Miling Grain Receival Site Expansion
Native Vegetation Clearing Permit Application Supporting Document

CBH Group

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DOCUMENT TRACKING

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Template 2.8.1

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Abbreviations

Abbreviation	Description
AHD	Australian Height Datum
BAM Act	*Biosecurity and Agriculture Management Act 2007*
BC Act	*Biodiversity Conservation Act 2016*
BoM	Bureau of Meteorology
CBH	Cooperative Bulk Handling Group
DAWE	Department of Agriculture, Water and the Environment (now DCCEEW; see below)
DBCA	Department of Biodiversity, Conservation and Attraction
DBH	Diameter at Breast Height
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DER	Department of Environmental Regulation
DMIRS	Department of Mines, Industry Regulation and Safety
DoE	Department of the Environment
DotEE	Department of the Environment and Energy
DPaW	Department of Parks and Wildlife
DPIRD	Department of Primary Industries and Regional Development
DPLH	Department of Planning, Land and Heritage
DWER	Department of Water and Environmental Regulation
ELA	Eco Logical Australia Ltd
EMP	Environmental Management Plan
EN	Endangered
EP Act	*Environmental Protection Act 1986*
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
ESA	Environmental Sensitive Area
Ha	Hectares
IBRA	Interim Biogeographic Regionalisation for Australia
Mm	Millimetres
NVCP	Native Vegetation Clearing Permit
PEC	Priority Ecological Community
PTA	Public Transport Authority of Western Australia
SEWPaC	Department of Sustainability, Environment, Water, Population and Communities
TEC	Threatened Ecological Community
VC	Vegetation Community
WAH	Western Australian Herbarium
WAOL	Western Australian Organism List

1. Introduction

1.1. Background

The Cooperative Bulk Handling Group (CBH) proposes to expand the existing Miling Grain Receival Site (the Proposal) located west of the Miling townsite, approximately 200 km northeast of Perth, in Western Australia (WA; Figure 1-1). The Proposal will enable the development of up to four new open bulkheads to the southwest of the existing CBH facilities, along with additional roads, weighbridges, drainage basins, a sample hut and other supporting facilities within a 29.4 ha Development Envelope (Figure 1-2). The Proposal will cater for approximately 200,000 tonnes of grain storage required to service increased grain production in the Miling area.

The Proposal will result in clearing up to 18.4 ha of native vegetation within a 19.1 ha Disturbance Footprint, including poor quality habitat for the *Zanda* (ex. *Calyptorhynchus*) *latirostris* (Carnaby's Cockatoo) which is listed as Endangered under the State *Biodiversity Conservation Act 2016* (BC Act) and Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) (refer to Section 1.1.1).

The Proposal has been designed to avoid and mitigate impacts to areas of native vegetation as far as practical. The original Disturbance Footprint boundary was reduced significantly, resulting in approximately 4.8 ha of native vegetation being retained onsite.

Native vegetation can only be cleared with a permit obtained from either the Department of Water and Environmental Regulation (DWER) or the Department of Mines, Industry Regulation and Safety (DMIRS), or an approval under Part IV of the *Environmental Protection Act 1986* (EP Act), unless an exemption applies pursuant to the EP Act and the Environmental Protection (Clearing of Native Vegetation) Regulations 2004 (the Regulations).

This document has been prepared to support the granting of a Native Vegetation Clearing Permit (NVCP) for the Proposal under Part V Division 2 of the EP Act.

This NVCP application includes the following information:

- The justification for the Proposal
- An overview of the existing environmental conditions of the site
- An evaluation of potential impacts of the vegetation clearing
- Avoidance and mitigation measures
- An evaluation of compliance of the proposed clearing against the ten clearing principles listed under Schedule 5 of the EP Act
- Stakeholder consultation.

1.1.1. EPBC Act – Proposal is not a controlled action

Due to the proposed clearing of Carnaby's Cockatoo habitat, the Proposal was referred to the Department of Climate Change, Energy, the Environment and Water (DCCEEW) on 15 August 2022 (EPBC number 2022/09336). On 24 November 2022, the Minister for the Environment determined that the Proposed action is not a controlled action under section 75 of the EPBC Act, and therefore does not require assessment under the EPBC Act.

1.2. Location, ownership and zoning

The Disturbance Footprint is located adjacent to the existing Miling Grain Receival Site within the townsite of Miling, in the Shire of Moora (Figure 1-1). The Development Envelope occurs within a combination of land tenure (Figure 1-3), as follows:

- Lots 6 and 7 on Deposited Plan 418426, owned by CBH
- Lot 3954 on Deposited Plan 175371 and Lot 4089 on Deposited Plan 187070, rail reserves that occur on Crown Land (Crown Reserve 26009) and are the responsibility of the Public Transport Authority of Western Australia (PTA). CBH is currently leasing this land; the 99-year lease expires on 24 May 2102
- Lot 329 on Deposited Plan 409265 and other untitled reserves that comprise road reserve under the responsibility of the Shire of Moora.

Certificates of Title, Deposited Plan 418426 and the lease agreement associated with Lot 3954 and Lot 4089 are attached in Appendix A; Letters of Authority from the PTA and Shire of Moora are attached in Appendix B.

Under the Shire of Moora Local Planning Scheme No. 4 (District Scheme), most of the Disturbance Footprint is zoned as 'Industrial', with a small area zoned 'General Agriculture', road and rail reserve.

1.3. Project description

CBH is seeking to clear up to 18.4 ha of native vegetation within a 19.1 ha Disturbance Footprint (Figure 1-1). The remaining 0.7 ha consists of cleared areas.

The Disturbance Footprint is located within the 29.4 ha Development Envelope that contains the existing grain receival site, roads and railway (Figure 1-1). No vegetation will be cleared within the Development Envelope outside of the Disturbance Footprint.

The Proposal will enable the development of up to four new open bulkheads to the southwest of the existing CBH facilities, along with additional roads, weighbridges, drainage basins, sample hut and other supporting facilities (Figure 1-2).

The Proposal will cater for approximately 200,000 tonnes of grain storage required to service increased grain production in the Miling area. Operations at the site, once constructed, will continue indefinitely.

1.4. Proposal benefits

Established in 1933, CBH is Australia's largest co-operative and a leader in the Australian grains industry. It is a Western Australian based grain storage and handling organisation, with operations extending along the value chain from fertiliser to grain storage, handling, transport, marketing and processing. Owned and controlled by approximately 3,500 Western Australian grain growing businesses, the core purpose of CBH is to sustainably create and return value to both current and future growers. The CBH storage and handling system is world class and currently receives and exports around 90% of the Western Australian grain harvest through a network of more than 130 grain receival sites and 4 export terminals. A map of the CBH grain network is shown in Figure 1-4.

CBH has total assets with a replacement value of approximately $6.5 billion and employs approximately 1,100 permanent employees and up to 1,800 casual employees during the harvest period from October through to January. To meet its strategic objectives, CBH's storage capacity must be expanded at strategically chosen sites that meets the pace and innovation of growers, and investment to increase out-bound supply chain capacity via out-loading infrastructure, rail siding upgrades and rail lines is required.

The Miling Grain Receival Site has been Identified in the CBH Network Strategy as a primary (important) site of the future and for expansion within the CBH Operations Network Plan. The proposed development is required to cater for the growing quantities of grain receivals around the Miling region and surrounding catchments, which is driven by improved cropping and farming techniques, and higher yielding seed varieties being planted by WA growers.

In addition to operational, financial, grower and logistical considerations, when identifying expansion options, under its Operations Network Plan, CBH seeks to build or expand sites in proximity to regional towns and communities built around the original grain receival site. This contributes to the longevity of rural communities by employing local and regional residents and customers for local businesses during the out-loading of grain and peak harvest receival periods, whilst also reducing the need for employees to travel significant distances following long shifts.

As such, the options explored for Miling were focused on locations proximate to the local community and the existing CBH receival site.

As Miling is a CBH Network Strategy site of the future it has been identified for expansion in the CBH 2023-27 Network Plan. Expansion at Miling will allow for:

- Handling the forecast production growth in the area which is forecast to grow at a compound annual growth rate of 4.8%
- Additional grain services to be offered to Miling growers that are normally forced to cart longer distances to sites that have these segregations available (i.e., ability to offer canola and barley services which cannot currently be offered at the site due to lack of storage capacity)
- Miling being able to service the growers in its catchment without having to fill and then close
- Elimination of the historical requirement for 'essential harvest moves to Port' from Miling, which can increase trucks on road during the harvest receival period
- Improved service to growers through an increase in throughput capacity and a reduction in site turnaround time – this is an important metric to CBH, as it relates to the weather, quality, and financial risks to standing crops of growers not being able to harvest and deliver crops in a timely and efficient manner
- Operational and safety benefits to CBH and it's employees by providing an efficient, safe and upgraded permanent site.

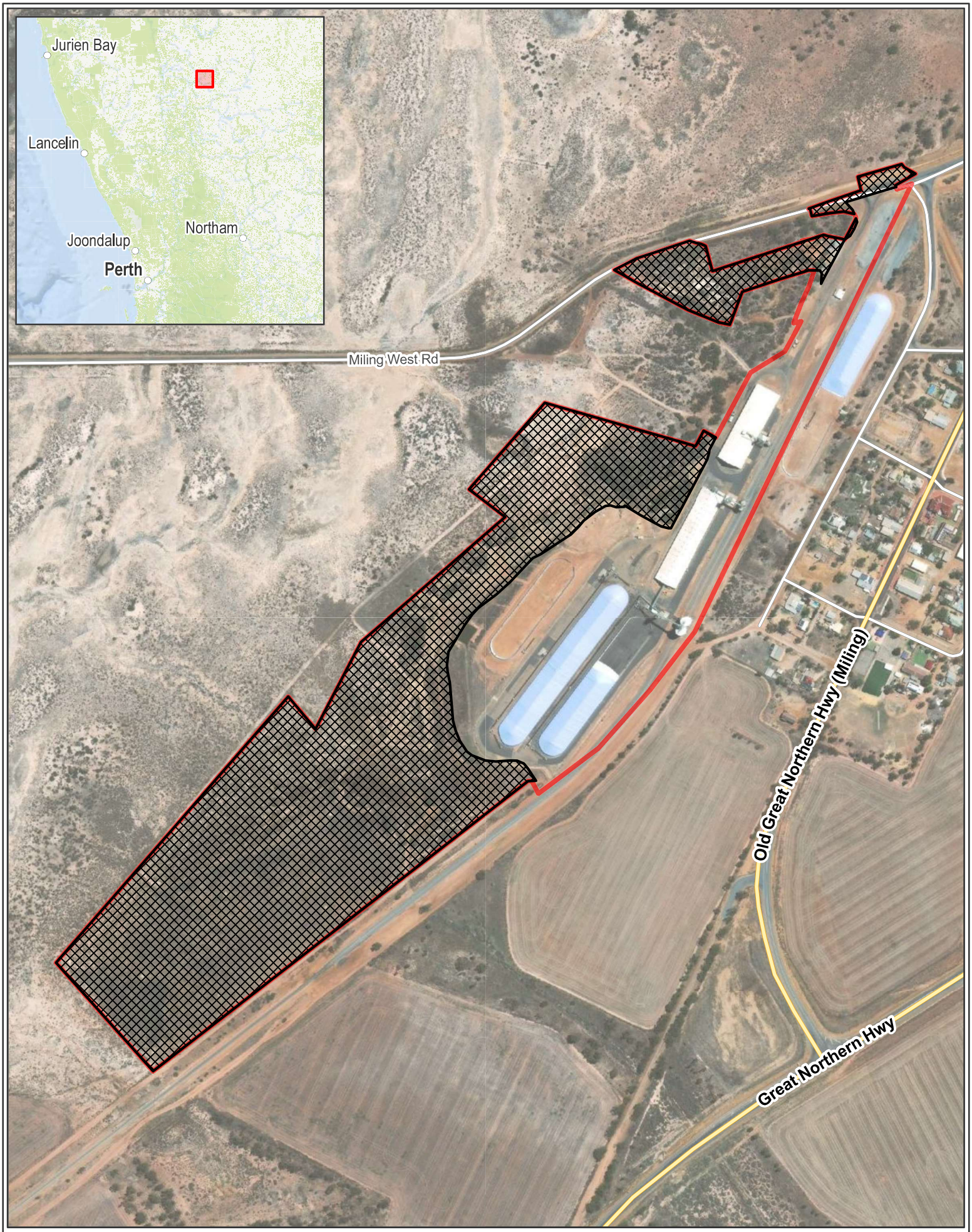

Figure 1-1: Location of the Proposal

Development Envelope

Disturbance Footprint

N

0 25 50 100

Metres

Datum/Projection:
GDA 1994 MGA Zone 50

Project: 20297-ED Date: 13/06/2023

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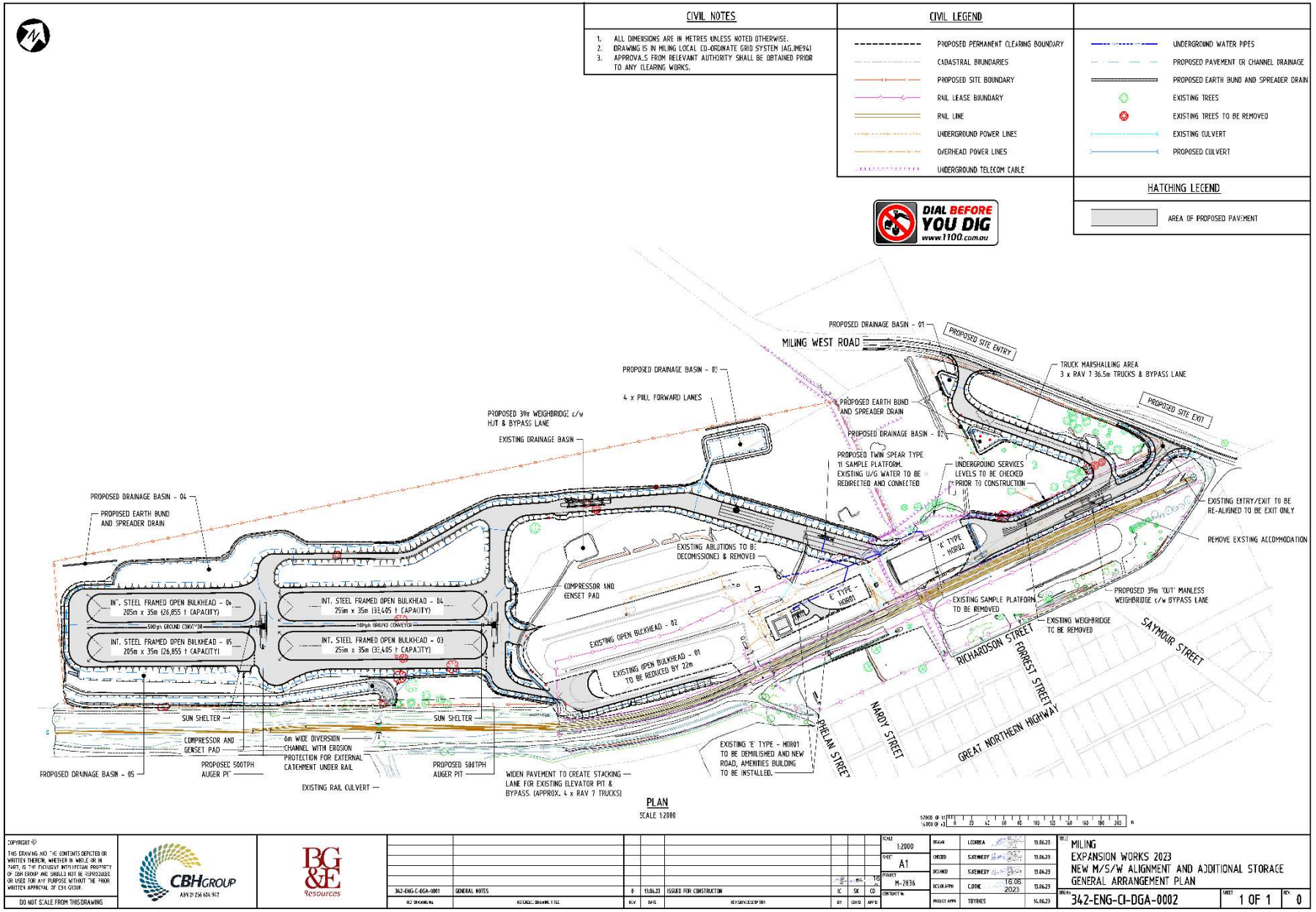

