within 500m.	Likely to occur.
Pseudomys chapmani	Western Pebble-mound Mouse, ngadji	P4	-	Stony hillsides with hummock grasslands.	No	50 records, closest 10 km north-west.	Unlikely to occur
Rhinonicteris aurantia (Pilbara form)	Pilbara Leaf-nosed Bat	VU	VU	Semi-desert adapted. Critical habitat: caves or mine adits with stable, very hot and very humid microclimates. Supporting foraging habitat: *Triodia* hummock grassland, sparse tree and shrub savannah, and riparian vegetation along drainage lines.	Yes (secondary)	Nil records, EPBC PMST only.	May occur (foraging visitor).

4 Formerly *Sminthopsis longicaudata*

Species Name	Common Name	Status †		Preferred Habitat	Habitat Available	Records and Comments	Likelihood of Occurrence in Survey Area
		State	Federal				
Macroderma gigas	Ghost Bat	VU	VU	Range of habitats that provide suitable caves for roost sites, Core habitat: gorges, gullies, free faces, incised hills. Secondary habitat: drainage systems, alluvial plains, and floodplains.	Yes (secondary)	5 records, closest 15.5 km east.	May occur (foraging visitor).
BIRDS							
Apus pacificus	Pacific Swift	MI	MI	Entirely aerial when in Australia.	Yes	1 record, 27 km south-east.	Likely to occur (aerial foraging visitor).
Charadrius veredus	Oriental Plover	MI	MI	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.	Yes (secondary)	2 records, closest 9 km south.	May occur (foraging visitor).
Rostratula australis	Australian Painted Snipe	EN	EN	Shallow, terrestrial freshwater wetlands (temporary and permanent lakes, swamps, claypans), inundated grassland or saltmarsh and dams. Often include tussocks of grass, sedges, rushes or reeds, or samphire. Breeding: shallow wetlands with areas of bare wet mud and both upper and canopy cover.	No	2 records, closest 33 km south.	Unlikely to occur.
Calidris acuminata	Sharp-tailed Sandpiper	MI	MI	Shallow freshwater and estuarine wetlands or wetland margins; less commonly coastal mudflats.	No	1 record, 9 km south.	Unlikely to occur.
Calidris ferruginea	Curlew Sandpiper	CR	CR; MI	Utilise a range of marine and freshwater wetland habitats including tidal mudflats, beaches, estuaries, sewage ponds, dams, salt lakes, creeks and freshwater wetlands.	No	Nil records, EPBC PMST only.	Unlikely to occur.

Species Name	Common Name	Status †		Preferred Habitat	Habitat Available	Records and Comments	Likelihood of Occurrence in Survey Area
		State	Federal				
Calidris ruficollis	Red-necked Stint	MI	MI	Muddy margins of saline, brackish and freshwater areas, including tidal mudflats, muddy fringes of freshwater wetlands, less commonly on sandy beaches.	No	2 records, closest 17.3 km south-east	Unlikely to occur.
Calidris melanotos	Pectoral Sandpiper	MI	MI	Shallow freshwater wetlands or wetland margins; less commonly estuarine and coastal mudflats.	No	Nil records, EPBC PMST only.	Unlikely to occur.
Actitis hypoleucos	Common Sandpiper	MI	MI/MA	Typically, narrow steep shorelines, mangrove lined creeks, avoids flat habitats.	No	1 record, 17.3 km south-east.	Unlikely to occur.
Tringa stagnatilis	Marsh Sandpiper	MI	MI	Shallows and margins freshwater wetlands, intertidal mudflats.	No	1 record, 9 km south.	Unlikely to occur.
Tringa glareola	Wood Sandpiper	MI	MI	Freshwater wetlands and sewage treatment works.	No	3 records, closest 17.3 km south-east.	Unlikely to occur.
Tringa nebularia	Common Greenshank	MI	MI	Mudflats, margins of fresh and saline wetlands.	No	3 records, closest 9 km south.	Unlikely to occur.
Gelochelidon nilotica	Gull-billed Tern spp.	MI	MI	Coastlines and estuaries, esp. with tidal flats, larger permanent and ephemeral wetlands inland, open plains (sometimes far from water).	No	6 records, closest 9 km south.	Unlikely to occur.
Hydroprogne caspia	Caspian Tern	MI	MI	Sheltered coasts, estuaries and large inland wetlands.	No	1 record, 17 km south-east.	Unlikely to occur.
Plegadis falcinellus	Glossy Ibis	MI	MI	Freshwater wetlands and floodplains; requires shallow water and mudflats, so is found in well-vegetated wetland, floodplains, mangroves and rice fields.	No	1 record, 17 km south-east. Limited potentially suitable habitat within the survey area and the species is infrequently recorded in the locality.	Unlikely to occur.
Erythrotriorchis radiatus	Red Goshawk	VU	EN	Open forest and woodland, especially along streams.	No	Nil records, EPBC PMST only. Scattered locations in Kimberley, some dispersal into Pilbara has been recorded.	Unlikely to occur.
Falco hypoleucos	Grey Falcon	VU	VU	Favours lightly wooded and untimbered lowland plains that are crossed by major watercourses lined with taller trees, or isolated man-made structures such as communications towers.	Yes	6 records, closest 9 km south.	Likely to occur (foraging visitor).

Species Name	Common Name	Status †		Preferred Habitat	Habitat Available	Records and Comments	Likelihood of Occurrence in Survey Area
		State	Federal				
Falco peregrinus	Peregrine Falcon	OS	-	Wide range of habitats including forest, woodlands, wetlands and open country.	Yes	7 records, closest 14.2 km north-west.	Likely to occur (foraging visitor).
Polytelis alexandrae	Princess Parrot	P4	VU	Core distribution Great Sandy Desert; records scattered across much of arid W and central Aus. Spreads into non-core areas following good rains. Mostly sand dune country with scattered trees and good cover of shrubs and *Triodia*, also in stands of Mulga and *Casuarina*.	No	None, EPBC PMST only.	Would not occur.
Pezoporus occidentalis	Night Parrot	CR	EN	Arid or semi-arid spinifex grasslands with large, established and unburnt hummocks, usually in association with palaeodrainage/drainage areas, salt lakes or rocky breakaways. Foraging habitat includes high productivity grassland areas, and shrublands of samphire, bluebush and saltbush.	Possible (secondary)	EPBC PMST only. Areas of large mature spinifex are patchy and halophytic vegetation largely absent. Recorded from Fortescue Marsh area.	Unlikely to occur.
Hirundo rustica	Barn Swallow	MI	MI	Open country with low vegetation, often near man-made structures.	No	None, EPBC PMST only.	Unlikely to occur.
Motacilla tschutschensis[5]	Eastern Yellow Wagtail	MI	MI	Short grasslands and open margins of water bodies, including human-modified environments such as sports fields and sewage ponds.	No	None, EPBC PMST only.	Unlikely to occur.
Motacilla cinerea	Grey Wagtail	MI	MI	In Australia, near running water in disused quarries, sandy, rocky streams in escarpments and rainforest, sewage ponds, ploughed fields and airfields	No	None, EPBC PMST only.	Unlikely to occur.
REPTILES							
Liopholis kintorei	Great Desert Skink	VU	VU	Spinifex grasslands around granite outcrops.	No	None, EPBC PMST only.	Would not occur

[5] Formerly *Motacilla flava*

Species Name	Common Name	Status †		Preferred Habitat	Habitat Available	Records and Comments	Likelihood of Occurrence in Survey Area
		State	Federal				
Anilios ganei	Gane's Blind Snake[1]	P1	-	Poorly known but records from moist gorges/gullies, mulga woodland and rocky screes.	Yes (secondary)	1 record, 37 km south-west.	May occur.
Liasis olivaceus barroni	Pilbara Olive Python	VU	VU	Gorges, escarpments, rocky outcrops and water holes, shelters in caves, beneath boulders, in pools of water and occasionally in trees overhanging water and spinifex grasslands. Associated with ephemeral or permanent water but may also be recorded in rocky habitats some distance from these features. Known to utilise man-made water bodies.	Yes (secondary)	5 records, closest 11.5 km east.	May occur (foraging visitor).

† CR = Critically Endangered; EN = Endangered; VU = Vulnerable; MI = Migratory; MA = Marine; P = Priority; CD = Conservation Dependent; OS = Other Specially Protected.

[1] In the absence of a common name in the WAM fauna checklist, we have used that as per Wilson and Swan (2021).

Appendix 5

Vegetation Structural Classification and Condition Ranking Scale

Vegetation structural classes based on modifications of the vegetation classification system of Specht (1970) by Muir (1977) and Aplin (1979).

Stratum	**Canopy Cover (%)**				
	70-100%	**30-70%**	**10-30%**	**2-10%**	**<2%**
Trees over 30 m	Tall closed forest	Tall open forest	Tall woodland	Tall open woodland	Scattered tall trees
Trees 10-30 m	Closed forest	Open forest	Woodland	Open woodland	Scattered trees
Trees under 10 m	Low closed forest	Low open forest	Low woodland	Low open woodland	Scattered low trees
Shrubs over 2 m	Tall closed scrub	Tall open scrub	Tall shrubland	Tall open shrubland	Scattered tall shrubs
Shrubs 1-2 m	Closed heath	Open heath	Shrubland	Open shrubland	Scattered shrubs
Shrubs under 1 m	Low closed heath	Low open heath	Low shrubland	Low open shrubland	Scattered low shrubs
Hummock grasses	Closed hummock grassland	Hummock grassland	Open hummock grassland	Very open hummock grassland	Scattered hummock grasses
Grasses, Sedges, Herbs	Closed tussock grassland / bunch grassland / sedgeland / herbland	Tussock grassland / bunch grassland / sedgeland / herbland	Open tussock grassland / bunch grassland / sedgeland / herbland	Very open tussock grassland / bunch grassland / sedgeland / herbland	Scattered tussock grasses / bunch grasses / sedges / herbs

Vegetation condition scale taken from EPA (2016), based on scales developed by Keighery (1994) and Trudgen (1988).

Vegetation Condition	South West and Interzone Botanical Provinces	Eremaean and Northern Botanical Provinces
Pristine	Pristine or nearly so, no obvious signs of disturbance or damage caused by human activities since European settlement.	
Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species. Damage to trees caused by fire, the presence of non-aggressive weeds and occasional vehicle tracks.	Pristine or nearly so, no obvious signs of damage caused by human activities since European settlement.
Very Good	Vegetation structure altered, obvious signs of disturbance. Disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.	Some relatively slight signs of damage caused by human activities since European settlement. For example, some signs of damage to tree trunks caused by repeated fire, the presence of some relatively non-aggressive weeds, or occasional vehicle tracks.
Good	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it. Disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.	More obvious signs of damage caused by human activity since European settlement, including some obvious impact on the vegetation structure such as that caused by low levels of grazing or slightly aggressive weeds.
Poor		Still retains basic vegetation structure or ability to regenerate it after very obvious impacts of human activities since European settlement, such as grazing, partial clearing, frequent fires or aggressive weeds.
Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. Disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds at high density, partial clearing, dieback and grazing.	Severely impacted by grazing, very frequent fires, clearing or a combination of these activities. Scope for some regeneration but not to a state approaching good condition without intensive management. Usually with a number of weed species present including very aggressive species.
Completely Degraded	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often described as 'parkland cleared' with the flora comprising weed or crop species with isolated native trees and shrubs.	Areas that are completely or almost completely without native species in the structure of their vegetation; i.e. areas that are cleared or 'parkland cleared' with their flora comprising weed or crop species with isolated native trees or shrubs.