Figure 1-2: Proposed site development plan (exact location of elements within the Development Envelope is subject to change)

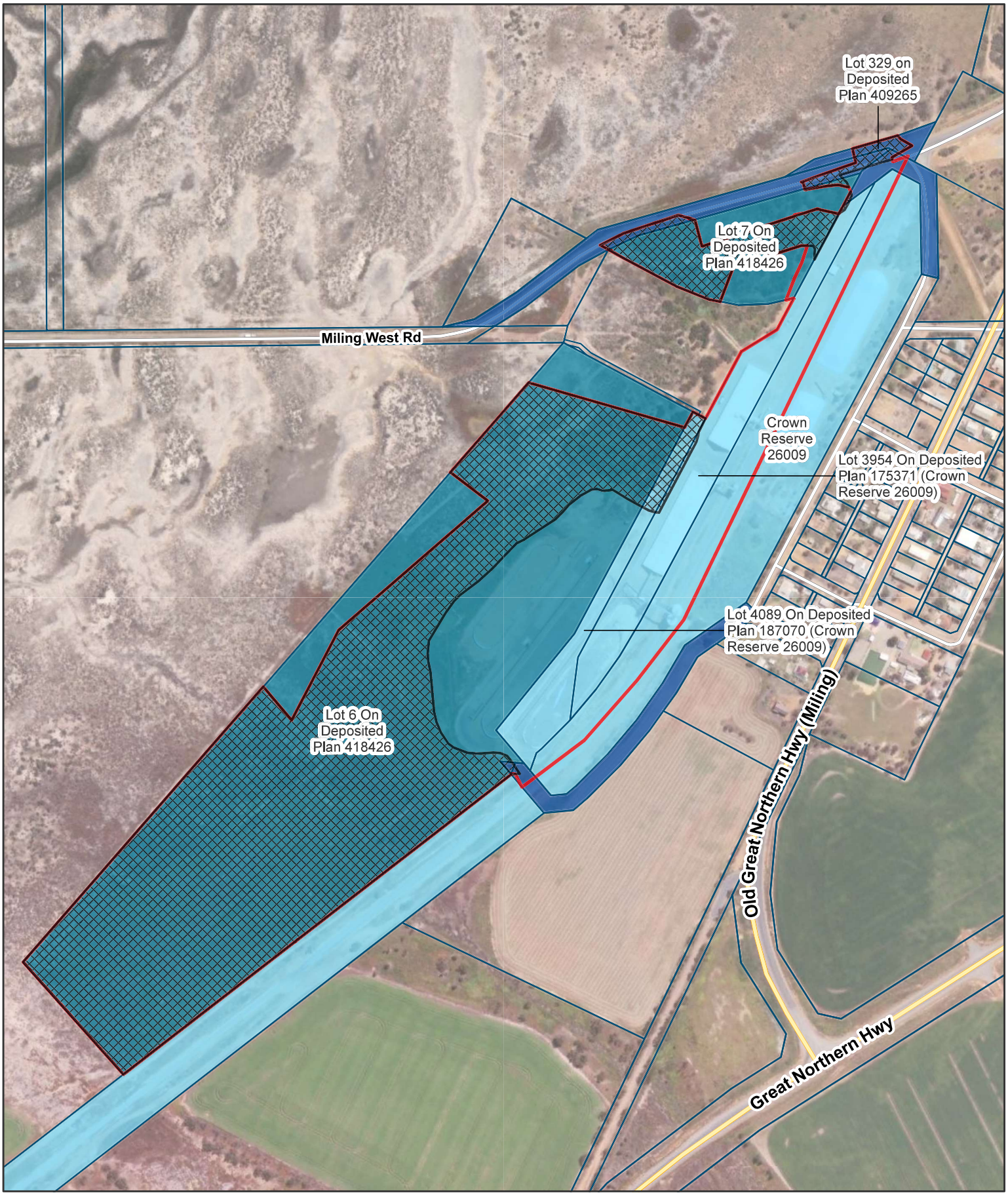

Figure 1-3: Land ownership within the Disturbance Footprint and Development Envelope

Development Envelope
Disturbance Footprint
Cadastre

Land ownership

CBH leasehold land (PTA rail reserve)
CBH owned land
Road reserve (Shire of Moora)

0 50 100 200
Metres

Datum/Projection:
GDA 1994 MGA Zone 50

Project: 20297-ED Date: 5/07/2023

N

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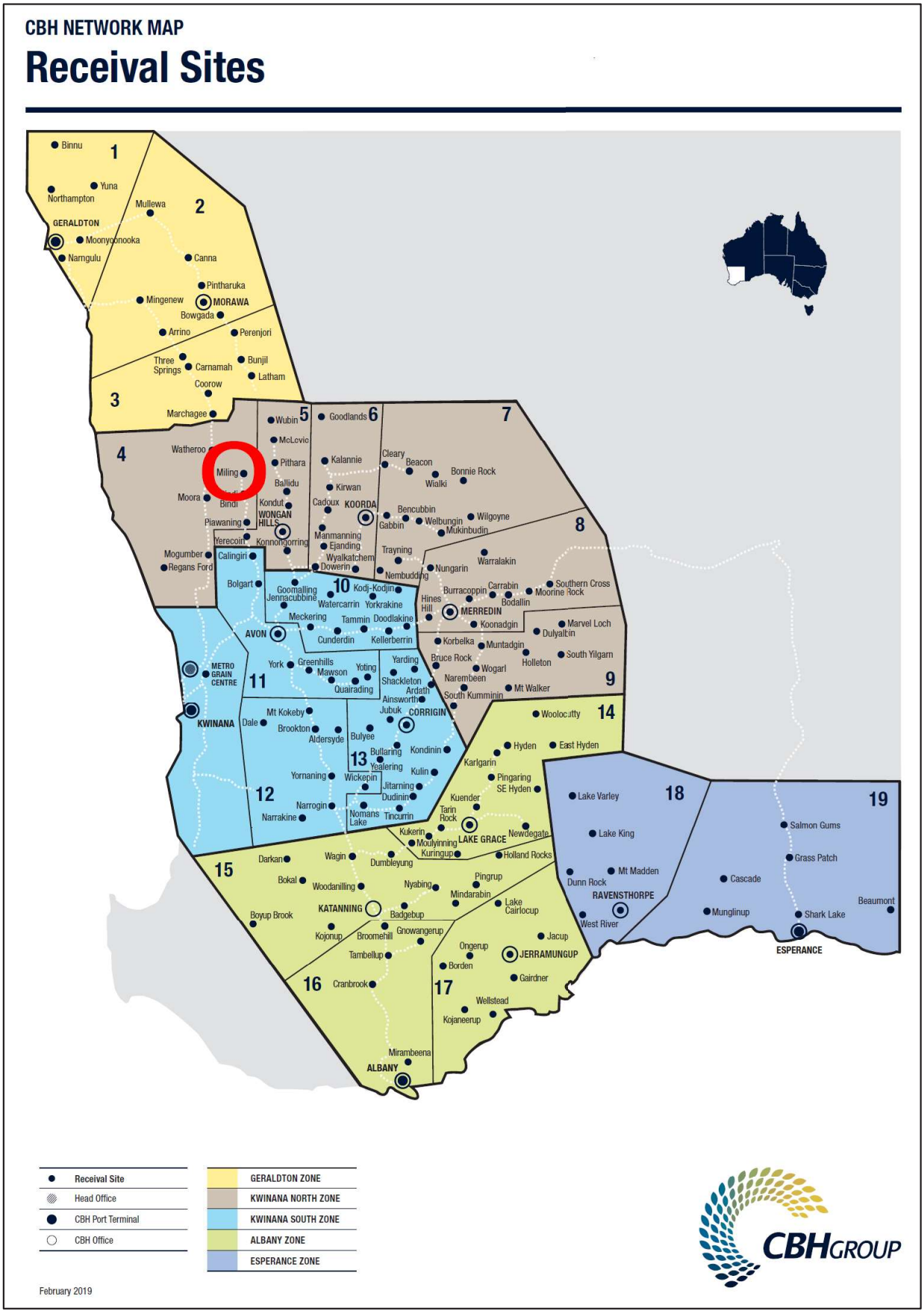

Figure 1-4: CBH network map for grain receival sites. Miling has been circled in red.

2. Physical Environment

2.1. Biogeographic and regional setting

Under the current version 7 of Interim Biogeographic Regionalisation for Australia (IBRA), the Disturbance Footprint is situated within the Avon Wheatbelt IBRA Bioregion and AVW02 - Katanning subregion (DAWE 2021). The Avon Wheatbelt bioregion is described as a dissected plateau of Tertiary laterite in the Yilgarn Craton with a semi-arid (dry) warm Mediterranean climate (Beecham 2001). The AVW02 subregion is further described as comprised of gently undulating rises to low hills with abrupt breakaways; its drainage is rejuvenated and comprises continuous stream channels that flow in most years. Residual lateritic uplands and derived sandplains are covered by areas of proteaceous scrub-heaths (which are rich in endemic species) and quaternary surfaces of erosional slopes and valley floors support woodlands of Wandoo, York Gum, Jam and Casuarina (Beecham 2001).

2.2. Climate

The region is described as having a semi-arid (dry) and warm Mediterranean Climate (Beecham 2001). Based on the Bureau of Meteorology (BoM) Miling weather station (station number 8085, climate data 1924-present), the area receives, on average, 364.3 mm of rainfall a year, with most rainfall occurring during the winter months of June and July (62.3 mm and 62.5 mm respectively; BoM 2022).

2.3. Geology, landform and soils

The Disturbance Footprint is situated on the Goomalling soil landscape system (Landgate 2021 and Purdie et al. 2004; Table 2-1).

Table 2-1: Soil landscape systems within the Disturbance Footprint

Soil Landscape System	Soil Landscape Zone	Description
Goomalling System	Xd2	Poorly drained valley flats, in the northern Zone of Rejuvenated Drainage, with grey deep sandy duplex (sometimes alkaline) and saline wet soil. York Gum-Jam-Wandoo-Salmon Gum-Sheoak woodland.

Geotechnical field investigations determined that the subsurface profile typically comprised of sand overlying sandy silt / silty sand / clayey sand / sandy clay / gravelly sand to termination depths, at most test pit locations (Coffey 2020).

2.4. Hydrology

The Disturbance Footprint is within the Moore-Hill Rivers Basin, within the Moore River catchment. An intermittent unnamed minor drainage line (a tributary of the Moore River North) runs through the Disturbance Footprint. The Disturbance Footprint is located approximately 800 m from the Moore River North main channel, with associated saline flats occurring across the valley floor, extending across the Disturbance Footprint boundary in parts.

There is potential for the development of perched groundwater tables at the site following periods of rainfall, with depth to perched groundwater ranging from 1.3-2.3 m below ground level during a March 2020 field assessment (11 sampling locations; Coffey 2020).

2.5. Broad-scale vegetation

Vegetation type and extent have been mapped at a regional scale by Beard (1975) who categorised vegetation into broad vegetation associations. Based on this mapping at a scale of 1:1,000,000, the Department of Primary Industries and Regional Development (DPIRD) has compiled a list of vegetation extent and types across WA (Shepherd et al. 2002; DPIRD 2019a).

The Disturbance Footprint occurs over two pre-European vegetation associations (DPIRD 2019a; Table 2-2; Figure 2-1): Victoria Plains 631 (16.8 ha) and Victoria Plains 142 (1.7 ha). Both associations only have a small proportion of their pre-European extent within the AVW02 IBRA subregion remaining (Government of Western Australia 2019; Table 2-2).

Table 2-2: Beard's (1975) vegetation associations of the Survey Area (Government of Western Australia 2019)

Vegetation association	Description	Pre-European extent within AVW02 subregion (ha)	Current extent within AVW02 subregion (ha)	% remaining within AVW02 subregion	Current extent within Disturbance Footprint (ha)	% remaining within Disturbance Footprint
Victoria Plains 142	Medium woodland; York gum & salmon gum	224,265.6	16,054.8	7.2	1.7	0.01
Victoria Plains 631	Succulent steppe with woodland and thicket; York gum over *Melaleuca thyoides* & samphire	11,821.4	1,702.9	14.4	16.8	0.98

2.6. Areas of Conservation Significance

2.6.1. Environmentally Sensitive Areas

Environmentally Sensitive Areas (ESAs) are defined in the *Environmental Protection (Environmentally Sensitive Areas) Notice 2005* under s 51B of the State EP Act. ESAs include areas declared as World Heritage, included on the Register of the National Estate, defined wetlands, and vegetation containing rare (Threatened) flora and Threatened Ecological Communities (TECs) listed under the BC Act.

Priority Ecological Communities (PECs) are biological flora or fauna communities that are recognised by the WA Minister for Environment to be of significance, but which do not meet the criteria for a TEC. There are five categories of PECs, none of which are currently protected under State or Commonwealth legislation.

The *Eucalyptus Woodlands of the Western Australian Wheatbelt* (Wheatbelt Woodlands) TEC, listed as Critically Endangered under the Commonwealth EPBC Act and Priority 3 by the Western Australian Department of Biodiversity, Conservation and Attractions (DBCA), occurs throughout the wheatbelt region in southwestern Western Australia, in which the Disturbance Footprint is located. This TEC is not considered an ESA as it is not listed as Threatened under the BC Act.

2.6.2. Nature reserves and conservation estate

There are no nature reserves or conservation estates within the Disturbance Footprint. The closest conservation estate is the Damboring Nature Reserve, approximately 31 km to the east.

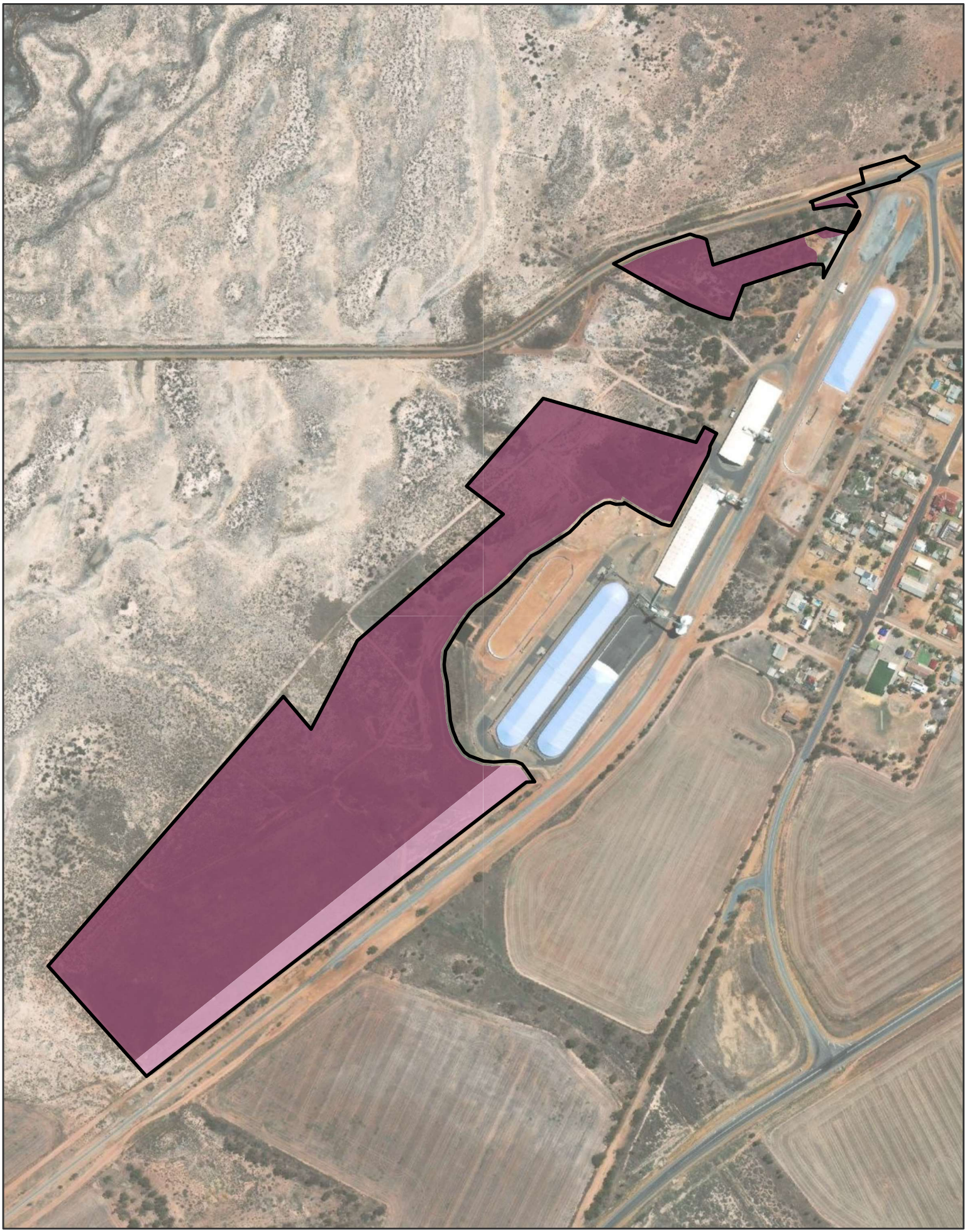

Figure 2-1: Pre-European Vegetation Associations within the Disturbance Footprint

Disturbance Footprint

Pre-European Vegetation

Victoria Plains (142)

Victoria Plains (631)

N

0 50 100 200

Metres

Datum/Projection:
GDA 1994 MGA Zone 50

Project: 20297-ED Date: 13/06/2023

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3. Biological Environment

3.1. Previous ecological surveys

Four biological surveys have been undertaken within the Survey Area (approximately 33.8 ha [refer to Figure 3-1 to Figure 3-4]), that encompasses the 19.1 ha Disturbance Footprint.

A reconnaissance level flora and vegetation, basic fauna and targeted Carnaby's Cockatoo assessment was undertaken in October 2020 (ELA 2021a; Appendix C). Following this survey, a number of targeted surveys were undertaken including:

- Targeted flora survey undertaken in September 2021 (ELA 2021b; Appendix D)
- Targeted Western Spiny Tailed Skink survey undertaken in July 2021 (ELA 2021c; Appendix E)
- Targeted Short-range Endemic and conservation significant invertebrate survey undertaken in July 2021 (Invertebrate Solutions 2021; Appendix F).

The results of these surveys are summarised below. Data is presented for the Survey Area where it is unable to be differentiated from the Disturbance Footprint.

3.2. Flora and vegetation

3.2.1. Flora

A total of 79 flora species, representing 23 families and 60 genera were recorded within the Survey Area from a combination of 15 relevés and opportunistic collections (ELA 2021a). Families with the highest number of species recorded were Poaceae (15 species), Chenopodiaceae (14 species) and Asteraceae (10 species) (ELA 2021a). The best represented genera were *Acacia* (five species), *Atriplex* (four species) and *Eucalyptus* (three species). No Threatened flora species listed under the EPBC Act or the BC Act or Priority flora species listed by DBCA were recorded within the Survey Area (and therefore the Disturbance Footprint) during the field surveys (ELA 2021a, b).

A total of 51 conservation significant flora species were initially identified as possibly occurring within the Survey Area, including (ELA 2021a):

- One identified with Potential to occur: *Urodon capitatus* (Priority 3)
- Two identified as Likely to occur:
  - *Caladenia drakeoides* (Hinged Dragon Orchid; listed as Endangered under the EPBC Act and Critically Endangered under the BC Act)
  - *Caladenia cristata* (Crested Spider Orchid; Priority 1).

Following targeted surveys, no conservation significant species were considered to occur due to a lack of suitable habitat and lack of records, despite extensive survey effort (ELA 2021b).

3.2.1.1. Introduced flora

A total of 27 introduced (weed) flora species were recorded in the Survey Area (ELA 2021a). One species, **Echium plantagineum* (Paterson's curse), is listed as a Declared Pest (s22[2]) under the *Biosecurity and Agriculture Management Act 2007* (BAM Act) (Western Australian Organism List [WAOL]; Department of Primary Industries and Regional Development 2022). This species was recorded in ten locations; two

located within the Disturbance Footprint. The remaining 26 species are listed on the WAOL database as s11 (permitted) species, indicating that no specific management of these species is required.

3.2.2. Vegetation

3.2.2.1. Local vegetation

A total of six vegetation communities were delineated and mapped within the Disturbance Footprint comprising (ELA 2021a; Table 3-1; Figure 3-1):

- Two eucalypt woodland communities (VC1 and VC6)
- Three mixed shrubland communities (VC3, VC4 and VC5)
- One samphire shrubland community (VC2).

These vegetation communities occur within 96.5% (18.4 ha) of the Disturbance Footprint, with the remaining 3.5% (0.7 ha) being cleared (Table 3-1). The most widespread vegetation communities within the Disturbance Footprint are VC2 and VC3, which cover 37.4% and 40.7% of the Disturbance Footprint, respectively (ELA 2021a; Table 3-1; Figure 3-1).

Table 3-1: Vegetation communities within the Disturbance Footprint

Vegetation community	Area (ha)	%
VC1: *Eucalyptus loxophleba* low open mallee woodland	0.1	0.6
VC2: *Tecticornia undulata* and *T. pergranulata* low open samphire shrubland	7.1	37.4
VC3: *Acacia hemiteles* isolated shrubs over *Maireana brevifolia* and *Salsola australis* low open chenopod shrubland	7.8	40.7
VC4: *Casuarina obesa*, *Hakea preissii*, *Melaleuca lateriflora* and *M. stereophloia* tall shrubland	0.9	4.8
VC5: *Acacia lineolata* subsp. *lineolata*, *Melaleuca lateriflora* and *Hakea preissii* tall sparse shrubland	1.1	6.0
VC6: *Eucalyptus loxophleba* open woodland	1.3	7.0
Total vegetation communities	**18.4**	**96.5**
Cleared areas/existing site	0.7	3.5
Total area	**19.1***	**100.0***

*DIFFERENCES MAY OCCUR DUE TO ROUNDING

3.2.2.2. Conservation significant ecological communities

Two of the vegetation communities delineated within the Disturbance Footprint (VC1 and VC6) comprised eucalypt woodlands that had the potential to represent floristic and structural aspects of the Wheatbelt Woodlands TEC, as indicated in the Approved Conservation Advice for the community (Department of the Environment and Energy [DotEE] 2015; ELA 2021a).

An assessment of these vegetation communities was undertaken utilising key diagnostic characteristics of the Wheatbelt Woodlands TEC (DotEE 2015; ELA 2021a). This key diagnostic assessment concluded that whilst some characteristics represented the Wheatbelt Woodlands TEC, others did not. Crown cover was greater than 10% in VC1 (*Eucalyptus loxophleba* low open mallee woodland), dominated by

a mallee eucalypt (ELA 2021a). Community VC6 (*E. loxophleba* open woodland) contained mature trees; however, the crown cover was less than 10% (2-5%). Therefore, neither vegetation community represents the Wheatbelt Woodland TEC (ELA 2021a).

No other significant ecological communities were recorded within the Survey Area or Disturbance Footprint (ELA 2021a).

3.2.2.3. Vegetation condition

Most vegetation in the Disturbance Footprint is classed as either Good condition (8.9 ha, 46.7%) or Completely Degraded (7.8 ha, 40.8%; Table 3-2). The remaining areas include Very Good (0.3 ha, 1.8%) and Degraded (1.4 ha, 7.2%); see Table 3-2. Cleared areas, including roads and tracks, cover 3.5% (0.7 ha) of the Disturbance Footprint. Primary disturbances included clearing for agriculture and infrastructure and the presence of introduced (weed) species.

Table 3-2: Vegetation condition within the Disturbance Footprint

Vegetation condition	Area (ha)	%
Very Good	0.3	1.8
Good	8.9	46.7
Degraded	1.4	7.2
Completely Degraded	7.8	40.8
Cleared	0.7	3.5
Grand Total	**19.1**	**100.0**

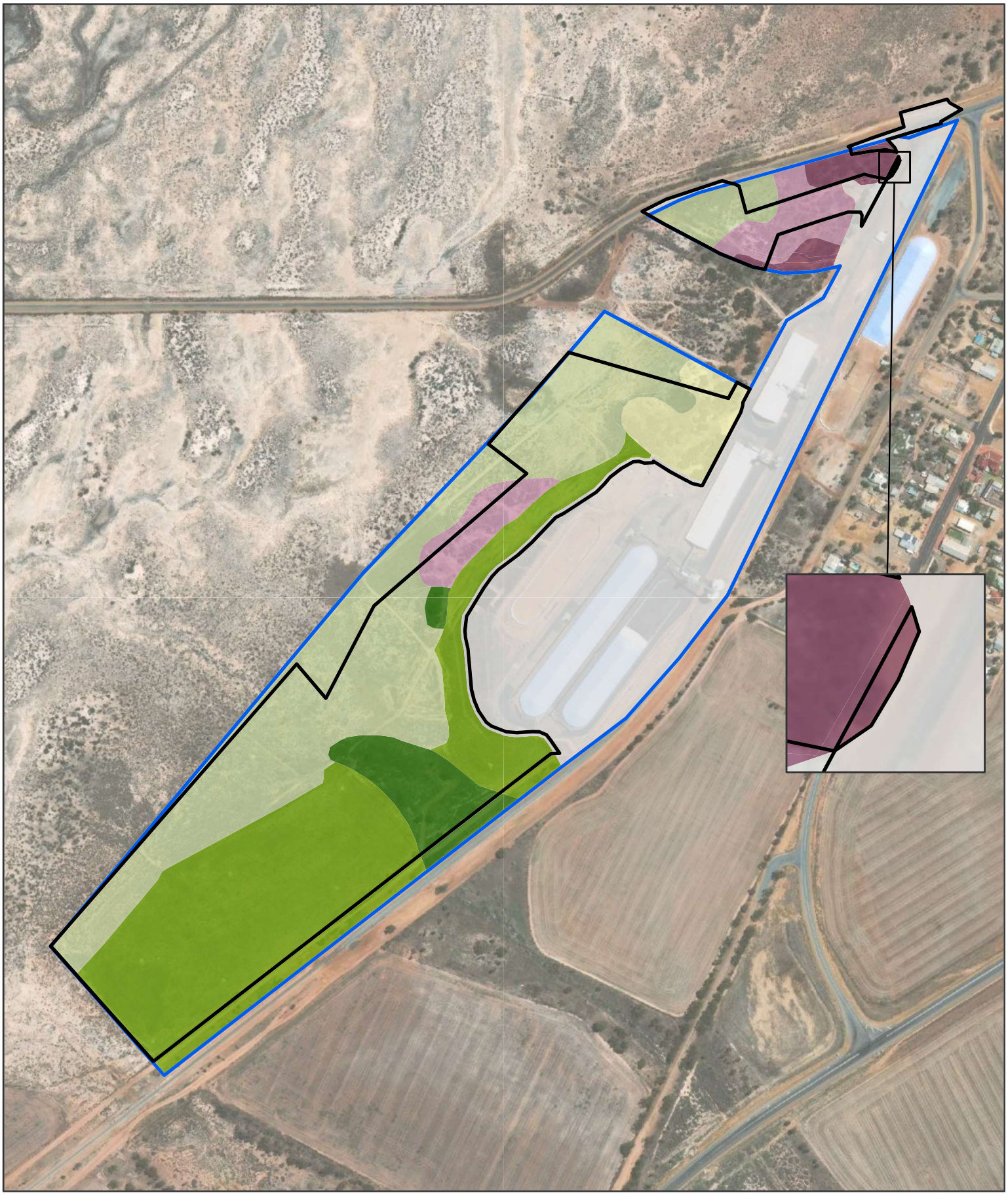

Figure 3-1: Vegetation communities recorded within the Survey Area and Disturbance Footprint