Appendix 6

Flora Raw Site Data

Site CSF01-R

Described by JTRH **Date** 21/05/2023 **Type** Relevé 20x125m

MGA Zone 50 781704 mE, 7517216 mN

Habitat Gentle S-sloping moderate drainage line with washed out steep banks and shallow flowlines flanking each side.

Soil Reddish brown (2.5YR 3/4) clay loam.

Rock Type Ironstone.

Vegetation *Acacia aptaneura, Acacia coriacea* subsp. *pendens* low open forest over *A. tetragonophylla* scattered tall shrubs over **Cenchrus ciliaris, *C. setiger, Themeda triandra* tussock grassland.

Veg Condition Good: **Cenchrus* spp. at high density, cattle tracks and scats.

Fire Age Very long unburnt.

Species	Cover (%)	Height (cm)	Specimen	Notes
Abutilon lepidum	0.1	45	CSFR01-13	
Abutilon sp.	0.1	40	CSFR10-15=	IM; juvenile.
Acacia ? aptaneura	0.1	35	CSFR01-09	IM; juvenile.
Acacia aptaneura	52	600	CSFR01-08	
Acacia coriacea subsp. *pendens*	2.5	550	CSFR01-01	
Acacia pruinocarpa	0.1	70		
Acacia pyrifolia var. *pyrifolia*	0.1	450	CSF-RH-09=	
Acacia synchronicia	0.1	280		
Acacia tetragonophylla	1	300		
Acacia trachycarpa	0.1	190	CSFR01-10	
Alternanthera denticulata	0.1	20	CSFR01-04	
Amyema fitzgeraldii	0.1	350	CSF05-05=	
Aristida contorta	0.1	25		
Atalaya hemiglauca	0.1	350	CSFR10-09=	
Boerhavia repleta	0.1	8	CSFR01-12	
**Cenchrus ciliaris*	22	65		
**Cenchrus setiger*	22	60		
Chrysopogon fallax	0.1	70		
**Citrullus colocynthis*	0.1	5	CSFR03-09=	
Corchorus tridens	0.1	5	CSF05-13=	
Cucumis variabilis	0.1	35		
Dactyloctenium radulans	0.1	5		
**Echinochloa colona*	0.1	20	CSFR01-03	
Ehretia saligna var. *saligna*	0.1	250		
Eragrostis tenellula	0.1	10	CSF05-12=	
Euphorbia sp. *(biconvexa/trigonosperma)*	0.1	8	CSFR01-05	IM; sterile.
Evolvulus alsinoides var. *villosicalyx*	0.1	15	CSF04-04=	
Glycine canescens	0.1	20	CSF02-19=	
Ipomoea muelleri	0.1	10	CSFR03-06=	
Iseilema membranaceum	0.1	5	CSFR01-06	
Jasminum didymum subsp. *lineare*	0.1	200		
**Malvastrum americanum*	0.1	45		
Marsilea exarata	0.1	5	CSF-RH-13=	
Nellica maderaspatensis	0.1	8	CSF10-14=	
Panicum decompositum	0.1	55	CSF05-09=	
Portulaca oleracea/intraterranea	0.1	5	CSFR09-12=	seeds nippled.
Pterocaulon sphacelatum	0.1	55	CSFR01-11	
Ptilotus gomphrenoides	0.1	25	CSFR01-07	
Rhagodia eremaea	0.1	250	CSFR01-15	
Rhynchosia minima	0.1	15	CSF04-05=	

Species	Cover (%)	Height (cm)	Specimen	Notes
Senna artemisioides subsp. *helmsii*	0.1	165	CSFR01-14	
Solanum lasiophyllum	0.1	45	CSF04-23=	
Themeda triandra	12	75	CSFR01-02	
Trianthema triquetrum	0.1	4	CSF02-15=	

Site CSF02

Described by JTRH **Date** 21/05/2023 **Type** Quadrat 50x50m

MGA Zone 50 782533 mE, 7517347 mN

Habitat Hybrid drainage line/stony floodplain with very shallow clay flowlines on margins.

Soil Reddish brown (2.5YR 3/4) clay loam.

Rock Type Ironstone.

Vegetation *Acacia aptaneura* low open forest over *A. tetragonophylla* scattered tall shrubs over *Senna artemisioides* subsp. *oligophylla* (thinly sericeous form MET 15,035), *S. artemisioides* subsp. *helmsii* open shrubland over **Malvastrum americanum, Sida* sp. L (A.M. Ashby 4202) low open shrubland over **Cenchrus ciliaris, *C. setiger, Aristida contorta* (*Enneapogon polyphyllus, Digitaria brownii, Eragrostis xerophila*) tussock grassland.

Veg Condition Good: weeds at high density, cattle tracks and scats, cattle observed.

Fire Age Very long unburnt.

Species	Cover (%)	Height (cm)	Specimen	Notes
Abutilon lepidum	0.1	75	CSF04-22=	Sens. lat.
Abutilon macrum	0.1	80	CSF02-30	
Acacia aptaneura	65	900	CSF02-01	
Acacia tetragonophylla	1.5	400		
Achyranthes aspera	0.1	15		
Alternanthera nana	0.1	20	CSF02-08	
Alysicarpus muelleri	0.1	25	CSF02-21	
Amaranthus undulatus	0.1	30	CSFR10-04=	
Amyema fitzgeraldii	0.1	400	CSF05-05=	
Aristida contorta	10	40		
Aristida latifolia	0.1	65	CSF04-08=	
Arivela viscosa	0.1	35		
**Bidens bipinnata*	0.1	45		N=1
Boerhavia burbidgeana	0.1	5	CSF02-24	
Boerhavia coccinea	0.1	15	CSF02-33	
**Cenchrus ciliaris*	20	65		
**Cenchrus setiger*	20	65		
Chloris pectinata	0.1	30	CSF02-10	
Chrysopogon fallax	0.1	80		
Commelina ensifolia	0.1	8	CSF04-13=	
Corchorus tridens	0.1	10	CSF05-13=	
Cucumis variabilis	0.1	80		
Dichanthium sericeum subsp. *humilius*	0.1	25	CSF05-15=	
Digitaria brownii	1.5	45	CSF02-17	
Digitaria ctenantha	0.1	15	CSF02-18	
Enchylaena tomentosa var. *tomentosa*	0.1	70		
Enneapogon polyphyllus	2	40		
Eragrostis leptocarpa	0.1	45	CSF02-20	
Eragrostis xerophila	1	35	CSF02-27	
Eremophila lanceolata	0.1	35	CSF-RH-08=	
Eremophila latrobei subsp. *filiformis*	0.1	50	CSFR03-23=	
Evolvulus alsinoides var. *villosicalyx*	0.1	30	CSF02-16	
Glycine canescens	0.1	50	CSF02-19	Sens. Lat
Gomphrena kanisii	0.1	15	CSF-RH-06=	
Goodenia nuda	0.1	25	CSF02-11	
Goodenia prostrata	0.1	3	CSF02-31	
Hibiscus sturtii var. *grandiflorus*	0.1	25	CSF02-25	

Species	Cover (%)	Height (cm)	Specimen	Notes
Indigofera linnaei	0.1	20	CSF02-06	
Ipomoea muelleri	0.1	5	CSFR03-06=	
Iseilema membranaceum	0.1	10	CSF02-03	
Jasminum didymum subsp. *lineare*	0.1	80		
Maireana planifolia	0.1	45	CSF02-22	
**Malvastrum americanum*	3	40		
Panicum effusum	0.1	40	CSF02-29	
Portulaca oleracea/intraterranea	0.1	3	CSF02-02	seeds nippled
Portulaca ole				
Portulaca pilosa/filifolia	0.1	35	CSF02-07	sp. Indeterminate
Pterocaulon sphacelatum	0.1	15		
Ptilotus gomphrenoides	0.1	8	CSF05-10=	
Ptilotus obovatus var. *obovatus*	0.1	45		
Rhagodia eremaea	0.1		CSF04-21=	
Rhynchosia minima	0.1	20	CSF04-05=	
Rostellularia adscendens var. *clementii*	0.1	5	CSF02-09	
Sclerolaena cornishiana	0.1	15	CSF02-26	
Sclerolaena costata	0.1	15	CSF02-13	
Senna artemisioides subsp. *helmsii*	1	120	CSF02-04	
Senna artemisioides subsp. *oligophylla* (thinly sericeous form MET 15,035)	1	140	CSF02-32	
Sida fibulifera	0.1	35	CSF02-12	Sens. Lat.
Sida sp. L (A.M. Ashby 4202)	0.5	30	CSF02-05	
Solanum lasiophyllum	0.1	40	CSF02-28	
Sporobolus australasicus	0.1	5		
Trianthema triquetrum	0.1	8	CSF02-15	
Urochloa occidentalis var. *ciliata*	0.1	30	CSFR03-03=	
Zaleya galericulata subsp. *galericulata*	0.1	15	CSF02-14	

Site CSF03-R

Described by JTRH **Date** 19/05/2023 **Type** Relevé 50x50m

MGA Zone 50 783493 mE, 7517319 mN

Habitat Gentle S-sloping moderate drainage line with shallow clay minor flowlines on margins.

Soil Reddish brown (2.5YR 4/4) clay loam.

Rock Type Ironstone.

Vegetation *Acacia aptaneura* low open forest over *A. tetragonophylla* scattered tall shrubs over **Malvastrum americanum*, *Indigofera georgei* scattered shrubs over *Aristida contorta*, *A. latifolia*, *Enneapogon polyphyllus*, **Cenchrus ciliaris* open tussock grassland.

Veg Condition Good: many weed species but at low density, cattle tracks and scats.

Fire Age Very long unburnt.

Species	Cover (%)	Height (cm)	Specimen	Notes
Abutilon lepidum	0.1	90	CSF04-22=	Sens. lat.
Abutilon macrum	0.1	100	CSFR03-12	
Abutilon otocarpum	0.1	25		
Acacia aptaneura	60	700	CSFR03-01	
Acacia synchronicia	0.1	50		
Acacia tetragonophylla	1	400		
Achyranthes aspera	0.1	45		
Alternanthera denticulata	0.1	20	CSFR03-15	
Aristida contorta	7	25		
Aristida latifolia	5	80	CSF04-08=	
**Cenchrus ciliaris*	3	50		
**Cenchrus setiger*	0.1	40		N=40
**Citrullus colocynthis*	0.1	20	CSFR03-09	
Commelina ensifolia	0.1	5	CSF04-13=	
Cymbopogon ambiguus	0.1	85	CSFR03-19	
Enchylaena tomentosa var. *tomentosa*	0.1	50	CSF04-17=	
Enneapogon polyphyllus	4	35	CSFR03-02	
Eremophila latrobei subsp. *filiformis*	0.1	110	CSFR03-23	
Evolvulus alsinoides var. *villosicalyx*	0.1	25	CSFR03-05	
Glycine canescens	0.1	200	CSFR03-18	Sens. lat.
Gomphrena kanisii	0.1	15	CSF-RH-06=	
Hibiscus burtonii	0.1	70		
Indigofera georgei	0.5	40	CSFR03-08	
Ipomoea muelleri	0.1	15	CSF-R03-06	
Maireana villosa	0.1	30	CSF-R03-25	
**Malvastrum americanum*	1	50		
Marsilea exarata	0.1	5	CSFR03-13	
Portulaca oleracea/intraterranea	0.1	5	CSFR03-14	seeds not nippled.
Psydrax latifolia	0.1	60	CSFR03-20	
Psydrax suaveolens	0.1	185	CSFR03-26	
Pterocaulon sphacelatum	0.1	35	CSFR03-07	
Rhagodia eremaea	0.1	100	CSF04-21=	
Rhynchosia minima	0.1	70	CSF04-05=	
Rostellularia adscendens var. clementii	0.1	20	CSFR03-04	
Sclerolaena cornishiana	0.1	45	CSF04-19=	
Senna artemisioides subsp. *oligophylla* (thinly sericeous form MET 15,035)	0.1	90	CSFR03-11	
Sida aff. *fibulifera* (glabrous mericarps)	0.1	25	CSF04-07=	PLdK det.