Disturbance Footprint

Survey Area

Cleared

Vegetation Communities (ELA, 2021)

VC1: *Eucalyptus loxophleba* open woodland

VC2: *Tecticornia undulata* and *T. pergranulata* low open samphire shrubland

VC3: *Acacia hemiteles* isolated shrubs over *Maireana brevifolia* and *Salsola australis* low open chenopod shrubland

VC4: *Casuarina obesa, Hakea preissii, Melaleuca lateriflora* and *M. stereophloia* tall shrubland

VC5: *Acacia lineolata* subsp. *lineolata, Melaleuca lateriflora* and *Hakea preissii* tall sparse shrubland

VC6: *Eucalyptus loxophleba* low open mallee woodland

0 50 100 200

Metres

Datum/Projection:
GDA 1994 MGA Zone 50

Project: 20297-ED Date: 13/06/2023

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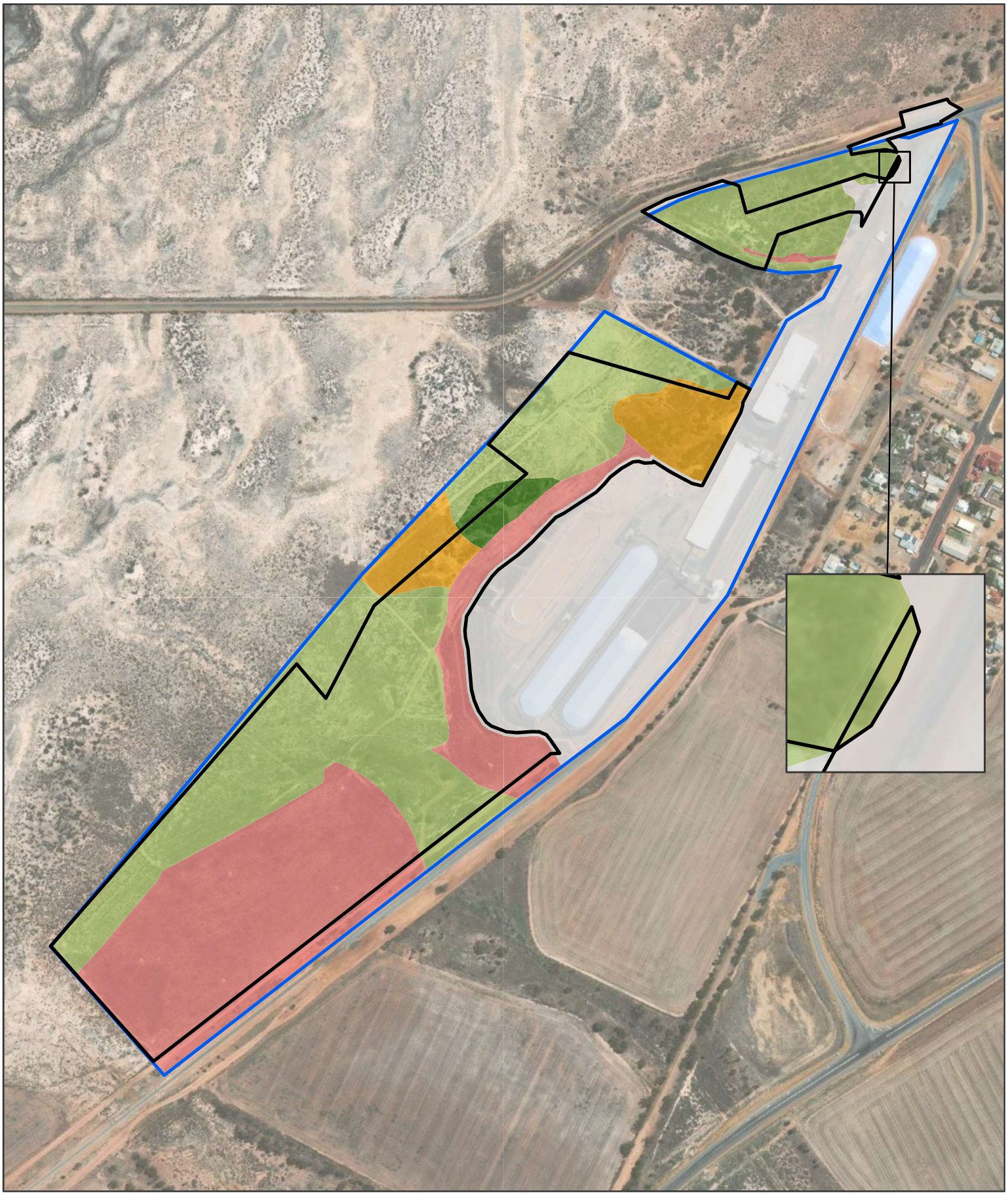

Figure 3-2: Vegetation condition within the Survey Area and Disturbance Footprint

3.3. Terrestrial fauna

3.3.1. Terrestrial fauna habitat

Of the four fauna habitats recorded within the Disturbance Footprint, the most widespread is Mixed low shrubland (7.8 ha; 40.7%), followed by Samphire shrubland (7.1 ha; 37.4%), *Hakea* and *Melaleuca* shrubland (2.1 ha; 10.8%) and *Eucalyptus loxophleba* woodland (1.4 ha; 7.6%) (Table 3-3; Figure 3-3; ELA 2021a). The remaining 0.7 ha (3.5%) is cleared.

Table 3-3: Fauna habitat within the Disturbance Footprint

Fauna habitat	Area (ha)	%
Eucalyptus loxophleba woodland	1.4	7.6
Samphire shrubland	7.1	37.4
Mixed low shrubland	7.8	40.7
Hakea and *Melaleuca* shrubland	2.1	10.8
Total fauna habitat	**18.4**	**96.5**
Cleared (i.e. existing receival site, roads, tracks)	0.7	3.5
Total	**19.1***	**100.0***

3.3.1. Terrestrial fauna species

A total of 27 vertebrate fauna species were recorded within the Survey Area (therefore, also considered to occur within the Disturbance Footprint), comprising 23 birds, three mammals and one reptile (ELA 2021a). No evidence of Threatened or Priority fauna species listed under the EPBC Act or the BC Act or listed by DBCA were recorded during the recent surveys (ELA 2021a, b; Invertebrate Solutions 2021).

A total of 23 conservation significant fauna species were identified from a desktop assessment as possibly occurring within the Survey Area (and therefore possibly occurring within the Disturbance Footprint), one of which was considered to potentially occur based on the availability of suitable habitat and proximity of nearby records: Carnaby's Cockatoo (*Zanda latirostris*) listed as Endangered under the EPBC Act and BC Act (ELA 2021a).

The remaining 22 fauna species are considered as unlikely to occur or do not occur based on lack of suitable habitat for these species and/distance of known records (ELA 2021a). This includes the Western Spiny-tailed Skink (*Egernia stokesii* subsp. *badia*), listed as Endangered under the EPBC Act (ELA 2021c), and any listed Threatened invertebrates which are considered unlikely to occur following targeted field surveys for these species (Invertebrate Solutions 2021).

3.3.1.1. Carnaby's Cockatoo

An assessment of Carnaby's Cockatoo habitat was undertaken in accordance with the Department of Sustainability, Environment, Water, Population and Communities (SEWPaC) EPBC Act referral guidelines for three threatened black cockatoo species (SEWPaC 2012; ELA 2021a). This survey was undertaken prior to the recent release of Referral Guideline for 3 species of black cockatoo (DCCEEW 2022), however the survey methodology is consistent with the new guideline.

Vegetation present within the Survey Area (and therefore, the Disturbance Footprint) was assessed for its potential to provide foraging, breeding and roosting habitat for Carnaby's Cockatoo, and the extent

of potential suitable habitat within the Survey Area was mapped. Observations were also made of any Carnaby's Cockatoo foraging activity or feeding residue such as chewed cones, *Eucalyptus* seeds or branch clippings, and any individuals within the Survey Area.

Potential breeding habitat for black cockatoos was also mapped as per the SEWPaC (2012) guideline and consisted of recording trees of suitable species with a Diameter at Breast Height (DBH) greater than 500 mm; >300 mm for Salmon Gum (*Eucalyptus salmonophloia*) and Wandoo (*Eucalyptus wandoo*) (SEWPaC 2012). Trees with a DBH greater than 500 mm (or >300 mm for Salmon Gum and Wandoo) are large enough to potentially contain hollows suitable for nesting Carnaby's Cockatoo or have the potential to develop suitable hollows over the next 50 years. Suitable nesting hollows (i.e. near vertical or vertical hollows with an entrance opening greater than 10 cm) were also recorded.

A description of the black cockatoo habitat assessment methodology is provided in Appendix C (ELA 2021a). The Survey Area and Disturbance Footprint only occur within the modelled distribution of Carnaby's Cockatoo (SEWPaC 2012), and so this species was the focus of the survey. The results of the habitat assessment are provided below.

3.3.1.1.1. Foraging habitat

Approximately 3.5 ha (18.4%) of poor quality foraging habitat for Carnaby's Cockatoo occurs within the Disturbance Footprint, mostly within the *Eucalyptus loxophleba* woodland and *Hakea* and *Melaleuca* shrubland fauna habitats (Table 3-4; Figure 3-4; ELA 2021a), with the majority (81.6%) of the Disturbance Footprint containing no foraging habitat (nil) for the species (Table 3-4; Figure 3-4).

Suitable foraging plant species present included *Hakea preissii* (Plate 1) and *Eucalyptus loxophleba* (Plate 2). Both species were present at a low density (i.e. 10-20% or less than 10%; Plate 1; Plate 2), resulting in the quality of the foraging vegetation being classed as 'poor' (Table 3-4; ELA 2021a).

No evidence of foraging by Carnaby's Cockatoo was observed within the within the Disturbance Footprint. However, two species records occur approximately 9 km northeast and 10 km east of the Disturbance Footprint, and as such the species is considered to have the potential to occur (ELA 2021a; Atlas of Living Australia 2022; DBCA 2020).

Foraging habitat for black cockatoos is generally defined as the availability of plant food sources within an area (Finn 2012). Food availability for black cockatoos is a function of the diversity, abundance, distribution, energetic and nutritional qualities, and seasonality (phenology) of the food sources within a particular area.

Carnaby's Cockatoo's foraging habitat was determined using vegetation associations defined in the vegetation assessment and from ground-truthing in the field. The quality of foraging habitat for Carnaby's Cockatoo within the Disturbance Footprint (as defined in Table 3-4) was assessed based on the availability and density of plant food sources as observed on site (ELA 2021a).

Table 3-4: Definition and extent of black cockatoo foraging habitat quality within the Disturbance Footprint

Foraging quality	Justification	Area (ha)	%
Good	High density of species suitable for foraging by black cockatoos (i.e. foliage cover of suitable species >60%) but food sources only present at one or two strata (e.g. canopy and midstorey).	0.0	0.0
Moderate	Moderate foraging value density of species suitable for foraging by black cockatoos (i.e. foliage cover of suitable species 20-40%) and food sources only present at one or two strata (e.g. canopy and midstorey).	0.0	0.0
Poor	Low density of species suitable for foraging by black cockatoos (i.e. foliage cover of suitable species 10-20%) and presence of food sources at only one stratum (i.e. canopy)	3.5	18.4
Nil	Cleared areas or no suitable vegetation present.	15.6	81.6
Total		**19.1**	**100.0**

Plate 1: *Hakea preissii* shrubs present at 5-10% cover (left) and 1% cover (right)

Plate 2: York Gum present at 2% cover (left) and 15% cover (right)

3.3.1.1.2. Breeding and roosting habitat

One potential breeding and roosting tree (a planted *Eucalyptus* sp.) for Carnaby's Cockatoo occurs within the Disturbance Footprint, of the three such trees identified within the Survey Area (Figure 3-4; ELA 2021a). This tree provides approximately 0.01 ha of potential roosting habitat. The other two potential breeding/roosting trees are immediately adjacent to the Disturbance Footprint (Figure 3-4). No evidence of Carnaby's Cockatoo utilising the Disturbance Footprint or Survey Area for breeding or roosting was observed during the survey.

These trees all have a DBH over 500 mm; however, none contained hollows suitable for breeding. It should be noted that *Eucalyptus* sp. (planted) is not a known or documented breeding tree for Carnaby's Cockatoo as defined in the SEWPaC (2012) or DCCEEW (2022) guidelines but has been included under the Precautionary Principle.

Searches of DBCA and Birdlife databases indicate that there are no known roosting sites within 12 km of the Disturbance Footprint; however, the Disturbance Footprint does occur on the edge of a known breeding buffer, indicating that there is a known breeding site within 20 km of the Disturbance Footprint (DBCA 2022). Given the low quality and degraded nature of the foraging habitat present within the Disturbance Footprint, it would be unlikely to support breeding should any occur nearby. In addition, the closest species record is approximately 8.6 km away and no evidence of Carnaby's Cockatoo utilising the Disturbance Footprint for foraging, breeding or roosting was observed during recent surveys (ALA 2022; DBCA 2020; ELA 2021a). Approximately 3,067 ha of native vegetation will remain within a 12 km radius of the Disturbance Footprint, although it is unknown how much represents suitable habitat for Carnaby's Cockatoo (DPIRD 2020).