Species	Cover (%)	Height (cm)	Specimen	Notes
Sida ectogama	0.1	140	CSFR03-24	
Sida sp. L (A.M. Ashby 4202)	0.1	25	CSFR03-21	
Solanum horridum	0.1	20	CSFR03-10	
Solanum lasiophyllum	0.1	35	CSF04-23=	
Sporobolus australasicus	0.1	10		
Stenopetalum nutans	0.1	30	CSFR03-27	
Streptoglossa sp.	0.1	35	CSFR03-17	IM; Sterile.
Urochloa occidentalis var. *ciliata*	0.1	20	CSFR03-03	
**Vachellia farnesiana*	0.1	35		Seedling.
Waltheria indica	0.1	40	CSFR03-22	

Site CSF04

Described by JTRH **Date** 19/05/2023 **Type** Quadrat 50x50m

MGA Zone 50 784298 mE, 7517434 mN

Habitat Stony floodplain with discrete areas of minor clay depressions.

Soil Reddish brown (2.5YR 4/4) clay loam.

Rock Type Ironstone.

Vegetation *Acacia aptaneura* low open woodland over *A. tetragonophylla*, *Senna glutinosa* subsp. x *luerssenii* scattered tall shrubs over *Eremophila cuneifolia*, *Senna artemisioides* subsp. *oligophylla* (thinly sericeous form MET 15,035), *S. artemisioides* subsp. *oligophylla*, *Acacia synchronicia* shrubland over *Sida* aff. *fibulifera* (glabrous mericarps) scattered low shrubs over *Aristida latifolia*, (*Eragrostis xerophila*, *Aristida contorta*) very open tussock grassland.

Veg Condition Very Good: two weed species present at low density, dusty veg from access track/road.

Fire Age Very long unburnt.

Species	Cover (%)	Height (cm)	Specimen	Notes
Abutilon lepidum	0.1	15	CSF04-22	Sens. lat.
Acacia aptaneura	4	450	CSF04-11	
Acacia synchronicia	2.5	135	CSF04-14	
Acacia tetragonophylla	1	280		
Aristida contorta	1	15		
Aristida latifolia	6	45	CSF04-08	
**Cenchrus ciliaris*	0.1	30		N=2
Commelina ensifolia	0.1	10	CSF04-13	
Crotalaria dissitiflora subsp. *benthamiana*	0.1	30	CSF04-12	
Enchylaena tomentosa var. *tomentosa*	0.1	70	CSF04-17	
Eragrostis xerophila	0.1	25	CSF04-16	
Eremophila cuneifolia	8	150	CSF04-01	
Eriachne pulchella subsp. *pulchella*	0.1	5		
Evolvulus alsinoides var. *villosicalyx*	0.1	15	CSF04-04	
Hibiscus brachysiphonius	0.1	10	CSF04-24	
**Malvastrum americanum*	0.1	20		N=1
Neptunia scutata	0.1	20	CSF04-15	
Ptilotus exaltatus	0.1	5		
Rhagodia eremaea	0.1	75	CSF04-18	
Rhynchosia minima	0.1	35	CSF04-05	
Salsola australis	0.1	35		
Sclerolaena cornishiana	0.1	10	CSF04-19	
Senna artemisioides subsp. *oligophylla*	7	120	CSF04-10	
Senna artemisioides subsp. *oligophylla* (thinly sericeous form MET 15,035)	7	110	CSF04-03	
Senna glutinosa subsp. x *luerssenii*	0.5	210	CSF04-02	
Senna sp. Karijini (M.E. Trudgen 10392)	0.1	100	CSF04-09	
Sida aff. *fibulifera (*glabrous mericarps)	0.5	20	CSF04-07	PLdK det.
Solanum lasiophyllum	0.1	30	CSF04-23	
Tephrosia ? sp. clay soils (S. van Leeuwen et al. PBS 0273)	0.1	20	CSF04-06	IM; Sterile.
**Vachellia farnesiana*	0.1	150		

Site CSF05

Described by JTRH **Date** 20/05/2023 **Type** Quadrat 50x50m

MGA Zone 50 782726 mE, 7517241 mN

Habitat Stony floodplain with discrete areas of minor clay depressions.

Soil Reddish brown (2.5YR 4/4) clay loam.

Rock Type Ironstone.

Vegetation *Acacia aptaneura* low open woodland over *Senna artemisioides* subsp. *oligophylla* (thinly sericeous form MET 15,035), *Eremophila cuneifolia, Acacia synchronicia, A. tetragonophylla* open shrubland over *Aristida latifolia, A. contorta, *Cenchrus setiger, *C. ciliaris, Eragrostis xerophila* open tussock grassland over *Sclerolaena cornishiana* scattered herbs.

Veg Condition Good: **Cenchrus* spp. at 10% cover, **Malvastrum* present under shady spots.

Fire Age Very long unburnt.

Species	Cover (%)	Height (cm)	Specimen	Notes
Abutilon lepidum	0.1	55	CSF05-18	
Abutilon macrum	0.1	25	CSFR03-12=	
Acacia aptaneura	8	450	CSF05-06	
Acacia synchronicia	1	150		
Acacia tetragonophylla	0.5	140		
Alternanthera denticulata	0.1	2	CSF05-17	
Amyema fitzgeraldii	0.1	300	CSF05-05	
Aristida contorta	5	25		
Aristida latifolia	9	65	CSF05-02	
**Cenchrus ciliaris*	5	40		
**Cenchrus setiger*	5	35		
Centipeda minima subsp. *macrocephala*	0.1	10	CSF05-11	
Chrysopogon fallax	0.1	60		
Commelina ensifolia	0.1	5	CSF04-13=	
Corchorus tridens	0.1	2	CSF05-13	
Dactyloctenium radulans	0.1	3		
Dichanthium sericeum subsp. *humilius*	0.1	20	CSF05-15	
Enneapogon polyphyllus	0.1	30		
Eragrostis leptocarpa	0.1	30	CSF05-16	
Eragrostis tenellula	0.1	10	CSF05-12	
Eragrostis xerophila	1	45	CSF-JT-02=	
Eremophila cuneifolia	1	120	CSF04-01=	
Eremophila latrobei subsp. *filiformis*	0.1	100	CSFR03-23=	
Evolvulus alsinoides var. *villosicalyx*	0.1	8	CSF04-04=	
Gomphrena kanisii	0.1	25	CSF-RH-06=	
Hibiscus sturtii var. *grandiflorus*	0.1	35	CSF05-08	
Iseilema vaginiflorum	0.1	5	CSF05-14	
**Malvastrum americanum*	0.1	45		N=8
Neptunia scutata	0.1	15	CSF05-19	
Panicum decompositum	0.1	65	CSF05-09	
Portulaca oleracea/intraterranea	0.1	4	CSF05-21	seeds nippled.
Portulaca pilosa/filifolia	0.1	15	CSF05-22	Indeterminate
Pterocaulon sphacelatum	0.1	40		
Ptilotus gomphrenoides	0.1	15	CSF05-10	
Rhagodia eremaea	0.1	80	CSF05-07	
Rhynchosia minima	0.1	20	CSF04-05=	
Salsola australis	0.1	20		
Sclerolaena cornishiana	0.5	20	CSF04-19=	

Species	Cover (%)	Height (cm)	Specimen	Notes
Sclerolaena costata	0.1	20	CSF05-03	
Sclerolaena densiflora	0.1	10	CSF05-01	Sens. Lat.
Senna artemisioides subsp. *helmsii*	0.1	90	CSF05-23	
Senna artemisioides subsp. *oligophylla* (thinly sericeous form MET 15,035)	5	110	CSF05-04	
Sida aff. *fibulifera* (glabrous mericarps)	0.1	25	CSF05-20	PLdK det.
Sporobolus australasicus	0.1	5		
Urochloa occidentalis var. *ciliata*	0.1	8	CSFR03-03=	

Site CSF06

Described by JTRH **Date** 22/05/2023 **Type** Quadrat 50x50m

MGA Zone 50 783066 mE, 7518825 mN

Habitat Stony floodplain with discrete areas of minor clay depressions.

Soil Reddish brown (2.5YR 4/4) sandy clay loam.

Rock Type Ironstone.

Vegetation *Acacia aptaneura* low open woodland over *A. synchronicia* scattered tall shrubs over *Senna artemisioides* subsp. *helmsii*, *Sida* aff. *fibulifera* (glabrous mericarps) low open shrubland over *Aristida latifolia, Chrysopogon fallax, Aristida contorta, Eragrostis xerophila, Enneapogon polyphyllus, *Cenchrus ciliaris* very open tussock grassland over *Sclerolaena cornishiana* scattered herbs.

Veg Condition Very Good: weeds at low density; cattle scats; rabbit scats.

Fire Age Very long unburnt.

Species	Cover (%)	Height (cm)	Specimen	Notes
Abutilon lepidum	0.1	15	CSF06-04	
Abutilon macrum	0.1	55	CSFR03-12=	
Acacia aptaneura	6	420	CSF06-01	
Acacia synchronicia	1.5	380		
Acacia tetragonophylla	0.1	120		
Aristida contorta	1	20		
Aristida latifolia	3	100	CSF04-08=	
**Cenchrus ciliaris*	0.5	60		
**Cenchrus setiger*	0.1	50		
Cheilanthes sieberi subsp. *sieberi*	0.1	20	CSF06-02	
Chrysopogon fallax	2	90		
Commelina ensifolia	0.1	5	CSF04-13=	
Dactyloctenium radulans	0.1	3	CSF08-14=	
Dichanthium sericeum subsp. *humilius*	0.1	20	CSF05-15=	
Digitaria brownii	0.1	50	CSF02-17=	
Enneapogon polyphyllus	0.5	20		
Eragrostis xerophila	1	30	CSF-JT-02=	
Eremophila cuneifolia	0.1	90	CSF04-01=	
Eremophila latrobei subsp. filiformis	0.1	60	CSF-RH-22=	
Evolvulus alsinoides var. *villosicalyx*	0.1	15	CSF06-13	
Gomphrena kanisii	0.1	15	CSF-RH-06=	
Goodenia prostrata	0.1	5	CSF02-31=	
Hibiscus burtonii	0.1	60	CSF-JT-04=	
Hibiscus sturtii var. *grandiflorus*	0.1	35	CSF06-05	
Indigofera georgei	0.1	70	CSF06-14	
Iseilema vaginiflorum	0.1	5	CSF06-03	
Jasminum didymum subsp. *lineare*	0.1	200		
Maireana planifolia x *villosa*	0.1	80	CSF06-15=	
**Malvastrum americanum*	0.1	40		N=10
Nellica maderaspatensis	0.1	20	CSF06-11	
Panicum decompositum	0.1	35	CSF05-09=	
Portulaca oleracea/intraterranea	0.1	4	CSF05-21=	seeds nippled.
Portulaca pilosa/filifolia	0.1	30	CSF05-22=	Indeterminate
Psydrax latifolia	0.1	250	CSF-RH-12=	
Psydrax ? rigidula	0.1	30	CSF06-12	IM; Juvenile
Ptilotus exaltatus	0.1	5		
Ptilotus helipteroides	0.1	35	CSF06-07	
Rhagodia eremaea	0.1	250	CSF04-21=	