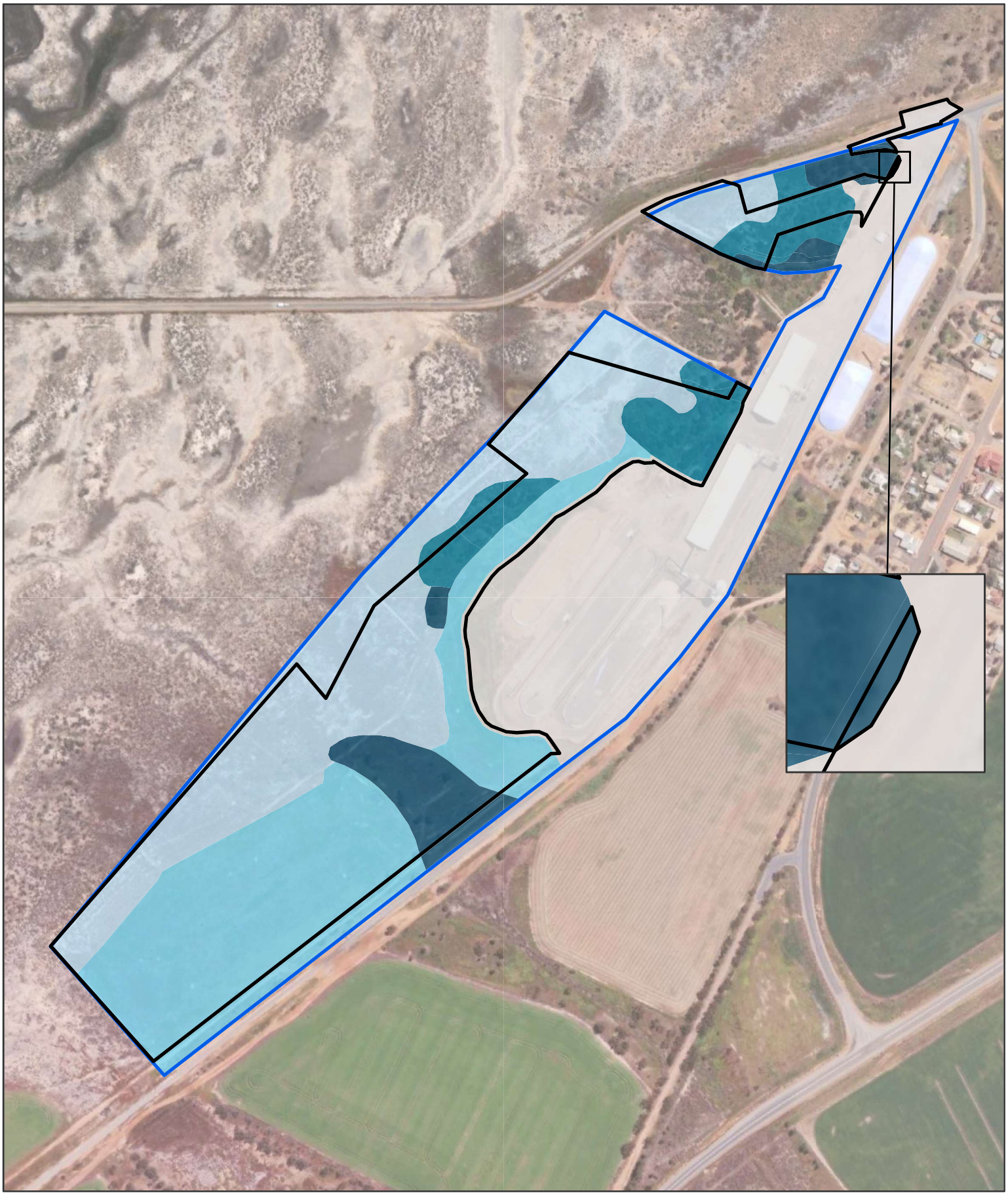

Figure 3-3: Fauna habitat recorded within the Survey Area and Disturbance Footprint

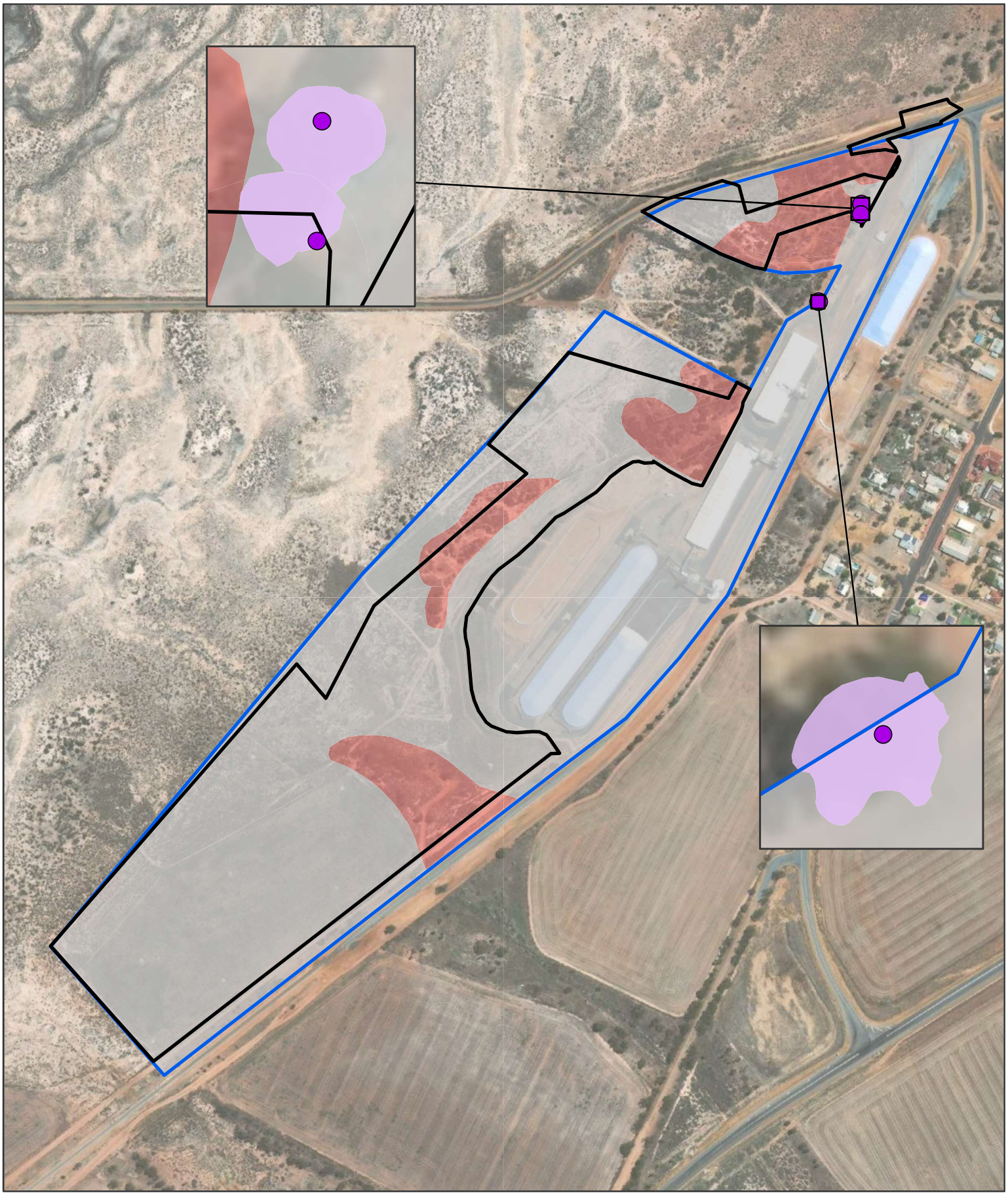

Figure 3-4: Carnaby's Cockatoo potential habitat within the Survey Area and Disturbance Footprint

Disturbance Footprint

Roosting Habitat

Potential Carnaby's Cockatoo Trees

Eucalyptus sp. (planted), DBH >50 cm, No Hollow

Carnaby's Cockatoo Foraging Habitat (ELA, 2021)

Poor

Nil

0 50 100 200

Metres

Datum/Projection:
GDA 1994 MGA Zone 50

Project: 20297-ED Date: 13/06/2023

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4. Clearing of Native Vegetation

Excluding activities that are exempt under Schedule 6 of the EP Act or section 5 (Prescribed Clearing) of the Environmental Protection (Clearing of Native Vegetation) Regulations 2004, all native vegetation clearing should be done in accordance with an NVCP.

4.1. Proposed clearing

The Proposal will include clearing up to 18.4 ha of native vegetation within a 19.1 ha Disturbance Footprint. This includes clearing:

- Approximately 3.5 ha of poor-quality foraging habitat for Carnaby's Cockatoo
- One potential breeding and roosting tree for Carnaby's Cockatoo, providing approximately 0.01 ha of potential roosting habitat.

The remaining 14.9 ha of native vegetation within the Disturbance Footprint does not contain any values for conservation significant listed flora, fauna or ecological communities.

Clearing will only be undertaken within the Disturbance Footprint. Vegetation or habitat values that occur adjacent to the Disturbance Footprint, including two adjacent potential breeding/roosting trees for Carnaby's Cockatoo, will be managed to avoid and minimise indirect impacts (described in Section 4.2 below).

4.2. Measures to avoid and mitigate clearing

All practicable measures to avoid and minimise disturbance and clearing will be undertaken. Measures taken to avoid and mitigate clearing and associated impacts include (but are not limited to):

- Redesigning the Disturbance Footprint to reduce impacts to native vegetation as far as practicable. The original Disturbance Footprint was reduced from 29.4 ha to 19.1 ha, avoiding up to approximately 4.8 ha of native vegetation.
- Reducing the original Disturbance Footprint boundary, avoiding approximately 1.5 ha of poor-quality foraging habitat and two potential breeding/roosting trees for Carnaby's Cockatoo.
- Revegetating areas disturbed for construction activities that will not be required for ongoing operations (1.1 ha; Section 4.2.1).
- Undertaking restoration planting and management activities (including weed control) within non-operational areas to improve the quality/condition of the native vegetation surrounding the site (2.6 ha; Section 4.2.1).
- Developing an environmental management plan (EMP) following the granting of the NVCP to manage the potential environmental impacts associated with clearing, construction and operational activities prior to clearing. The EMP will be prepared according to both industry and CBH standards to manage potential indirect impacts to prevent degradation of surrounding areas of native vegetation and Carnaby's Cockatoo habitat.
- Implementing operational measures to manage impacts associated with weeds and/or disease, wastewater or stormwater run-off, excessive dust and/or contamination from hazardous

material with the objective of minimising indirect impacts to areas of surrounding vegetation or habitat.

- Undertaking clearing progressively in the direction of a vegetated boundary to reduce the potential impact of the Proposal on fauna, thereby allowing fauna to move away from clearing activities to the surrounding remnant vegetation.

4.2.1. Onsite rehabilitation and revegetation

CBH proposes to rehabilitate three areas of native vegetation located adjacent to the Disturbance Footprint to improve the condition of the vegetation present (2.6 ha of vegetation in total). There are an additional two areas proposed to be cleared as part of construction activities undertaken for the Proposal that will not be required for ongoing operations. These additional areas (1.1 ha in total, located within the Disturbance Footprint), will be revegetated. The rehabilitation and revegetation areas are shown in Figure 4-1 and are all located within the Victoria Plains 631 pre-European vegetation association (DPIRD 2019a). There is 14.4% of this vegetation association remaining within the AVW02 IBRA subregion.

On-ground management activities will include targeted revegetation and supplementary planting, as well as activities such as clearing rubbish, soil ripping, installing/upgrading fencing and restricting access, and weed control. These on-ground management activities are intended to prevent further degradation and maintain or improve the quality and condition of existing remnant vegetation, or revegetate areas cleared for the Proposal.

Following site preparation activities within the rehabilitation and revegetation areas, native flora species will be planted to reflect the current vegetation communities present (ELA 2021a). A diverse mix of species will be used to create different strata (where appropriate) to provide a more complex and robust habitat. Planting will occur either via manual hand planting (seedlings) using a tree planting tool or tractor-mounted planting machine, or a combination of both, depending on site conditions on the advice of the revegetation contractor. Direct seeding is aimed at supplementing the seedlings and is expected to be mostly undertaken via a tractor-mounted machine, although some parts may be better suited to manual seeding. Seed used for seedlings and direct seeding will preferably be of local provenance (e.g. within 50 km of the Disturbance Footprint) where possible.

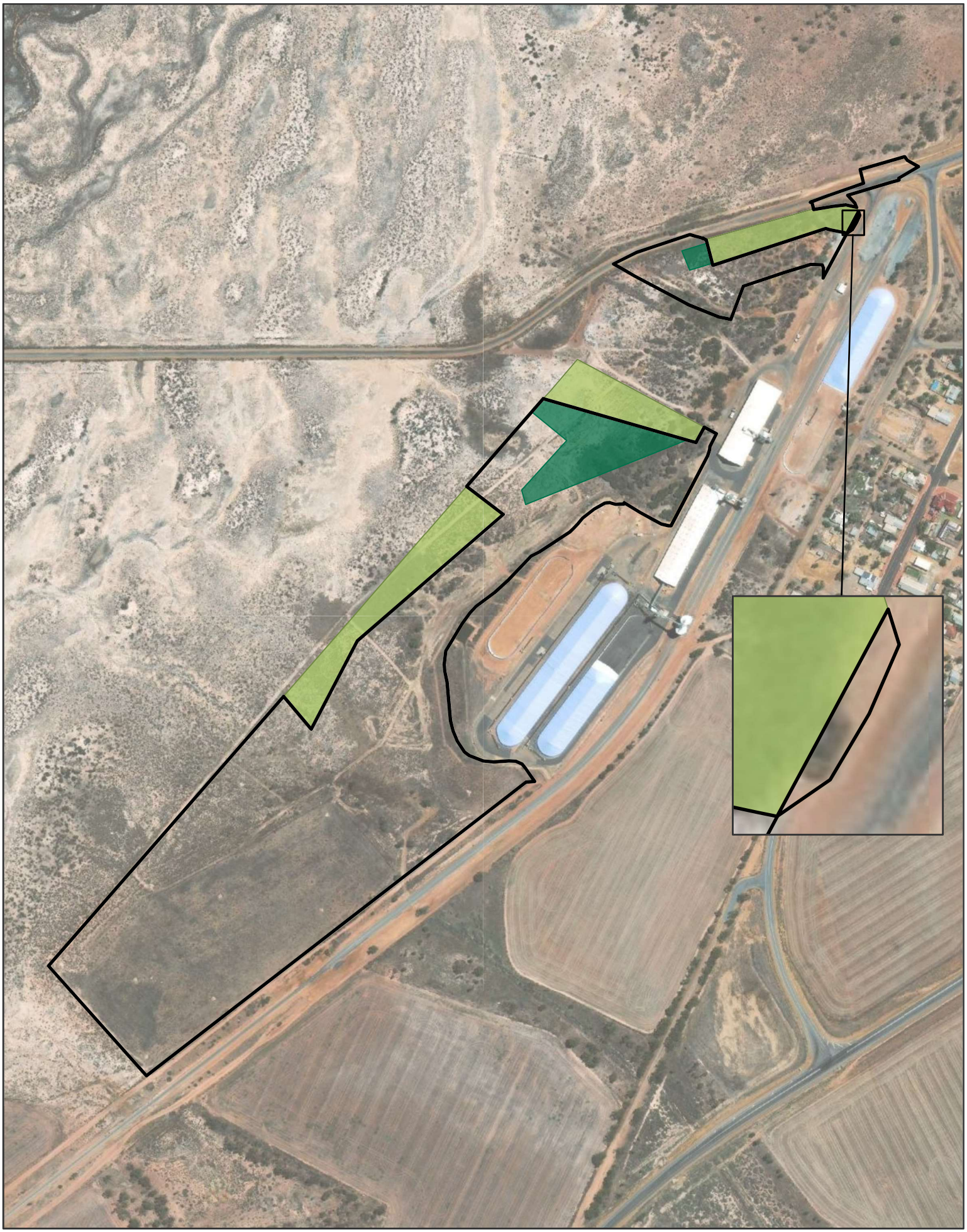

Figure 4-1: Proposed rehabilitation and revegetation areas

5. Assessment against the Ten Clearing Principles

A detailed assessment of the proposed clearing of up to 18.4 ha of native vegetation against the ten Clearing Principles contained in Schedule 5 of the EP Act is provided in Sections 5.1 to 5.10. Table 5-1 provides a summary of the assessment.

The Proposal is not considered to be at variance with nine of the Clearing Principles. However, it may be considered at variance to Principle e.

Table 5-1: Summary of assessment against the ten clearing principles

Clearing Principle	Is not at variance	May be at variance
a) Native vegetation should not be cleared if it comprises a high level of biological diversity	☒	☐
b) Native vegetation should not be cleared if it comprises the whole, or part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to Western Australia	☒	☐
c) Native vegetation should not be cleared if it includes or is necessary for the continued existence of Rare flora	☒	☐
d) Native vegetation should not be cleared if it comprises the whole, or part of, or is necessary for the maintenance of a threatened ecological community (TEC)	☒	☐
e) Native vegetation should not be cleared if it is significant as remnant vegetation in an area that has been extensively cleared	☐	☒
f) Native vegetation should not be cleared if it is growing in or in association with an environment associated with a watercourse or wetland	☒	☐
g) Native vegetation should not be cleared if the clearing of vegetation is likely to cause appreciable land degradation	☒	☐
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	☒	☐
i) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water	☒	☐
j) Native vegetation should not be cleared if the clearing of vegetation is likely to cause, or exacerbate, the incidence of flooding	☒	☐

5.1. Comprises a high level of biological diversity

Principle (a): Native vegetation should not be cleared if it comprises a high level of biological diversity.

A total of 79 flora species, representing 23 families and 60 genera were recorded within the Survey Area from a combination of 15 relevés and opportunistic collections (ELA 2021a). This includes 27 weed species, one of which is listed as a Declared Pest (section 22[2]) under the BAM Act: **Echium plantagineum* (Paterson's curse). Relevé ELA11 (located within the Disturbance Footprint) recorded the highest weed diversity, with 13 different weed species recorded within this area.

A total of six vegetation communities occur within the Disturbance Footprint, comprising two eucalypt woodland communities, three mixed shrubland communities and one samphire shrubland community (ELA 2021a). None of the vegetation communities mapped within the Disturbance Footprint represent TECs or PECs. The most widespread vegetation communities are VC2 (*Tecticornia undulata* and *T. pergranulata* low open samphire shrubland; 37.4%) and VC3 (*Acacia hemiteles* isolated shrubs over *Maireana brevifolia* and *Salsola australis* low open chenopod shrubland; 40.7%), with approximately 3.5% of the Disturbance Footprint comprising cleared areas or the existing grain receival site.

The species richness in the eucalypt woodlands recorded in relevés during the surveys ranged from 8 species to 14 species, with an average of 11.3 native species, which is less diverse than what could be expected from eucalypt woodland within the Avon Wheatbelt region of similar vegetation assemblages, where previous studies have found the average species found within a 100 m^2 quadrat ranges from on average 25 to 33 species (Harvey and Keighery 2012). Species from all the communities recorded are known from the Avon Wheatbelt region and are expected to be typical of flora within the region.

Half of the Disturbance Footprint contains poor quality or no vegetation, with 48.0% Degraded or Completely Degraded and 3.5% Cleared. None of the vegetation within the Disturbance Footprint is considered in Excellent or better condition, and a small part (1.8%) in Very Good condition. Less than half (46.7%) is in Good condition.

A total of 27 vertebrate fauna species were recorded within the Survey Area, consisting primarily of common bird species (23 bird species), three mammals (one of which is introduced) and one reptile (ELA 2021a). No evidence of Threatened or Priority fauna species listed under the EPBC Act or the BC Act or listed by DBCA were recorded within the Disturbance Footprint (ELA 2021a, c; Invertebrate Solutions 2021).

One conservation significant fauna species is considered to potentially occur based on the availability of suitable habitat and proximity of nearby records; Carnaby's Cockatoo listed as Endangered under the EPBC Act and BC Act (ELA 2021a). However, the habitat is considered poor quality due to the low density of the only two foraging species present. The remaining 22 fauna species identified in the desktop assessment with possibly occurring are considered as unlikely to occur or do not occur within the Survey Area (and therefore Disturbance Footprint) based on lack of suitable habitat for these species and/distance of known records (ELA 2021a).

5.1.1. Conclusion: Not at variance with this Principle

The Disturbance Footprint generally lacks significant values for Threatened and/or Priority listed species, ecological communities or habitat. The majority of the Disturbance Footprint contains poor condition vegetation or is cleared. Weed diversity was elevated (27 species recorded) and formed a high proportion (35%) of the total number of species recorded during the field survey; this was largely expected, given the surrounding pastoral land use. Overall, flora and fauna diversity in the Disturbance Footprint is not expected to be atypical high of that in extant native vegetation of the surrounding area. As such, the Disturbance Footprint is not considered to contain a high level of biodiversity. The biological diversity of areas immediately surrounding the Disturbance Footprint are not expected to be significantly affected, given the relatively small area of vegetation proposed for clearing (i.e. 18.4 ha) and given that mitigation measures will be implemented to prevent degradation to surrounding vegetation or habitat.

5.2. Potential impact to any significant habitat for fauna indigenous to Western Australia

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

The Disturbance Footprint comprises mostly mixed low shrubland (approximately 40.7% [7.8 ha]), followed by samphire shrubland (37.4% [7.1 ha]). Neither of these fauna habitats provide habitat for conservation significant fauna. Approximately 0.7 ha (3.5%) of the Disturbance Footprint is cleared and does not provide habitat for any fauna.

One conservation significant fauna species is considered to potentially occur within the Disturbance Footprint based on the availability of suitable habitat and proximity of nearby records; Carnaby's Cockatoo, listed as Endangered under the EPBC Act and BC Act (ELA 2021a). The remaining 3.5 ha of fauna habitat provides poor quality foraging habitat for Carnaby's Cockatoo. This includes approximately 1.4 ha of *Eucalyptus loxophleba* woodland and approximately 2.1 ha of *Hakea* and *Melaleuca* shrubland. These habitats contain two foraging species - York Gum and *Hakea preissii*, both of which are generally scattered and present at a low density; therefore, not expected to be a significant resource for Carnaby's Cockatoo. No evidence of Carnaby's Cockatoo utilising the Disturbance Footprint was observed during the recent surveys (ELA 2021a, c). In addition, whilst a potential breeding/roosting tree was recorded within the Disturbance Footprint, it does not currently contain hollows suitable for breeding of Carnaby's Cockatoo and has only been assigned 'potential breeding status' based on DBH.

The Disturbance Footprint does not contain any habitat for any other Threatened or Priority fauna species, and none are considered to possibly occur based on lack of suitable habitat and/distance of known records (ELA 2021a).

5.2.1. Conclusion: Not at variance with this Principle

The Proposal will remove approximately 18.4 ha of habitat for indigenous fauna species, including up to 3.5 ha of potential habitat for one conservation listed fauna species, Carnaby's Cockatoo. However, given the poor quality of the habitat present, this habitat is not considered significant to the survival of any indigenous fauna species, including Carnaby's Cockatoo. In general terms, the fauna habitats present were generally degraded and do not provide any ecological linkages to the surrounding areas. Approximately 3,067 ha of native vegetation will remain within a 12 km radius of the Disturbance Footprint.

5.3. Potential impact on any rare flora

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

No flora species listed as Threatened under the EPBC Act or BC Act or Priority flora species listed by DBCA were recorded or considered to possibly occur within the Disturbance Footprint following the field surveys. This was due to the lack of suitable habitat present, lack of species detection despite adequate survey effort during flowering season, and/or lack of nearby records (ELA 2021a, b).

5.3.1. Conclusion: Not at variance with this Principle

No Rare flora were recorded or are considered to possibly occur.

5.4. Potential of any threatened ecological communities

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

Two of the vegetation communities delineated within the Disturbance Footprint (VC1 and VC6) comprised eucalypt woodlands that had the potential to represent floristic and structural aspects of the Wheatbelt Woodlands TEC, as indicated in the Approved Conservation Advice for the community (DotEE 2015; ELA 2021a). However, assessment of these vegetation communities utilising key diagnostic characteristics of the Wheatbelt Woodlands TEC concluded that whilst some characteristics represented the Wheatbelt Woodlands TEC, others did not. Whilst crown cover was greater than 10% in VC1 (*Eucalyptus loxophleba* low open mallee woodland), this was dominated by a mallee eucalypt. Whilst VC6 (*E. loxophleba* open woodland) contained mature trees, the crown cover was less than 10% (2-5%). Therefore, neither vegetation community represents the Wheatbelt Woodland TEC.

5.4.1. Conclusion: Not at variance with this Principle

None of the vegetation communities present within the Disturbance Footprint comprise whole, or part of, a TEC.

5.5. Significance as a remnant of native vegetation in the area that has been extensively cleared

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

The Proposal is in Miling within the Shire of Moora, which occurs within the Avon Wheatbelt IBRA Bioregion. The Avon Wheatbelt has been extensively cleared for agriculture with approximately more than 80% of native vegetation cleared since European settlement (Government of Western Australia 2019).

Mapping of two pre-European vegetation associations occurs within the Disturbance Footprint: Victoria Plains 631 and Victoria Plains 142. The Proposal will result in clearing approximately 16.8 ha of Victoria Plains 631 and 1.7 ha of Victoria Plains 142. A small proportion of the pre-European extent of Victoria Plains 631 (14.4% or 1,702.9 ha) and Victoria Plains 142 (7.2% or 16,054.8 ha) remains within the AVW02 IBRA subregion (Government of Western Australia 2019). The proposed clearing represents 0.98% of the remaining extent of Victoria Plains 631 and 0.01% of the remaining extent of Victoria Plains 142 within AVW02. However, 1.1 ha of vegetation representing Victoria Plains 631 (representing 0.07% of the remaining extent of this vegetation association within AVW02), is proposed to be revegetated within the Disturbance Footprint to mitigate the impacts of the Proposal.

Six vegetation communities have been mapped within the Disturbance Footprint, which are predominantly represented by mixed *Acacia* shrubland and samphire shrublands, with some small areas of eucalypt woodland (ELA 2021a). These vegetation communities present are largely intact; however, at least 48.0% of the vegetation present is described as being in Degraded or lower condition, and a further 3.5% of the Disturbance Footprint is cleared (ELA 2021a).

Although the part of Victoria Plains 631 within the Disturbance Footprint is not what would typically be understood to be a large area (16.8 ha) and is in primarily in a poor condition, as the vegetation

association has been extensively cleared with only 14.4% of its previous extent extant, any further clearing may be considered significant. However, 1.1 ha of this association is proposed to be revegetated within the Disturbance Footprint post-construction. The clearing of 1.7 ha or 0.01% of Victoria Plains 142 is considered a very small impact and therefore is not significant.

5.5.1. Conclusion: May be at variance with this Principle

Although the native vegetation within the Disturbance Footprint can generally be characterised as representing minimal conservation significance value, it does occur in an extensively cleared landscape and thus the proposed clearing may be at variance to this principle.

5.6. Impact on any watercourses and/or wetlands

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

The Disturbance Footprint is located approximately 800 m from the Moore River North main channel, with associated saline flats occurring across the valley floor, extending across the Disturbance Footprint boundary in parts (VC2 and VC5). Excluding halophyte species, there is no true riparian vegetation located within the Disturbance Footprint. An intermittent unnamed minor drainage line (a minor [first-order] tributary of the Moore River North) runs through the Disturbance Footprint. Water management infrastructure will be installed and surface and groundwater flows will be managed within the Disturbance Footprint to avoid pooling of water and to ensure adequate drainage to five designated drainage basins. Water will be discharged from these basins off site when required, including downstream into the minor drainage line off site. No impacts are expected to the Moore River North due to the distance of the main river channel from the Disturbance Footprint.

5.6.1. Conclusion: Not at variance with this Principle

As there is no riparian vegetation present within the Disturbance Footprint, the clearing for the Proposal is not considered to be at variance to this Principle.

5.7. Potential to cause appreciable land degradation

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

The Disturbance Footprint is approximately 800 m from the Moore River North and contains salt flats. The saline content within the soil is moderate to high within a small area (1.4 ha) containing the halophyte vegetation VC2 and VC5 mapped as M2 '30-50% of map unit has a moderate to high salinity risk or is presently saline' (DPIRD 2019b). This same area is also at moderate risk of acid sulfate soils and wind erosion and is mapped as M1 (10-30% of map unit has pHCa <4.5 [DPIRD 2019c]) and H1 (50-70% of the map unit has a high to extreme wind erosion risk [DPIRD 2019d]).