Species	Cover (%)	Height (cm)	Specimen	Notes
Rhynchosia minima	0.1	30	CSF04-05=	
Salsola australis	0.1	10		
Sclerolaena cornishiana	0.5	30	CSF04-19=	
Sclerolaena densiflora	0.1	8	CSF05-01=	
Senna artemisioides subsp. *helmsii*	2	60	CSF06-06	
Senna artemisioides subsp. oligophylla (thinly sericeous form MET 15,035)	0.1	60	CSF06-10	
Senna glutinosa subsp. x *luerssenii*	0.1	80	CSF06-08	
Sida aff. *fibulifera* (glabrous mericarps)	0.5	15	CSF04-07=	PLdK Det.
Solanum lasiophyllum	0.1	25	CSF04-23=	
Sporobolus australasicus	0.1	15		
Trianthema triquetrum	0.1	5	CSF08-07=	
Tripogonella loliiformis	0.1	2	CSF08-18=	
Urochloa occidentalis var. *ciliata*	0.1	8	CSFR03-03=	

Site CSF07

Described by JTRH **Date** 22/05/2023 **Type** Quadrat 50x50m

MGA Zone 50 782260 mE, 7518269 mN

Habitat Stony floodplain with minor areas of shallow flowlines and depressions.

Soil Reddish brown (2.5YR 3/3) sandy clay loam.

Rock Type Ironstone.

Vegetation *Acacia aptaneura* scattered low trees over *A. synchronicia* scattered tall shrubs over *A. tetragonophylla* scattered shrubs over *Enneapogon polyphyllus, Aristida contorta, Eragrostis xerophila* scattered tussock grasses.

Veg Condition Very Good: cattle tracks and scats.

Fire Age Very long unburnt.

Species	Cover	Height	Specimen	Notes
Abutilon ? sp. Dioicum (A.A. Mitchell PRP 1618)	0.1	3	CSF07-03	IM; Juvenile
Acacia aptaneura	1.5	480	CSF07-01	
Acacia synchronicia	0.5	240		
Acacia tetragonophylla	0.5	120		
Aristida contorta	0.5	20		
Arivela viscosa	0.1	20		
Chloris pectinata	0.1	25	CSF07-05	
Cynodon prostratus	0.1	4	CSF07-04	
Dactyloctenium radulans	0.1	5		
Enneapogon polyphyllus	0.5	20		
Eragrostis xerophila	0.5	40	CSF-JT-02=	
Evolvulus alsinoides var. *villosicalyx*	0.1	20	CSF04-04=	
Gomphrena kanisii	0.1	12	CSF-RH-06=	
Portulaca conspicua	0.1	2	CSF08-06=	
Portulaca oleracea/intraterranea	0.1	5	CSFR03-14=	seeds not nippled
Portulaca pilosa/filifolia	0.1	10	CSF05-22=	Indeterminate
Ptilotus aervoides	0.1	3	CSF08-16=	
Ptilotus gomphrenoides	0.1	5	CSF05-10=	
Rhagodia eremaea	0.1	65	CSFR01-15=	
Salsola australis	0.1	8		
Sclerolaena cornishiana	0.1	25	CSF04-19=	
Sclerolaena costata	0.1	10	CSF05-03=	
Senna artemisioides subsp. *helmsii*	0.1	80	CSF07-07	
Sida aff. *fibulifera* (glabrous mericarps)	0.1	15	CSF07-02	
Sporobolus australasicus	0.1	10		
Trianthema triquetrum	0.1	10	CSF08-07=	
**Tribulus terrestris*	0.1	2	CSF07-06	

Site CSF08

Described by JTRH **Date** 21/05/2023 **Type** Quadrat 50x50m

MGA Zone 50 782339 mE, 7517602 mN

Habitat Stony floodplain with minor areas of very shallow flowlines and depressions.

Soil Reddish brown (2.5YR 4/4) sandy clay.

Rock Type Ironstone.

Vegetation *Acacia aptaneura* low open woodland over *A. pruinocarpa, A. synchronicia* scattered tall shrubs *over A. tetragonophylla* scattered shrubs over *Aristida contorta, Enneapogon polyphyllus, Eragrostis xerophila* very open tussock grassland *over Sclerolaena cornishiana, S. costata* scattered herbs.

Veg Condition Very Good: weeds at low density, cattle scats next to vehicle track.

Fire Age Very long unburnt.

Species	Cover (%)	Height (cm)	Specimen	Notes
Acacia aptaneura	2	350	CSF08-01	
Acacia pruinocarpa	0.5	300		
Acacia synchronicia	0.5	260		
Acacia tetragonophylla	0.5	160		
Aristida contorta	1	10		
Aristida latifolia	0.1	45	CSF04-08=	
**Cenchrus ciliaris*	0.1	60		
Chloris pectinata	0.1	25	CSF08-04	
Corchorus tridens	0.1	5	CSF05-13=	
Cynodon convergens	0.1	15	CSF08-03	
Dactyloctenium radulans	0.1	3		
Enchylaena tomentosa var. *tomentosa*	0.1	40		
Enneapogon caerulescens	0.1	15	CSF08-11	
Enneapogon polyphyllus	0.5	30		
Eragrostis leptocarpa	0.1	50	CSF08-05	
Eragrostis xerophila	0.5	35	CSF08-02	
Eremophila lanceolata	0.1	30	CSF-RH-08=	
Evolvulus alsinoides var. *villosicalyx*	0.1	6	CSF04-04=	
Gomphrena kanisii	0.1	10	CSF-RH-06=	
Goodenia prostrata	0.1	3	CSF02-31=	
Maireana planifolia	0.1	50	CSF08-15	
Polygala glaucifolia	0.1	5	CSF08-14	
Portulaca conspicua	0.1	3	CSF08-06	
Portulaca oleracea/intraterranea	0.1	5	CSFR03-14=	seeds not nippled
Portulaca pilosa/filifolia	0.1	5	CSF05-22=	Indeterminate
Ptilotus aervoides	0.1	3	CSF08-16	
Ptilotus gomphrenoides	0.1	10	CSF05-10=	
Salsola australis	0.1	10		
Sclerolaena cornishiana	0.5	25	CSF04-19=	
Sclerolaena costata	0.5	10	CSF05-03=	
Sclerolaena cuneata	0.1	15	CSF08-08	
Sclerolaena densiflora	0.1	20	CSF08-13	
Senna artemisioides subsp. *helmsii*	0.1	65	CSF08-09	
Senna artemisioides subsp. *oligophylla* (thinly sericeous form MET 15,035)	0.1	55	CSF08-17	
Sida fibulifera	0.1	15	CSF08-12	Sens. Lat
Solanum horridum	0.1	20	CSF08-10	
Sporobolus australasicus	0.1	5		
Trianthema triquetrum	0.1	5	CSF08-07	

Species	Cover (%)	Height (cm)	Specimen	Notes
Tripogonella loliiformis	0.1	30	CSF08-18	

Site CSF09-R

Described by JTRH **Date** 21/05/2023 **Type** Relevé 20x125m

MGA Zone 50 781638 mE, 7517437 mN

Habitat Stony floodplain with minor areas of very shallow flowlines and depressions.

Soil Reddish brown (2.5YR 4/6) sandy clay loam.

Rock Type Ironstone.

Vegetation *Acacia aptaneura* scattered low trees over *A. synchronicia* scattered tall shrubs over *Aristida contorta, Enneapogon polyphyllus, *Cenchrus ciliaris* scattered tussock grasses *over Sclerolaena costata* scattered herbs.

Veg Condition Very Good: **Cenchrus* at low density, cattle scats.

Fire Age Very long unburnt.

Species	Cover (%)	Height (cm)	Specimen	Notes
Acacia aptaneura	1.5	320	CSFR09-07	
Acacia coriacea subsp. *pendens*	0.1	200	CSFR09-11	
Acacia pruinocarpa	0.1	220		
Acacia synchronicia	1	200		
Acacia tetragonophylla	0.1	160		
Aristida contorta	0.5	30		
Aristida latifolia	0.1	60	CSF05-02=	
**Cenchrus ciliaris*	0.5	55		
**Cenchrus setiger*	0.1	55		
Chloris pectinata	0.1	8	CSF02-10=	
Dactyloctenium radulans	0.1	10		
Enneapogon caerulescens	0.1	10	CSFR09-09	
Enneapogon polyphyllus	0.5	20		
Enteropogon ramosus	0.1	25	CSF11-03=	
Eragrostis setifolia	0.1	40	CSFR09-10	
Eragrostis xerophila	0.1	25	CSFR09-08	
Eremophila cuneifolia	0.1	45	CSF04-01=	
Eremophila lanceolata	0.1	15	CSF-RH-08=	
Evolvulus alsinoides var. *villosicalyx*	0.1	8	CSF04-04=	
Gomphrena kanisii	0.1	10	CSF-RH-06=	
Hakea lorea subsp. *lorea*	0.1	172	CSFR09-05	
Hibiscus sturtii var. *grandiflorus*	0.1	25	CSF05-08=	
Neptunia scutata	0.1	8	CSF05-19=	
Portulaca oleracea/intraterranea	0.1	3	CSFR09-12	
Rhynchosia minima	0.1	5	CSF04-05=	
Salsola australis	0.1	5		
Sclerolaena cornishiana	0.1	10	CSFR09-04	
Sclerolaena costata	0.5	10	CSF05-03=	
Sclerolaena densiflora	0.1	10	CSFR09-02	
Senna artemisioides subsp. *helmsii*	0.1	65	CSFR09-03	
Senna artemisioides subsp. *oligophylla* (thinly sericeous form MET 15,035)	0.1	45	CSFR09-01	
Sida fibulifera	0.1	25	CSFR09-06	Sens. lat.
Trianthema triquetrum	0.1	2	CSF02-15=	

Site CSF10-R

Described by JTRH **Date** 20/05/2023 **Type** Relevé 20x125m

MGA Zone 50 782200 mE, 7517169 mN

Habitat Major ephemeral drainage line.

Soil Reddish brown (2.5YR 4/4) sandy clay loam.

Rock Type Ironstone.

Vegetation *Eucalyptus victrix, Acacia coriacea* subsp. *pendens, Atalaya hemiglauca, Acacia aptaneura, Ehretia saligna* var. *saligna* low woodland over *Acacia tetragonophylla* scattered low shrubs over **Cenchrus ciliaris, *C. setiger* tussock grassland.

Veg Condition Good: High **Cenchrus* cover on banks.

Fire Age Very long unburnt.

Species	Cover (%)	Height (cm)	Specimen	Notes
Abutilon lepidum	0.1	50	CSF04-22=	Sens. lat.
Abutilon sp.	0.1	5	CSFR10-15	Sterile; IM.
Acacia aptaneura	2	650	CSFR10-07	
Acacia coriacea subsp. *pendens*	7	700	CSFR10-03	
Acacia pyrifolia var. *pyrifolia*	0.1	50	CSF-RH-09=	
Acacia tetragonophylla	1	40		
Achyranthes aspera	0.1	70		
Alternanthera denticulata	0.1	10	CSFR10-16	
Alternanthera nana	0.1	5	CSFR10-12	
Amaranthus undulatus	0.1	25	CSFR10-04	
Amyema fitzgeraldii	0.1	400	CSF-RH-07=	
Arivela viscosa	0.1	35		
Atalaya hemiglauca	3	350	CSFR10-09	
**Cenchrus ciliaris*	16	60		
**Cenchrus setiger*	16	60		
**Citrullus colocynthis*	0.1	30	CSFR03-09=	
Crotalaria medicaginea var. *neglecta*	0.1	25	CSFR10-21	
Cucumis melo	0.1	50	CSFR10-13	
Cucumis variabilis	0.1	50		
Dactyloctenium radulans	0.1	2		
Dichanthium fecundum	0.1	75	CSFR10-08	
Ehretia saligna var. *saligna*	1	450	CSFR10-02	
Enneapogon caerulescens	0.1	25	CSFR10-18	
Enneapogon polyphyllus	0.1	25		
Eucalyptus victrix	14	850	CSFR10-01	
Euphorbia australis var. *subtomentosa*	0.1	5	CSFR10-05	
Euphorbia biconvexa	0.1	10	CSFR10-10	
Ipomoea muelleri	0.1	5	CSFR03-06=	
Jasminum didymum subsp. *lineare*	0.1	70		
**Malvastrum americanum*	0.1	35		N=11
Nellica maderaspatensis	0.1	20	CSFR10-14	
Petalostylis labicheoides	0.1	70	CSFR10-06	
Pluchea dentex	0.1	20	CSFR10-17	
Ptilotus exaltatus	0.1	40		
Rostellularia adscendens var. *clementii*	0.1	10	CSFR10-20	
Sesbania cannabina	0.1	50	CSFR10-19	
Sporobolus australasicus	0.1	10		

Site CSF11

Described by JTRH **Date** 20/05/2023 **Type** Quadrat 50x50m

MGA Zone 50 782862 mE, 7517277mN

Habitat Gentle S-sloping stony gibber floodplain.

Soil Reddish brown (2.5YR 3/4) clay loam.

Rock Type Ironstone.

Vegetation *Acacia xiphophylla* low open woodland over *Senna artemisioides* subsp. *oligophylla* (thinly sericeous form MET 15,035) open shrubland over *Eremophila cuneifolia* scattered low shrubs over *Enteropogon ramosus*, *Aristida contorta* scattered tussock grasses over *Sclerolaena cornishiana* scattered herbs.

Veg Condition Excellent: some cattle scats, no weeds.

Fire Age Very long unburnt.

Species	Cover (%)	Height (cm)	Specimen	Notes
Abutilon macrum	0.1	20	CSFR03-12=	
Acacia synchronicia	0.1	105		
Acacia tetragonophylla	0.1	50		
Acacia xiphophylla	11	450		
Aristida contorta	0.5	25		
Aristida latifolia	0.1	45	CSF05-02=	
Enchylaena tomentosa var. *tomentosa*	0.1	45	CSF04-17=	
Enneapogon polyphyllus	0.1	20		
Enteropogon ramosus	1	45	CSF11-03	
Eremophila cuneifolia	0.5	50	CSF04-01=	
Eremophila latrobei subsp. *filiformis*	0.1	60	CSFR03-23=	
Evolvulus alsinoides var. *villosicalyx*	0.1	3	CSF04-04=	
Gomphrena kanisii	0.1	8	CSF11-05	
Hibiscus burtonii	0.1	25		
Hibiscus sturtii var. *grandiflorus*	0.1	20	CSF05-08=	
Ptilotus obovatus var. *obovatus*	0.1	90		
Rhagodia eremaea	0.1	80	CSF05-07=	
Salsola australis	0.1	15		
Sclerolaena cornishiana	1.5	12	CSF11-02	
Sclerolaena costata	0.1	8	CSF05-03=	
Senna artemisioides subsp. *oligophylla* (thinly sericeous form MET 15,035)	2	120	CSF11-01	
Senna glutinosa subsp. x *luerssenii*	0.1	140	CSF11-04	
Sida aff. *fibulifera* (glabrous mericarps)	0.1	25	CSF05-20=	PLdK det.
Trianthema glossostigmum	0.1	2	CSF11-06	

Site CSF12

Described by JTRH **Date** 21/05/2023 **Type** Quadrat 50x50m

MGA Zone 50 783136 mE, 7517062 mN

Habitat Gentle undulating S-sloping stony gibber floodplain.

Soil Reddish brown (2.5YR 4/4) clay loam.

Rock Type Ironstone.

Vegetation *Acacia xiphophylla* low open woodland over *Senna artemisioides* subsp. *oligophylla* (thinly sericeous form MET 15,035), *Eremophila cuneifolia* scattered low shrubs over *Enteropogon ramosus*, *Aristida contorta* scattered tussock grasses over *Sclerolaena cornishiana* scattered herbs.

Veg Condition Very Good: two weed species at low density, cattle scats.

Fire Age Very long unburnt.

Species	Cover (%)	Height (cm)	Specimen	Notes
Acacia synchronicia	0.1	60		
Acacia tetragonophylla	0.1	40		
Acacia xiphophylla	8	400		
Aristida contorta	0.5	30		
Aristida latifolia	0.1	50	CSF05-02=	
**Cenchrus ciliaris*	0.1	40		N=3
Commelina ensifolia	0.1	10	CSF04-13=	
Enchylaena tomentosa var. *tomentosa*	0.1	40	CSF04-17=	
Enneapogon polyphyllus	0.1	20		
Enteropogon ramosus	0.5	45	CSF11-03=	
Eragrostis xerophila	0.1	30	CSF-JT-02=	
Eremophila cuneifolia	0.5	70	CSF04-01=	
Evolvulus alsinoides var. *villosicalyx*	0.1	5	CSF04-04=	
Gomphrena kanisii	0.1	15	CSF11-05=	
Hibiscus sturtii var. *grandiflorus*	0.1	40	CSF05-08=	
**Malvastrum americanum*	0.1	30		N=5
Ptilotus exaltatus	0.1	5		
Rhagodia eremaea	0.1	60	CSF05-07=	
Salsola australis	0.1	20		
Sclerolaena cornishiana	1	25	CSF04-19=	
Sclerolaena costata	0.1	10	CSF05-03=	
Sclerolaena densiflora	0.1	10	CSF12-03	
Senna artemisioides subsp. *oligophylla* (thinly sericeous form MET 15,035)	1	95	CSF12-01	
Senna glutinosa subsp. x *luerssenii*	0.1	65	CSF12-02	
Senna hamersleyensis	0.1	25	CSF12-04	
Sida aff. *fibulifera* (glabrous mericarps)	0.1	10	CSF04-07=	PLdK det.

Appendix 7

List of Vascular Flora Recorded from the Survey Area

† IM = insufficient material for further identification.

Family	Species	Status / Notes †
Acanthaceae	*Dicladanthera forrestii*	
	Rostellularia adscendens var. *clementii*	
Aizoaceae	*Trianthema glossostigmum*	
	Trianthema triquetrum	
	Zaleya galericulata subsp. *galericulata*	
Amaranthaceae	*Achyranthes aspera*	
	**Aerva javanica*	Weed
	Alternanthera denticulata	
	Alternanthera nana	
	Amaranthus undulatus	
	Gomphrena kanisii	
	Ptilotus aervoides	
	Ptilotus exaltatus	
	Ptilotus gaudichaudii	
	Ptilotus gomphrenoides	
	Ptilotus helipteroides	
	Ptilotus obovatus var. *obovatus*	
Asteraceae	**Bidens bipinnata*	Weed
	Centipeda minima subsp. *macrocephala*	
	Pluchea dentex	
	Pterocaulon sphacelatum	
	Streptoglossa bubakii	
	Streptoglossa sp.	IM; sterile.
Boraginaceae	*Ehretia saligna* var. *saligna*	
Brassicaceae	*Stenopetalum nutans*	
Chenopodiaceae	*Enchylaena tomentosa* var. *tomentosa*	
	Maireana planifolia	
	Maireana planifolia x *villosa*	
	Maireana villosa	
	Rhagodia eremaea	
	Salsola australis	
	Sclerolaena cornishiana	
	Sclerolaena costata	
	Sclerolaena cuneata	
	Sclerolaena densiflora	
Cleomaceae	*Arivela viscosa*	
Commelinaceae	*Commelina ensifolia*	
Convolvulaceae	*Evolvulus alsinoides* var. *villosicalyx*	
	Ipomoea coptica	
	Ipomoea muelleri	
Cucurbitaceae	**Citrullus colocynthis*	Weed
	Cucumis melo	
	Cucumis variabilis	
Euphorbiaceae	*Euphorbia australis* var. *subtomentosa*	

Family	Species	Status / Notes †
Euphorbiaceae (cont.)	*Euphorbia biconvexa*	
	Euphorbia sp. (*biconvexa*/ *trigonosperma*; sterile)	IM; sterile.
Fabaceae	*Acacia aptaneura*	
	Acacia ? *aptaneura*	IM; juvenile.
	Acacia coriacea subsp. *pendens*	
	Acacia pruinocarpa	
	Acacia pyrifolia var. *pyrifolia*	
	Acacia synchronicia	
	Acacia tetragonophylla	
	Acacia trachycarpa	
	Acacia xiphophylla	
	Alysicarpus muelleri	
	Crotalaria dissitiflora subsp. *benthamiana*	
	Crotalaria medicaginea var. *neglecta*	
	Glycine canescens	
	Indigofera colutea	
	Indigofera georgei	
	Indigofera linnaei	
	Neptunia scutata	
	Petalostylis labicheoides	
	Rhynchosia minima	
	Senna artemisioides subsp. *helmsii*	
	Senna artemisioides subsp. *oligophylla*	
	Senna artemisioides subsp. *oligophylla* (thinly sericeous form MET 15,035)	
	Senna glutinosa subsp. x *luerssenii*	
	Senna hamersleyensis	
	Senna sp. Karijini (M.E. Trudgen 10392)	
	Sesbania cannabina	
	Tephrosia ? sp. clay soils (S. van Leeuwen et al. PBS 0273)	IM; sterile.
	**Vachellia farnesiana*	Weed
Goodeniaceae	*Goodenia nuda*	
	Goodenia prostrata	
Loranthaceae	*Amyema fitzgeraldii*	
Malvaceae	*Abutilon lepidum*	
	Abutilon macrum	
	Abutilon otocarpum	
	Abutilon ? sp. Dioicum (A.A. Mitchell PRP 1618)	IM; juvenile.
	Abutilon sp.	IM; juvenile.
	Corchorus tridens	
	Hibiscus brachysiphonius	
	Hibiscus burtonii	
	Hibiscus sturtii var. *grandiflorus*	
	**Malvastrum americanum*	Weed
	Sida ectogama	
	Sida fibulifera	