The remaindering 92.6% of the Disturbance Footprint has a lower risk of salinity, acid sulfate soils and wind erosion and is marked as L1 '<3% of map unit has a moderate to high salinity risk or is presently saline' (DPIRD 2019b), L1 '<3% of map unit has pHCa <4.5' (DPIRD 2019c) and L1 '<3% of map unit has a high to extreme wind erosion risk' (DPIRD 2019d).

A site-specific geotechnical investigation (Coffey 2020) determined from analytical data obtained from 14 soil samples from 13 test pits in the Survey Area that no existing acidity (i.e. from historical acidification) or potential acidity appears to be present. The field pH (pH_F) and field oxidised pH (pH_{FOX}) values did not exceed the Department of Environment Regulation (DER 2015) Acid Sulfate Soil criteria.

The removal of vegetation has the potential to cause stormwater ponding on or near the surface due to the poorly drained salt flats. However, water management infrastructure will be installed and surface and groundwater flows will be managed within the Disturbance Footprint to avoid pooling of water and flooding and to ensure adequate drainage to designated areas.

5.7.1. Conclusion: Not at variance with this Principle

The Proposal is not expected to result in severe water logging, land degradation, acid sulfate soils, water or wind erosion within the Disturbance Footprint or immediate surroundings following management measures. The Proposal is not expected to be at variance to this Principle.

5.8. Potential to impact on the environmental values of adjacent or nearby conservation areas

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

There are no nature reserves or conservation areas within 20 km of the Disturbance Footprint.

5.8.1. Conclusion: Not at variance with this Principle

The Proposal is not considered to be at variance with this Principle.

5.9. Potential deterioration in the quality of surface or underground water

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

Groundwater underlying the entire Disturbance Footprint is expected to have a salinity of between 7,000-14,000 mg/L (saline/highly saline), due to its proximity to the Moore River and the presence of salt flats (DWER 2018). The Disturbance Footprint is not located within a Public Drinking Water Source Area (DWER 2022).

Saline content within the soil is moderate to high within a small area of 1.4 ha located in the northwest of the Disturbance Footprint. This area contains the halophyte vegetation VC2 and VC5 and is mapped as M2 '30-50% of map unit has a moderate to high salinity risk or is presently saline'. This same area is also at moderate risk of acid sulfate soils and is mapped as M1 (10-30% of map unit has pHCa <4.5 [DPIRD 2019b]). The remainder of the Disturbance Footprint has a lower risk of salinity and acid sulfate soils and is marked as L1 '<3% of map unit has a moderate to high salinity risk or is presently saline' (DPIRD 2019a) and L1 '<3% of map unit has pHCa <4.5' (DPIRD 2019b). An intermittent unnamed minor drainage line (a minor tributary of the Moore River North) runs through the Disturbance Footprint.

A site-specific geotechnical investigation (Coffey 2020) determined from the analytical data obtained from 14 soil samples from 13 test pits in the Survey Area that no existing (from historical acidification) or potential acidity appears to be present. Although the pH_F and pH_{FOX} values did not exceed the DER

(2015) Acid Sulfate Soil criteria, they are still considered to be moderately low. However, future testing would be required to confirm the net acidities within the soil profile.

Water management infrastructure will be installed and surface and groundwater flows will be managed within the Disturbance Footprint to avoid pooling of water and to ensure adequate drainage to designated areas, including downstream into the minor drainage line offsite. Drainage design will also be finalised as development of the project progresses, to ensure stormwater capacity is sufficient under final constructed conditions.

Management of water quality and hydrocarbon and chemical storage will be consistent with CBH Environmental Management Standards which outlines minimum requirements for water quality, management of spills, and other mandatory water management measures that must be implemented.

5.9.1. Conclusion: Not at variance with this Principle

The Proposal is unlikely to cause deterioration in the quality of surface or underground water and is therefore not at variance with this Principal.

5.10. Potential of clearing to cause, or exacerbate, the incidence of flooding

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

The Disturbance Footprint is relatively flat and low lying, ranging from 250 to 252 m Australian Height Datum (AHD) to the east (Landgate 2021). There is potential for the development of perched groundwater tables at the site following periods of rainfall, with depth to perched groundwater ranging from 1.3-2.3 m below ground level (Coffey 2020). The Miling area receives low levels of rainfall; on average 369 mm per annum (BoM 2022). Surface water flows will be managed within the proposed clearing area, to avoid pooling of water and flooding, and to ensure adequate drainage into designated areas.

5.10.1. Conclusion: Not at variance with this Principle

The Proposal design will manage water flows on site and is not anticipated to cause or exacerbate flooding. The Proposal is therefore not considered to be at variance with this Principle.

6. Stakeholder Consultation

Stakeholder consultation will be required prior to native vegetation clearing and the implementation of the Proposal.

Sections of the Development Envelope occur on Crown land. Detailed consultation has been undertaken with the PTA (rail reserve) and Shire of Moora (road reserve) regarding CBH use of this land, including vegetation clearing. Letters of Authority from these entities are attached in Appendix B.

A pre-referral meeting was held with DCCEEW held on 2 June 2022. During the meeting, a number of key areas that required further information or clarification were discussed including:

- Advice to double check accuracy of figures
- Impact assessment on indirectly affected habitat
- Confirmation of the number of trees within the clearing footprint
- Our advice to address each EPBC matter within the environmental reporting tool, even if they were not present during the surveys.

The Proposal was referred to the DCCEEW on 15 August 2022 (EPBC number 2022/09336). On 24 November 2022, the Minister for the Environment determined that the Proposed action is not a controlled action under section 75 of the EPBC Act, and therefore does not require assessment under the EPBC Act.

A Heritage due diligence report was prepared for the proposed project for CBH by Archae-aus in March 2022. An Activity Notice for the proposed project was issued to Southwest Aboriginal Land and Sea Council on 25 March 2022.

7. References

Atlas of Living Australia (ALA). 2022. *Occurrence records: Calyptorhynchus latirostris*. Retrieved on October 2022. Available at: https://biocache.ala.org.au/

Beard, J.S. 1975. *The vegetation survey of Western Australia.* Explanatory notes to Sheet 4, 1:1,000,000 Series Vegetation Survey of Western Australia. University of Western Australia Press, Nedlands, WA.

Beecham, B. 2001. Avon Wheatbelt 2 (AW2 – Re-juvenated Drainage subregion). In '*A Biodiversity Audit of Western Australia's 53 Biogeographical Subregions in 2002*'. Department of Conservation and Land Management, Kensington, WA.

Bureau of Meteorology (BoM) 2022. *Climate Data Online*. Available from: http://www.bom.gov.au/climate/data/index.shtml

Coffey Services Australia (Coffey). 2020. *Future Expansion Works (Land Due Diligence) CBH Miling. Geotechnical Investigation Report*. Prepared for CBH Group.

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

Department of Biodiversity, Conservation and Attractions (DBCA). 2020. *Threatened, Specially Protected and Priority Fauna Database Search Request # 2020/000669 #6500*.

Department of Agriculture, Water and the Environment (DAWE) 2021. *Australia's bioregions (IBRA).* Available from: https://www.environment.gov.au/land/nrs/science/ibra

Department of Biodiversity, Conservation and Attractions (DBCA). 2022. *Carnaby's Cockatoo Datasets*. Available from: Datasets - data.wa.gov.au. Accessed February 2022.

Department of Climate Change, Energy, the Environment and Water (DCCEEW). 2022. *Referral guideline for 3 WA threatened black cockatoo species: Carnaby's Cockatoo, Baudin's Cockatoo and the Forest Red-tailed Black cockatoo.* Department of Agriculture, Water and the Environment, Canberra, February.

Department of Environment (DoE) 2013. *Matters of National Environmental Significance: Significant impact guidelines 1.1 Environment Protection and Biodiversity Conservation Act 1999.* Australian Government, Canberra.

Department of Environment Regulation (DER). 2015. *Identification and Investigation of Acid Sulfate Soils and Acidic Landscapes*. Perth, WA.

Department of Parks and Wildlife (DPaW). 2013. *Carnaby's Cockatoo (Calyptorhynchus latirostris) Recovery Plan*. Perth, WA.

Department of Primary Industries and Regional Development (DPIRD) 2019a. *Pre-European Vegetation (DPIRD-006)*. Available from: Pre-European Vegetation (DPIRD-006) - Datasets - data.wa.gov.au.

Department of Primary Industries and Regional Development (DPIRD) 2019b. *Soil landscape land quality - Salinity Risk (DPIRD-009).* Available from: Soil landscape land quality - Salinity Risk (DPIRD-009) - Datasets - data.wa.gov.au

Department of Primary Industries and Regional Development (DPIRD) 2019c. *Soil landscape land quality - Surface Acidity (current) (DPIRD-035).* Available from: Soil landscape land quality - Surface Acidity (current) (DPIRD-035) - Datasets - data.wa.gov.au

Department of Primary Industries and Regional Development (DPIRD) 2019d. *Soil Landscape Land Quality – Wind Erosion Risk (DPIRD-016).* Available from: Soil landscape land quality - Wind Erosion Risk (DPIRD-016) - Datasets - data.wa.gov.au

Department of Primary Industries and Regional Development (DPIRD) 2020*. Native Vegetation Extent (DPIRD-005).* Available from: https://catalogue.data.wa.gov.au/dataset/native-vegetation-extent.

Department of Primary Industries and Regional Development (DPIRD) 2022. *Western Australian Organism List (WAOL).* Available from: Western Australian Organism List | Agriculture and Food.

Department of Planning, Lands and Heritage (DPLH). 2021. *Aboriginal Heritage Inquiry System.* [Online]. Accessed June 2021. Available from https://espatial.dplh.wa.gov.au/AHIS/index.html?viewer=AHIS.

Department of Sustainability, Environment, Water, Populations and Communities (SEWPaC). 2012. *EPBC Act referral guidelines for three threatened black cockatoo species: Carnaby's Cockatoo (Endangered) Calyptorhynchus latirostris, Baudin's Cockatoo (Vulnerable) Calyptorhynchus baudinii, Forest Red-tailed Black cockatoo (Vulnerable) Calyptorhynchus banksii naso*. Australian Government Department of Sustainability, Environment, Water, Populations and Communities, Canberra, ACT.

Department of the Environment and Energy (DotEE) 2015. *Approved Conservation Advice (including listing advice) for the Eucalypt Woodlands of the Western Australian Wheatbelt*. Department of the Environment and Energy, Canberra, ACT. Available from: http://www.environment.gov.au/biodiversity/threatened/communities/pubs/128-conservation-advice.pdf

Department of Water and Environmental Regulation (DWER) 2018. *Groundwater Salinity Statewide (DWER-026).* Available from: Groundwater Salinity Statewide (DWER-026) - Datasets - data.wa.gov.au

Department of Water and Environmental Regulation (DWER) 2022. *Public Drinking Water Source Areas (DWER-033).* Available from: Public Drinking Water Source Areas (DWER-033) - Datasets - data.wa.gov.au

Eco Logical Australia (ELA) 2021a. *Miling Grain Receival Site Expansion Flora and Fauna Survey.* Prepared for CBH Group.

Eco Logical Australia (ELA) 2021b. *Targeted Flora Survey Report for the CBH Miling Expansion Project, Western Australia*. Prepared for CBH

Eco Logical Australia (ELA) 2021c. *Desktop assessment and targeted survey for Western Spiny-tailed Skink for the CBH Miling Expansion Project, Western Australia*. Prepared for CBH Group

Finn, H. 2012. *Assessment of habitat values for black-cockatoos within selected sites at Newmont Boddington Gold Mine*. Report prepared for Newmont Boddington Gold Pty Ltd.

Glossop, B., Clarke, K., Mitchell, D. and Barrett, G. 2011. *Methods for mapping of Carnaby's cockatoo habitat.* Available from: https://catalogue.data.wa.gov.au/dataset/carnabys-cockatoo-confirmed-breeding-areas/resource/879bf052-d309-4876-8920-d90793c9544f/view/0d928e1f-54b5-4c94-8414-3ddf24a5184c. Accessed March 2022.

Government of Western Australia. 2019. *2018 Statewide Vegetation Statistics incorporating the CAR Reserve Analysis (Full Report). Current as of March 2019.* WA Department of Biodiversity, Conservation and Attractions, Perth, WA. Available from https://catalogue.data.wa.gov.au/dataset/dbca-statewide-vegetation-statistics

Harvey, J. M. and Keighery, G.J. 2012. *Benchmarking Wheatbelt Vegetation Communities. Classification and Description of Eucalypt Woodlands*. Wheatbelt Baselining Project. Wheatbelt Natural Resource Management Region and Department of Parks and Wildlife. Perth, Western Australia.

Invertebrate Solutions 2021. *Desktop assessment and targeted survey for SRE fauna for the CBH Miling Expansion Project, Western Australia*. Unpublished report to Eco Logical Australia Pty Ltd on behalf of Co-operative Bulk Handling Group Ltd, October 2021.

Keighery, B. J. 1994. *Bushland Plant Survey: A guide to plant community survey for the community.* Wildflower Society of Western Australia, Nedlands, WA.

Landgate 2021. Locate v5. *The Western Australian Land Information Authority.* Available from https://www0.landgate.wa.gov.au/maps-and-imagery/interactive-maps/locate

Purdie, B R, Tille, P J, and Schoknecht, N R. 2004*. Soil-landscape mapping in south-Western Australia: an overview of methodology and outputs.* Report 280, Department of Agriculture and Food Western Australia, Perth, WA.

Shepherd, D. P., Beeston, G. R. and Hopkins, A. J. M. 2002. *Native vegetation in Western Australia - extent, type and status.* Resource Management Technical Report 249. Department of Agriculture, South Perth, WA.