Family	Species	Status / Notes †
Malvaceae (cont.)	*Sida* aff. *fibulifera*	Glabrous mericarps.
	Sida sp. L (A.M. Ashby 4202)	
	Waltheria indica	
Marsileaceae	*Marsilea exarata*	
Myrtaceae	*Eucalyptus victrix*	
Nyctaginaceae	*Boerhavia burbidgeana*	
	Boerhavia coccinea	
	Boerhavia repleta	
Oleaceae	*Jasminum didymum* subsp. *lineare*	
Phyllanthaceae	*Nellica maderaspatensis*	
Poaceae	*Aristida contorta*	
	Aristida latifolia	
	**Cenchrus ciliaris*	Weed
	**Cenchrus setiger*	Weed
	Chloris pectinata	
	Chrysopogon fallax	
	Cymbopogon ambiguus	
	Cynodon convergens	
	Cynodon prostratus	
	Dactyloctenium radulans	
	Dichanthium fecundum	
	Dichanthium sericeum subsp. *humilius*	
	Digitaria brownii	
	Digitaria ctenantha	
	**Echinochloa colona*	Weed
	Enneapogon caerulescens	
	Enneapogon polyphyllus	
	Enteropogon ramosus	
	Eragrostis leptocarpa	
	Eragrostis setifolia	
	Eragrostis tenellula	
	Eragrostis xerophila	
	Eriachne pulchella subsp. *pulchella*	
	Iseilema macratherum	
	Iseilema membranaceum	
	Iseilema vaginiflorum	
	Panicum decompositum	
	Panicum effusum	
	Sporobolus australasicus	
	Themeda triandra	
	Tripogonella loliiformis	
	Urochloa occidentalis var. *ciliata*	
Polygalaceae	*Polygala glaucifolia*	
Portulacaceae	*Portulaca conspicua*	
	Portulaca oleracea/intraterranea	IM; sterile.
	Portulaca pilosa/filifolia	IM; sterile.

Family	Species	Status / Notes †
Proteaceae	*Hakea lorea* subsp. *lorea*	
Pteridaceae	*Cheilanthes sieberi* subsp. *sieberi*	
Rubiaceae	*Psydrax latifolia*	
	Psydrax ? rigidula	IM; juvenile.
	Psydrax suaveolens	
Sapindaceae	*Atalaya hemiglauca*	
	Dodonaea petiolaris	
Scrophulariaceae	*Eremophila cuneifolia*	
	Eremophila forrestii subsp. *forrestii*	
	Eremophila lanceolata	
	Eremophila latrobei subsp. *filiformis*	
Solanaceae	*Solanum horridum*	
	Solanum lasiophyllum	
Zygophyllaceae	**Tribulus terrestris*	Weed

Appendix 8

Introduced Flora Locations

Species	Site	Date	Zone	Easting (mE)	Northing (mN)	No. Individuals / % Cover
**Aerva javanica*	OPP-JT	22-May-23	50S	782862	7518849	N=5
**Bidens bipinnata*	CSF02	21-May-23	50S	782533	7517347	N=1
**Cenchrus ciliaris*	CSF04	19-May-23	50S	784298	7517434	N=2
**Cenchrus ciliaris*	OPP-JT	19-May-23	50S	783992	7517206	N=8
**Cenchrus ciliaris*	OPP-JT	19-May-23	50S	783398	7517064	N=20
**Cenchrus ciliaris*	CSF03-R	19-May-23	50S	783493	7517319	3%
**Cenchrus ciliaris*	OPP-JT	20-May-23	50S	782100	7517106	35%
**Cenchrus ciliaris*	OPP-JT	20-May-23	50S	781984	7517099	65%
**Cenchrus ciliaris*	OPP-JT	20-May-23	50S	781847	7517144	6%
**Cenchrus ciliaris*	CSF05	20-May-23	50S	782726	7517241	5%
**Cenchrus ciliaris*	CSF10-R	20-May-23	50S	782200	7517169	16%
**Cenchrus ciliaris*	OPP-JT	20-May-23	50S	782271	7517138	38%
**Cenchrus ciliaris*	OPP-JT	20-May-23	50S	782331	7517155	7%
**Cenchrus ciliaris*	OPP-JT	20-May-23	50S	782461	7517173	5%
**Cenchrus ciliaris*	OPP-JT	20-May-23	50S	782651	7517096	31%
**Cenchrus ciliaris*	OPP-JT	20-May-23	50S	781610	7517673	4%
**Cenchrus ciliaris*	CSF12	21-May-23	50S	783136	7517062	N=3
**Cenchrus ciliaris*	CSF02	21-May-23	50S	782533	7517347	20%
**Cenchrus ciliaris*	OPP-JT	21-May-23	50S	782571	7517165	50%
**Cenchrus ciliaris*	CSF09-R	21-May-23	50S	781638	7517437	0.5%
**Cenchrus ciliaris*	CSF01-R	21-May-23	50S	781704	7517216	22%
**Cenchrus ciliaris*	OPP-JT	21-May-23	50S	781767	7517303	3%
**Cenchrus ciliaris*	OPP-JT	21-May-23	50S	781710	7517409	50%
**Cenchrus ciliaris*	CSF08	21-May-23	50S	782339	7517602	0.1%
**Cenchrus ciliaris*	OPP-JT	21-May-23	50S	782432	7517592	55%
**Cenchrus ciliaris*	OPP-JT	22-May-23	50S	782248	7518026	25%
**Cenchrus ciliaris*	OPP-JT	22-May-23	50S	782495	7518790	28%
**Cenchrus ciliaris*	OPP-JT	22-May-23	50S	782540	7518742	20%
**Cenchrus ciliaris*	OPP-RH	22-May-23	50S	783276	7518646	33%
**Cenchrus ciliaris*	OPP-JT	22-May-23	50S	783624	7518436	69%
**Cenchrus ciliaris*	OPP-JT	22-May-23	50S	782670	7518896	1.5%
**Cenchrus ciliaris*	CSF06	22-May-23	50S	783066	7518825	0.5%
**Cenchrus ciliaris*	OPP-RH	22-May-23	50S	783408	7518644	1.5%
**Cenchrus ciliaris*	OPP-RH	22-May-23	50S	783517	7518558	65%
**Cenchrus ciliaris*	OPP-JT	22-May-23	50S	782989	7517334	62%
**Cenchrus ciliaris*	OPP-JT	23-May-23	50S	782255	7517035	72%
**Cenchrus ciliaris*	OPP-JT	23-May-23	50S	782097	7517042	64%
**Cenchrus ciliaris*	OPP-JT	23-May-23	50S	781926	7517065	6%
**Cenchrus ciliaris*	OPP-JT	23-May-23	50S	781799	7517060	6%
**Cenchrus ciliaris*	OPP-JT	23-May-23	50S	781843	7517277	6%
**Cenchrus ciliaris*	OPP-JT	23-May-23	50S	781961	7517205	65%
**Cenchrus ciliaris*	OPP-JT	23-May-23	50S	782042	7517193	65%
**Cenchrus ciliaris*	OPP-JT	23-May-23	50S	782138	7517163	65%

Species	Site	Date	Zone	Easting (mE)	Northing (mN)	No. Individuals / % Cover
*Cenchrus ciliaris	OPP-JT	23-May-23	50S	782254	7517160	65%
*Cenchrus ciliaris	OPP-JT	23-May-23	50S	782372	7517443	25%
*Cenchrus setiger	CSF03-R	19-May-23	50S	783493	7517319	N=40
*Cenchrus setiger	CSF05	20-May-23	50S	782726	7517241	5%
*Cenchrus setiger	CSF10-R	20-May-23	50S	782200	7517169	16%
*Cenchrus setiger	CSF02	21-May-23	50S	782533	7517347	20%
*Cenchrus setiger	CSF09-R	21-May-23	50S	781638	7517437	0.1%
*Cenchrus setiger	CSF01-R	21-May-23	50S	781704	7517216	22%
*Cenchrus setiger	CSF06	22-May-23	50S	783066	7518825	0.1%
*Cenchrus setiger	OPP-JT	22-May-23	50S	782981	7517364	2%
*Citrullus colocynthis	CSF03-R	19-May-23	50S	783493	7517319	N=1
*Citrullus colocynthis	CSF10-R	20-May-23	50S	782200	7517169	N=1
*Citrullus colocynthis	CSF01-R	21-May-23	50S	781704	7517216	N=5
*Echinochloa colona	CSF01-R	21-May-23	50S	781704	7517216	N=5
*Malvastrum americanum	CSF04	19-May-23	50S	784298	7517434	N=1
*Malvastrum americanum	OPP-RH	19-May-23	50S	783517	7517040	N=20
*Malvastrum americanum	OPP-JT	19-May-23	50S	783483	7517073	N=30
*Malvastrum americanum	OPP-JT	19-May-23	50S	783410	7517062	N=20
*Malvastrum americanum	OPP-RH	19-May-23	50S	783359	7517286	N=100
*Malvastrum americanum	OPP-RH	19-May-23	50S	783495	7517310	N=100
*Malvastrum americanum	CSF03-R	19-May-23	50S	783493	7517319	1%
*Malvastrum americanum	OPP-RH	20-May-23	50S	782498	7517394	N=100
*Malvastrum americanum	OPP-JT	20-May-23	50S	781887	7517147	N=20
*Malvastrum americanum	CSF05	20-May-23	50S	782726	7517241	N=8
*Malvastrum americanum	CSF10-R	20-May-23	50S	782200	7517169	N=11
*Malvastrum americanum	OPP-JT	20-May-23	50S	782331	7517155	N=30
*Malvastrum americanum	OPP-JT	20-May-23	50S	782444	7517161	5%
*Malvastrum americanum	OPP-JT	20-May-23	50S	782461	7517173	N=45
*Malvastrum americanum	OPP-JT	20-May-23	50S	782541	7517205	N=100
*Malvastrum americanum	OPP-JT	20-May-23	50S	782651	7517096	N=50
*Malvastrum americanum	CSF12	21-May-23	50S	783136	7517062	N=5
*Malvastrum americanum	CSF02	21-May-23	50S	782533	7517347	3%
*Malvastrum americanum	OPP-JT	21-May-23	50S	782571	7517165	N=40
*Malvastrum americanum	OPP-JT	21-May-23	50S	781514	7517729	N=25
*Malvastrum americanum	CSF01-R	21-May-23	50S	781704	7517216	0.1%
*Malvastrum americanum	OPP-JT	21-May-23	50S	782432	7517592	1%
*Malvastrum americanum	OPP-JT	22-May-23	50S	782248	7518026	N=35
*Malvastrum americanum	OPP-JT	22-May-23	50S	782495	7518790	N=20
*Malvastrum americanum	OPP-RH	22-May-23	50S	783276	7518646	N=20
*Malvastrum americanum	CSF06	22-May-23	50S	783066	7518825	N=10
*Malvastrum americanum	OPP-JT	22-May-23	50S	783565	7517683	6%
*Malvastrum americanum	OPP-JT	22-May-23	50S	782989	7517334	3%
*Malvastrum americanum	OPP-JT	22-May-23	50S	782982	7517364	2%

Species	Site	Date	Zone	Easting (mE)	Northing (mN)	No. Individuals / % Cover
**Malvastrum americanum*	OPP-JT	23-May-23	50S	781843	7517277	1%
**Malvastrum americanum*	OPP-JT	23-May-23	50S	782372	7517443	1%
**Tribulus terrestris*	CSF07	22-May-23	50S	782260	7518269	N=1
**Vachellia farnesiana*	OPP-JT	19-May-23	50S	784285	7517500	N=1
**Vachellia farnesiana*	CSF04	19-May-23	50S	784298	7517434	N=1
**Vachellia farnesiana*	OPP-JT	19-May-23	50S	784175	7517233	N=4
**Vachellia farnesiana*	CSF03-R	19-May-23	50S	783493	7517319	N=1
**Vachellia farnesiana*	OPP-JT	20-May-23	50S	782103	7517108	N=1
**Vachellia farnesiana*	OPP-JT	21-May-23	50S	781514	7517729	N=1
**Vachellia farnesiana*	OPP-JT	21-May-23	50S	781509	7517725	N=4
**Vachellia farnesiana*	OPP-JT	21-May-23	50S	781524	7517710	N=2
**Vachellia farnesiana*	OPP-RH	22-May-23	50S	783555	7517622	N=1
**Vachellia farnesiana*	OPP-JT	22-May-23	50S	782982	7517364	N=2
**Vachellia farnesiana*	OPP-JT	22-May-23	50S	782980	7517369	N=5
**Vachellia farnesiana*	OPP-JT	22-May-23	50S	782283	7517054	N=1
**Vachellia farnesiana*	OPP-JT	23-May-23	50S	782119	7517052	N=1

Appendix 9

Selected Inputs and Outputs of the PRIMER Floristic Analysis

Table 1: Rationalised table of species used in the analysis.

Original Taxon	Treated as Following for PRIMER
Cenchrus ciliaris	*Cenchrus* spp.
Cenchrus setiger	*Cenchrus* spp.
Senna artemisioides subsp. *oligophylla* (thinly sericeous form MET 15,035)	*Senna artemisioides* subsp. *oligophylla*
Abutilon ? sp. Dioicum (A.A. Mitchell PRP 1618)	Omitted; singleton
Abutilon otocarpum	Omitted; singleton
Acacia trachycarpa	Omitted; singleton
Alysicarpus muelleri	Omitted; singleton
Boerhavia burbidgeana	Omitted; singleton
Boerhavia coccinea	Omitted; singleton
Boerhavia repleta	Omitted; singleton
Centipeda minima subsp. *macrocephala*	Omitted; singleton
Cheilanthes sieberi subsp. *sieberi*	Omitted; singleton
Crotalaria dissitiflora subsp. *benthamiana*	Omitted; singleton
Crotalaria medicaginea var. *neglecta*	Omitted; singleton
Cucumis melo	Omitted; singleton
Cymbopogon ambiguus	Omitted; singleton
Cynodon convergens	Omitted; singleton
Cynodon prostratus	Omitted; singleton
Dichanthium fecundum	Omitted; singleton
Digitaria ctenantha	Omitted; singleton
Eragrostis setifolia	Omitted; singleton
Eriachne pulchella subsp. *pulchella*	Omitted; singleton
Euphorbia australis var. *subtomentosa*	Omitted; singleton
Euphorbia biconvexa	Omitted; singleton
Goodenia nuda	Omitted; singleton
Hakea lorea subsp. *lorea*	Omitted; singleton
Hibiscus brachysiphonius	Omitted; singleton
Indigofera linnaei	Omitted; singleton
Maireana planifolia x *villosa*	Omitted; singleton
Maireana villosa	Omitted; singleton
Panicum effusum	Omitted; singleton
Petalostylis labicheoides	Omitted; singleton
Pluchea dentex	Omitted; singleton
Polygala glaucifolia	Omitted; singleton
Psydrax ? *rigidula*	Omitted; singleton
Psydrax suaveolens	Omitted; singleton
Ptilotus helipteroides	Omitted; singleton
Sclerolaena cuneata	Omitted; singleton
Senna hamersleyensis	Omitted; singleton
Senna sp. Karijini (M.E. Trudgen 10392)	Omitted; singleton
Sesbania cannabina	Omitted; singleton
Sida ectogama	Omitted; singleton
Stenopetalum nutans	Omitted; singleton
Tephrosia ? sp. clay soils (S. van Leeuwen et al. PBS 0273)	Omitted; singleton
Trianthema glossostigmum	Omitted; singleton
Waltheria indica	Omitted; singleton
Zaleya galericulata subsp. galericulata	Omitted; singleton
Abutilon sp.	Omitted; indeterminate taxon
Acacia ? *aptaneura*	Omitted; indeterminate taxon

Original Taxon	Treated as Following for PRIMER
Euphorbia sp. (*biconvexa/coghlanii/trigonosperma*; sterile)	Omitted; indeterminate taxon
Streptoglossa sp.	Omitted; indeterminate taxon
Bidens bipinnata	Omitted; weed
Citrullus colocynthis	Omitted; weed
Echinochloa colona	Omitted; weed
Tribulus terrestris	Omitted; weed
Vachellia farnesiana	Omitted; weed

Table 2: Site x species matrix.

Taxon	CSF01-R	CSF02	CSF03-R	CSF04	CSF05	CSF06	CSF07	CSF08	CSF09-R	CSF10-R	CSF11	CSF12
Abutilon lepidum	0.1	0.1	0.1	0.1	0.1	0.1	0	0	0	0.1	0	0
Abutilon macrum	0	0.1	0.1	0	0.1	0.1	0	0	0	0	0.1	0
Acacia aptaneura	52	65	60	4	8	6	1.5	1.5	1.5	2	0	0
Acacia coriacea subsp. *pendens*	2.5	0	0	0	0	0	0	0	0.1	7	0	0
Acacia pruinocarpa	0.1	0	0	0	0	0	0	0.5	0.1	0	0	0
Acacia pyrifolia var. *pyrifolia*	0.1	0	0	0	0	0	0	0	0	0.1	0	0
Acacia synchronicia	0.1	0	0.1	2.5	1	1.5	0.5	0.5	1	0	0.1	0.1
Acacia tetragonophylla	1	1.5	1	1	0.5	0.1	0.5	0.5	0.1	1	0.1	0.1
Acacia xiphophylla	0	0	0	0	0	0	0	0	0	0	11	8
Achyranthes aspera	0	0.1	0.1	0	0	0	0	0	0	0.1	0	0
Alternanthera denticulata	0.1	0	0.1	0	0.1	0	0	0	0	0.1	0	0
Alternanthera nana	0	0.1	0	0	0	0	0	0	0	0.1	0	0
Amaranthus undulatus	0	0.1	0	0	0	0	0	0	0	0.1	0	0
Amyema fitzgeraldii	0.1	0.1	0	0	0.1	0	0	0	0	0.1	0	0
Aristida contorta	0.1	10	7	1	5	1	0.5	1	0.5	0	0.5	0.5
Aristida latifolia	0	0.1	5	6	9	3	0	0.1	0.1	0	0.1	0.1
Arivela viscosa	0	0.1	0	0	0	0	0.1	0	0	0.1	0	0
Atalaya hemiglauca	0.1	0	0	0	0	0	0	0	0	3	0	0
Cenchrus spp.	44	40	3.1	0.1	10	0.6	0	0.1	0.6	32	0	0.1
Chloris pectinata	0	0.1	0	0	0	0	0.1	0.1	0.1	0	0	0
Chrysopogon fallax	0.1	0.1	0	0	0.1	2	0	0	0	0	0	0
Commelina ensifolia	0	0.1	0.1	0.1	0.1	0.1	0	0	0	0	0	0.1
Corchorus tridens	0.1	0.1	0	0	0.1	0	0	0.1	0	0	0	0
Cucumis variabilis	0.1	0.1	0	0	0	0	0	0	0	0.1	0	0
Dactyloctenium radulans	0.1	0	0	0	0.1	0.1	0.1	0.1	0.1	0.1	0	0
Dichanthium sericeum subsp. *humilius*	0	0.1	0	0	0.1	0.1	0	0	0	0	0	0
Digitaria brownii	0	1.5	0	0	0	0.1	0	0	0	0	0	0
Ehretia saligna var. *saligna*	0.1	0	0	0	0	0	0	0	0	1	0	0
Enchylaena tomentosa var. *tomentosa*	0	0.1	0.1	0.1	0	0	0	0.1	0	0	0.1	0.1

Taxon	CSF01-R	CSF02	CSF03-R	CSF04	CSF05	CSF06	CSF07	CSF08	CSF09-R	CSF10-R	CSF11	CSF12
Enneapogon caerulescens	0	0	0	0	0	0	0	0.1	0.1	0.1	0	0
Enneapogon polyphyllus	0	2	4	0	0.1	0.5	0.5	0.5	0.5	0.1	0.1	0.1
Enteropogon ramosus	0	0	0	0	0	0	0	0	0.1	0	1	0.5
Eragrostis leptocarpa	0	0.1	0	0	0.1	0	0	0.1	0	0	0	0
Eragrostis tenellula	0.1	0	0	0	0.1	0	0	0	0	0	0	0
Eragrostis xerophila	0	1	0	0.1	1	1	0.5	0.5	0.1	0	0	0.1
Eremophila cuneifolia	0	0	0	8	1	0.1	0	0	0.1	0	0.5	0.5
Eremophila lanceolata	0	0.1	0	0	0	0	0	0.1	0.1	0	0	0
Eremophila latrobei subsp. *filiformis*	0	0.1	0.1	0	0.1	0.1	0	0	0	0	0.1	0
Eucalyptus victrix	0	0	0	0	0	0	0	0	0	14	0	0
Evolvulus alsinoides var. *villosicalyx*	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0	0.1	0.1
Glycine canescens	0.1	0.1	0.1	0	0	0	0	0	0	0	0	0
Gomphrena kanisii	0	0.1	0.1	0	0.1	0.1	0.1	0.1	0.1	0	0.1	0.1
Goodenia prostrata	0	0.1	0	0	0	0.1	0	0.1	0	0	0	0
Hibiscus burtonii	0	0	0.1	0	0	0.1	0	0	0	0	0.1	0
Hibiscus sturtii var. *grandiflorus*	0	0.1	0	0	0.1	0.1	0	0	0.1	0	0.1	0.1
Indigofera georgei	0	0	0.5	0	0	0.1	0	0	0	0	0	0
Ipomoea muelleri	0.1	0.1	0.1	0	0	0	0	0	0	0.1	0	0
Iseilema membranaceum	0.1	0.1	0	0	0	0	0	0	0	0	0	0
Iseilema vaginiflorum	0	0	0	0	0.1	0.1	0	0	0	0	0	0
Jasminum didymum subsp. *lineare*	0.1	0.1	0	0	0	0.1	0	0	0	0.1	0	0
Maireana planifolia	0	0.1	0	0	0	0	0	0.1	0	0	0	0
Malvastrum americanum	0.1	3	1	0.1	0.1	0.1	0	0	0	0.1	0	0.1
Marsilea exarata	0.1	0	0.1	0	0	0	0	0	0	0	0	0
Nellica maderaspatensis	0.1	0	0	0	0	0.1	0	0	0	0.1	0	0
Neptunia scutata	0	0	0	0.1	0.1	0	0	0	0.1	0	0	0
Panicum decompositum	0.1	0	0	0	0.1	0.1	0	0	0	0	0	0
Portulaca conspicua	0	0	0	0	0	0	0.1	0.1	0	0	0	0
Portulaca oleracea/intraterranea	0.1	0.1	0.1	0	0.1	0.1	0.1	0.1	0.1	0	0	0
Portulaca pilosa/filifolia	0	0.1	0	0	0.1	0.1	0.1	0.1	0	0	0	0

Taxon	CSF01-R	CSF02	CSF03-R	CSF04	CSF05	CSF06	CSF07	CSF08	CSF09-R	CSF10-R	CSF11	CSF12
Psydrax latifolia	0	0	0.1	0	0	0.1	0	0	0	0	0	0
Pterocaulon sphacelatum	0.1	0.1	0.1	0	0.1	0	0	0	0	0	0	0
Ptilotus aervoides	0	0	0	0	0	0	0.1	0.1	0	0	0	0
Ptilotus exaltatus	0	0	0	0.1	0	0.1	0	0	0	0.1	0	0.1
Ptilotus gomphrenoides	0.1	0.1	0	0	0.1	0	0.1	0.1	0	0	0	0
Ptilotus obovatus var. *obovatus*	0	0.1	0	0	0	0	0	0	0	0	0.1	0
Rhagodia eremaea	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0	0	0	0.1	0.1
Rhynchosia minima	0.1	0.1	0.1	0.1	0.1	0.1	0	0	0.1	0	0	0
Rostellularia adscendens var. *clementii*	0	0.1	0.1	0	0	0	0	0	0	0.1	0	0
Salsola australis	0	0	0	0.1	0.1	0.1	0.1	0.1	0.1	0	0.1	0.1
Sclerolaena cornishiana	0	0.1	0.1	0.1	0.5	0.5	0.1	0.5	0.1	0	1.5	1
Sclerolaena costata	0	0.1	0	0	0.1	0	0.1	0.5	0.5	0	0.1	0.1
Sclerolaena densiflora	0	0	0	0	0.1	0.1	0	0.1	0.1	0	0	0.1
Senna artemisioides subsp. *helmsii*	0.1	1	0	0	0.1	2	0.1	0.1	0.1	0	0	0
Senna artemisioides subsp. *oligophylla*	0	1	0.1	14	5	0.1	0	0.1	0.1	0	2	1
Senna glutinosa subsp. x *luerssenii*	0	0	0	0.5	0	0.1	0	0	0	0	0.1	0.1
Sida aff. *fibulifera* (glabrous mericarps)	0	0	0.1	0.5	0.1	0.5	0.1	0	0	0	0.1	0.1
Sida fibulifera	0	0.1	0	0	0	0	0	0.1	0.1	0	0	0
Sida sp. L (A.M. Ashby 4202)	0	0.5	0.1	0	0	0	0	0	0	0	0	0
Solanum horridum	0	0	0.1	0	0	0	0	0.1	0	0	0	0
Solanum lasiophyllum	0.1	0.1	0.1	0.1	0	0.1	0	0	0	0	0	0
Sporobolus australasicus	0	0.1	0.1	0	0.1	0.1	0.1	0.1	0	0.1	0	0
Themeda triandra	12	0	0	0	0	0	0	0	0	0	0	0
Trianthema triquetrum	0.1	0.1	0	0	0	0.1	0.1	0.1	0.1	0	0	0
Tripogonella loliiformis	0	0	0	0	0	0.1	0	0.1	0	0	0	0
Urochloa occidentalis var. *ciliata*	0	0.1	0.1	0	0.1	0.1	0	0	0	0	0	0

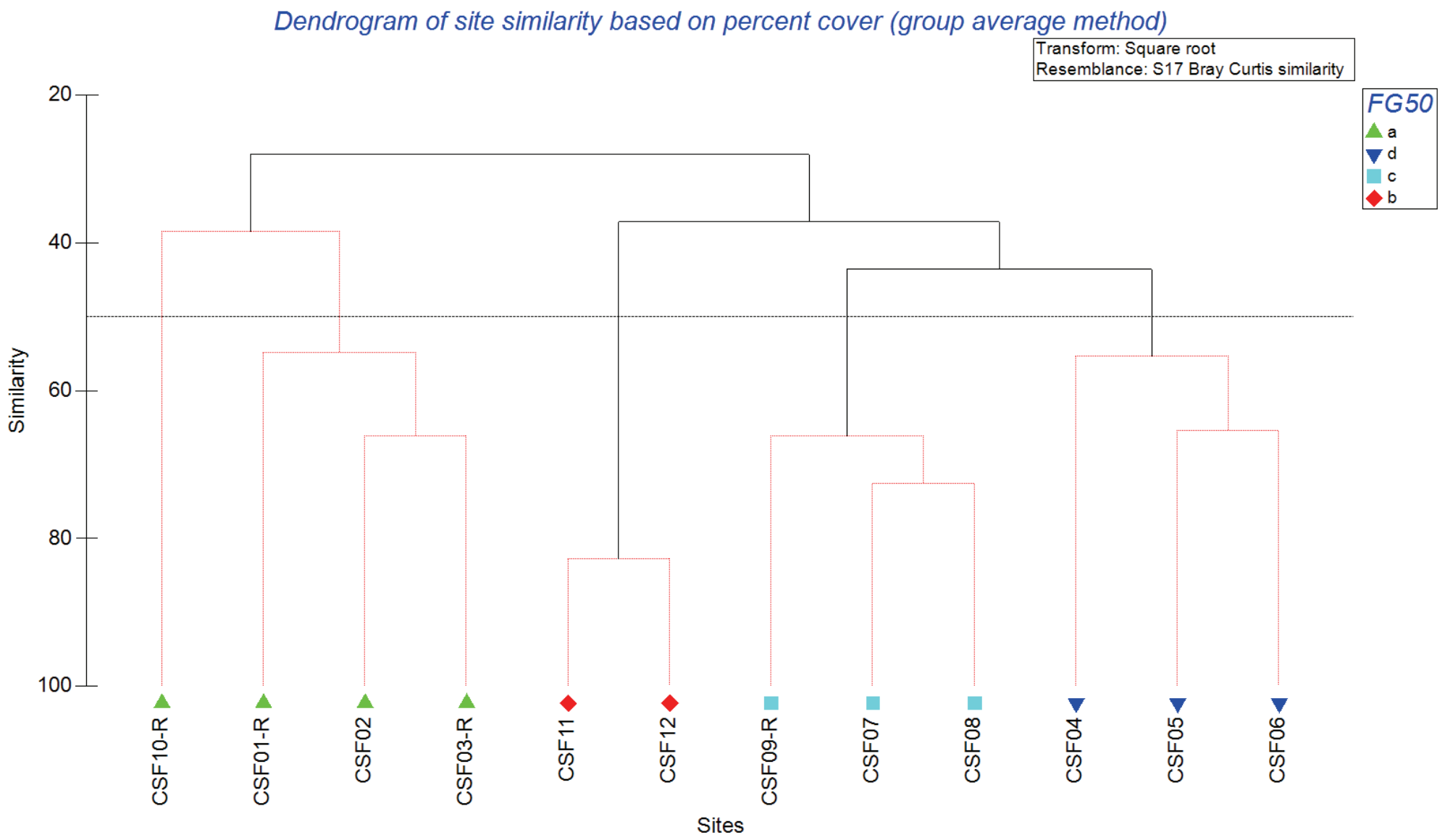

Figure 1: **Dendrogram based on percent cover of all species at each site sampled during the survey.**

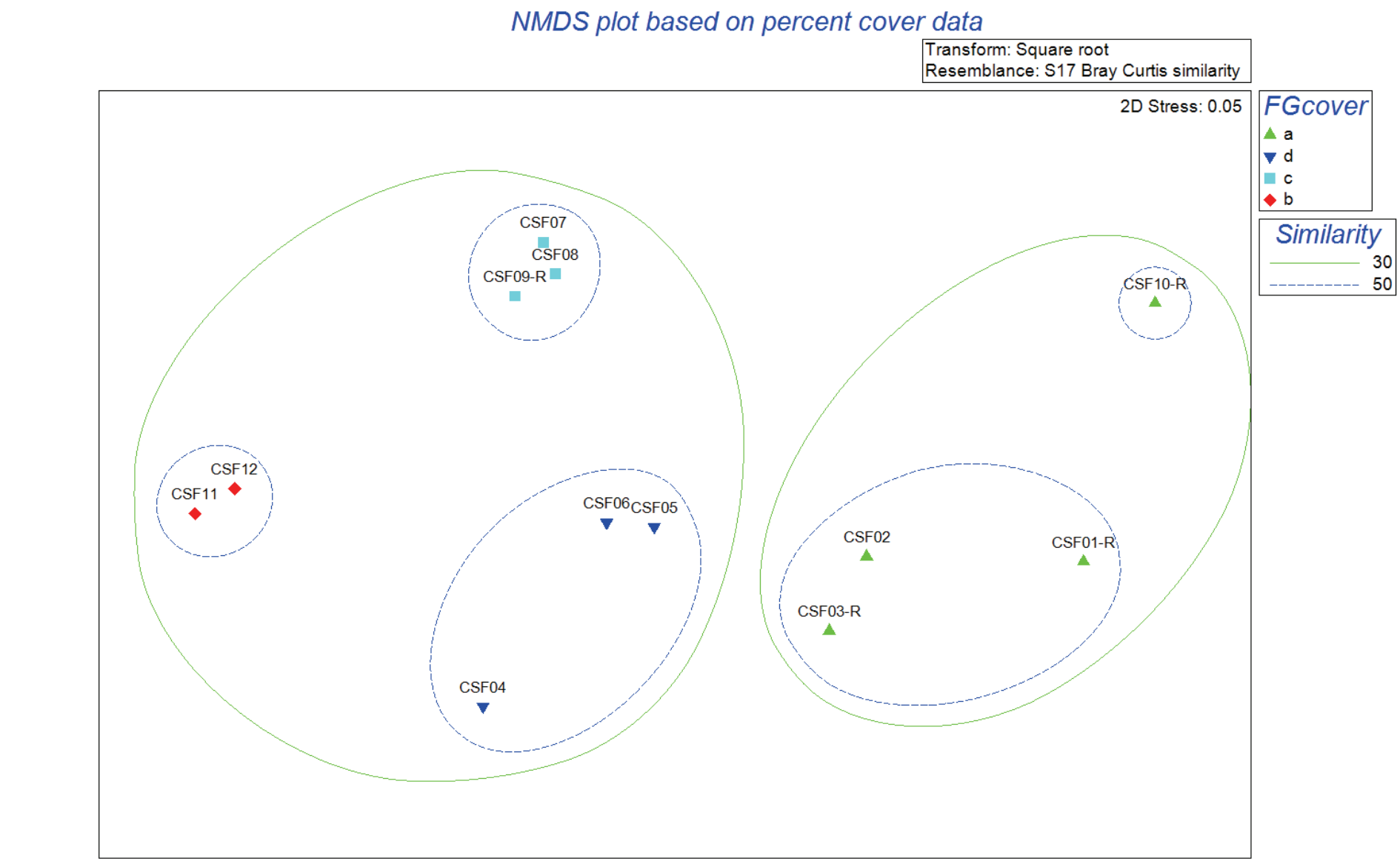

Figure 2: **NMDS plot based on percent cover of all species at each site sampled during the current survey work at 30% and 50% similarity.**

Table 3: Number of sites from the current survey in each floristic group at 50% similarity (based on cover of all species).

Vegetation Code	Floristic Group			
	a	*b*	*c*	*d*
D1	3			
D2	1			
F1				3
F2			3	
F3		2		