Appendix A Certificates of title

Appendix B Letters of Authority

Appendix C Miling Grain Receival Site Expansion Flora and Fauna Survey

Miling Grain Receival Site Expansion Flora and Fauna Survey

CBH Group

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DOCUMENT TRACKING

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Prepared by	Briana Wingfield
Reviewed by	**Jeff Cargill**
Approved by	**Jeff Cargill**
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Template 2.8.1

Contents

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Abbreviations

Abbreviation	Description
BAM Act	Biosecurity and Agriculture Management Act 2007 (Western Australia)
BC Act	Biodiversity Conservation Act 2016 (Western Australia)
BoM	Bureau of Meteorology
CBH	CBH Group
DAWE	Department of Agriculture, Water and the Environment
DBCA	Department of Biodiversity, Conservation and Attractions (Western Australia)
DBH	Diameter at Breast Height
DotEE	Department of the Environment and Energy (now DAWE)
ELA	Eco Logical Australia
EP Act	Environmental Protection Act 1986 (Western Australia)
EPA	Environmental Protection Authority (Western Australia)
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999
ESA	Environmentally Sensitive Area
IBRA	Interim Biogeographic Regionalisation for Australia
PEC	Priority Ecological Community
RCC	Roadside Conservation Committee of Western Australia
RCV	Roadside Conservation Value
SEWPaC	Department of Sustainability, Environment, Water, Population and Communities
TEC	Threatened Ecological Community
WAH	Western Australian Herbarium
WAM	Western Australian Museum
WAOL	Western Australian Organism List
Wheatbelt Woodlands TEC	Eucalyptus Woodlands of the Western Australian Wheatbelt Threatened Ecological Community
WoNS	Weed of National Significance

Executive Summary

Eco Logical Australia was engaged by CBH Group to conduct a Reconnaissance level flora and vegetation survey, a Basic fauna survey and Targeted conservation significant fauna species survey of the CBH Miling Grain Receival Site, totalling approximately 34 hectares (ha).

A desktop assessment reviewed relevant government databases within various buffers of the survey area to evaluate the potential for presence of conservation significant flora and fauna species and ecological communities listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), the *Biodiversity Conservation Act 2016* (BC Act) and by the Department of Biodiversity, Conservation and Attractions (DBCA).

The Reconnaissance flora and vegetation survey was undertaken in October 2020 in accordance with the Environmental Protection Authority *Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment* (2016). A total of 79 flora species, representing 23 families and 60 genera, were recorded from a combination of 15 relevés and opportunistic collections. Of these species, 27 introduced (weed) flora species were recorded one of which, **Echium plantagineum* (Paterson's curse), is a Declared Pest (s22[2]) under the State *Biosecurity and Management Act 2007*. The high proportion of introduced flora species (33%) was largely expected, given the surrounding pastoral land use.

No Threatened or Priority flora species listed under the EPBC Act or the BC Act, or listed by DBCA were recorded within the survey area. Of the 51 conservation significant flora species identified from the desktop assessment as possibly occurring within the survey area, one species was identified with the Potential to occur (*Urodon capitatus*), and two species were identified as Likely to occur (*Caladenia drakeoides* and *Caladenia cristata*).

A total of six vegetation communities were delineated and mapped within the survey area, comprising two eucalypt woodland communities (VC1 and VC6), three mixed shrubland communities (VC3, VC4 and VC5) and one samphire shrubland community (VC2). The most widespread community was VC2, which covered 9.44 ha (27.85%) of the survey area. Cleared areas, including roads and tracks, cover the majority (10.65 ha, 31.43%) of the survey area. The following vegetation communities were mapped within the survey area:

- VC1: *Eucalyptus loxophleba* low open mallee woodland;
- VC2: *Tecticornia undulata* and *T. pergranulata* low open samphire shrubland;
- VC3: *Acacia hemiteles* isolated shrubs over *Maireana brevifolia* and *Salsola australis* low open chenopod shrubland;
- VC4: *Casuarina obesa*, *Hakea preissii*, *Melaleuca lateriflora* and *M. stereophloia* tall shrubland;
- VC5: *Acacia lineolata* subsp. *lineolata*, *Melaleuca lateriflora* and *Hakea preissii* tall sparse shrubland; and
- VC6: *E. loxophleba* open woodland.

The E*ucalyptus Woodlands of the Western Australian Wheatbelt* threatened ecological community, listed as Critically Endangered under the EPBC Act, and Priority 3 by the DBCA, potentially occurs within the survey area. An assessment was undertaken utilising the key diagnostic characteristics of the threatened ecological community, as described in *Approved Conservation Advice (including listing advice) for the Eucalypt Woodlands of the Western Australian Wheatbelt* (Department of the

Environment and Energy [now Department of Agriculture, Water and the Environment] 2015). This key diagnostic assessment concluded that no vegetation communities mapped within the survey area are likely to represent the *Eucalyptus Woodlands of the Western Australian Wheatbelt* threatened ecological community.

A Basic fauna survey and Targeted conservation significant fauna species survey was undertaken within the survey area in accordance with the EPA *Technical Guidance: Terrestrial vertebrate fauna surveys for environmental impact assessment* (2020), *EPBC Act Referral Guidelines for Three Threatened Black Cockatoo Species* (SEWPaC 2012), *Survey Guidelines for Australia's threatened reptiles* (SEWPaC 2011) and EPA *Technical Guidance: Sampling of short range endemic invertebrate fauna* (EPA 2016b). A total of 27 vertebrate fauna species were recorded within the survey area, comprising 23 birds, three mammals and one reptile.

No Threatened or Priority fauna species listed under the EPBC Act or the BC Act, or listed by DBCA were recorded within the survey area. Of the 23 conservation significant fauna species identified from the desktop assessment as possibly occurring within the survey area, three species were identified as having the Potential to occur (Carnaby's Cockatoo [*Calyptorhynchus latirostris*], Western Spiny-tailed Skink [*Egernia stokesii* subsp. *badia*] and Shield-backed Trapdoor Spider [*Idiosoma nigrum*]).

The Carnaby's Cockatoo habitat assessment identified three potentially suitable breeding trees within the survey area, none of which contained hollows or potentially suitable hollows (over 100 mm in diameter). Foraging habitat within the survey area was classed as 'Poor' quality (5.06 ha, 14.93%), or 'Nil' quality (28.82 ha, 85.04%) where no suitable habitat was found. No evidence of foraging by Carnaby's Cockatoo was observed within the survey area.

Potential habitat was identified by Cardno *Level 1 Flora and Fauna Survey* (2014) for the Western Spiny-tailed Skink and Shield-backed Trapdoor Spider, therefore basic habitat assessments for these species was undertaken during the field survey. No Western Spiny-tailed Skink or Shield-backed Trapdoor Spider individuals or secondary signs were recorded. In the survey area, 'Poor' quality habitat (2.23 ha, 6.58%) was recorded in association with the *Eucalyptus loxophleba* woodland fauna habitat for both species.

Four fauna habitats were recorded within the survey area; *Eucalyptus loxophleba* woodland, Samphire shrubland, Mixed low shrubland and *Hakea* and *Melaleuca* shrubland.

1. Introduction

1.1 Project Background

Eco Logical Australia (ELA) was engaged by CBH Group (CBH) to conduct a Reconnaissance level flora and vegetation survey, a Basic fauna survey and Targeted conservation significant fauna species survey of the CBH Miling Grain Receival Site (the survey area) totalling approximately 34 ha (**Figure 1**). Miling is in the Shire of Moora, approximately 200 kilometres (km) north-east of Perth, Western Australia.

This survey is to inform the revision of the Miling Environmental Management Plan (EMP) and a future expansion of the Miling Grain Receival Site.

Figure 1: Site overview

Legend

Survey area

Service Layer Credits: Esri, HERE, Garmin, (c) OpenStreetMap contributors

0 50 100 200
Metres

Datum/Projection:
GDA 1994 MGA Zone 50

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Prepared by: SC Date: 18/02/2021

2. Environmental setting

2.1 Climate

The survey area is located in the Avon Wheatbelt bioregion, as defined by the Interim Biogeographic Regionalisation for Australia (IBRA; Department of Agriculture, Water and the Environment [DAWE] 2021). The region is described as having a semi-arid (dry) and warm Mediterranean Climate (Beecham 2001). Based on the Bureau of Meteorology (BoM) Miling weather station (station number 8085, climate data 1924-present), the area receives, on average, 364.3 mm of rainfall a year, with most rainfall occurring during the winter months of June and July (62.3 mm and 62.5 mm respectively; BoM 2021; **Table 1**).

In the 12 months preceding the field survey in October 2020, the area received a total of approximately 271 mm which is significantly below the long-term average (BoM 2021). In the three months preceding the field survey, a total of 97.9 mm of rainfall was recorded from the survey area, which is below the long-term average for the same time period (137.4 mm).

Table 1: Rainfall data recorded at the Miling weather station (8085) 12 months prior to the field survey compared to the long-term average (BoM 2021)

Rainfall (mm)	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
Average rainfall (mm) 1924-present	17.9	9.8	9.8	15.4	16.6	19.0	21.4	47.5	62.3	62.5	48.6	26.3	364.3
Rainfall (mm) 2019-2020	0.0	0.0	0.0	0.0	87.7	7.4	6.0	27.8	44.2	24.0	70.2[1]	3.7[1]	271[1]

[1]Miling weather station (8085) did not have any data for August or September 2020, therefore this data is from the next closest weather station, Mindalla (8087) which is 12 km from the survey area

2.2 Landform, topography and soils

The survey area is situated on the Goomalling soil landscape system (Landgate 2021 and Purdie et. al. 2004), details of which are given in Table 2.

Table 2: Soil landscape systems within the survey area

Soil Landscape System	Soil Landscape Zone	Description
Goomalling System	Xd2	Poorly drained valley flats, in the northern Zone of Rejuvenated Drainage, with grey deep sandy duplex (sometimes alkaline) and saline wet soil. York Gum-Jam-Wandoo-Salmon Gum-Sheoak woodland.

2.3 Hydrology

The survey area is located in the Moore-Hill Rivers Basin, within the Moore River catchment. No major or minor drainages run through or are adjacent to the survey area.

2.4 Interim Biogeographic Regionalisation for Australia

Under the current version 7 of IBRA, the survey area is situated within the Avon Wheatbelt IBRA Bioregion and AVW02- Katanning subregion (DAWE 2021a). The Avon Wheatbelt bioregion is described as a dissected plateau of Tertiary laterite in the Yilgarn Craton with a semi-arid (dry) warm

Mediterranean climate (Beecham 2001). The AVW02 subregion is further described as comprised of gently undulating rises to low hills with abrupt breakaways; its drainage is rejuvenated and comprises continuous stream channels that flow in most years. Residual lateritic uplands and derived sandplains are covered by areas of proteaceous scrub-heaths (which are rich in endemic species) and quaternary surfaces of erosional slopes and valley floors support woodlands of Wandoo, York gum, Jam and Casuarina (Beecham 2001).

2.5 Beard's (1975) Vegetation Mapping

Vegetation type and extent have been mapped at a regional scale by Beard (1975) who categorised vegetation into broad vegetation associations. Based on this mapping at a scale of 1:1,000,000, the Department of Primary Industries and Regional Development (previously Department of Agriculture and Food Western Australia) has compiled a list of vegetation extent and types across WA (Shepherd et al. 2002).

Two vegetation associations occur within the survey area, namely Victoria Plains 142 and Victoria Plains 631. Victoria Plains 631 covers almost all of the survey area and Victoria Plains 142 occurs along the south-eat border of the survey area. Details of these vegetation associations are given in **Table 3**. Both associations have only have a small proportion of their pre-European extent within the AVW02 IBRA subregion remaining (Government of Western Australia 2019).

Table 3: Beard's (1975) vegetation associations of the survey area (Government of Western Australia 2019)

Vegetation association	Description	Pre-European extent within AVW02 subregion (ha)	Current extent within AVW02 subregion (ha)	% remaining within AVW02 subregion
Victoria Plains 142	Medium woodland; York gum & salmon gum	224,265.61	16,054.80	7.16
Victoria Plains 631	Succulent steppe with woodland and thicket; York gum over *Melaleuca thyoides* & samphire	11,821.43	1,702.93	14.41

2.6 Areas of Conservation Significance

Environmentally Sensitive Areas (ESAs) are defined in the *Environmental Protection (Environmentally Sensitive Areas) Notice 2005* under s 51B of the State *Environmental Protection Act 1986* (EP Act). ESAs include areas declared as World Heritage, included on the Register of the National Estate, defined wetlands, and vegetation containing rare (Threatened) flora and Threatened Ecological Communities (TECs).

Priority Ecological Communities (PECs) are biological flora or fauna communities that are recognised by the WA Minister for Environment to be of significance, but which do not meet the criteria for a TEC. There are five categories of PECs, none of which are currently protected under State or Federal legislation.

The *Eucalyptus Woodlands of the Western Australian Wheatbelt* (Wheatbelt Woodlands) TEC, listed as Critically Endangered [CR] under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and Priority [P] 3 by the Western Australian Department of Biodiversity, Conservation and Attractions (DBCA), occurs throughout the wheatbelt region in southwestern Western Australia, in which the survey area is located.

3. Methodology

3.1 Desktop Assessment

3.1.1 Database Searches

The following Commonwealth and State databases were searched for existing data and information relating to conservation significant flora and ecological communities in order to inform the field survey. Database searches undertaken for the survey area are provided in **Table 4** below. Applied search areas given below are considered suitable based on flora and fauna assemblages expected to occur within the survey area.

Table 4: Database searches undertaken for the survey area

Database	Reference	Radius of search area (km)
EPBC Act Protected Matters Search Tool for Threatened species and communities listed under the EPBC Act.	DAWE 2021b	20
DBCA and Western Australian Museum (WAM) NatureMap online database for flora and fauna.	DBCA 2007-2021	20
DBCA Threatened and Priority flora database searches for Declared Rare Flora (DRF) listed under the latest WA Wildlife Conservation (Rare Flora) Notice and Priority Flora.	DBCA 2020a	30
DBCA Threatened and Priority fauna database searches for Scheduled fauna listed under the EPBC Act or latest WA Wildlife Conservation (Specially Protected Fauna) Notice and Priority Fauna.	DBCA 2020b	65
DBCA Threatened and Priority Ecological Communities' database search	DBCA 2020c	20

3.1.2 Likelihood of occurrence assessment

A likelihood of occurrence assessment was undertaken to identify conservation significant flora species that possibly occur within the survey area, identified from a review of key datasets and literature outlined in the above section. Conservation codes, categories and criteria for flora and fauna protected under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and the *Biodiversity Conservation Act 2016* (BC Act) are provided in **Appendix A**. Criteria used for this assessment are presented in **Appendix B**. The flora likelihood assessment is shown in **Appendix C** and that for fauna in **Appendix D**.

3.2 Field Survey

3.2.1 Survey Team and Timing

A Reconnaissance level flora and vegetation survey, a Basic fauna survey and a Targeted conservation significant fauna species survey were undertaken over one day on 21st October 2020. The survey team's relevant qualifications, experience and licences are provided in **Table 5** below. No rainfall was recorded during the field survey (BoM 2021).

Table 5: Survey Team

Name	Qualification	Relevant experience	Licences
Daniel Brassington	BSc. Hons. Environmental Science	Daniel has more than 10 years' experience in botanical surveys and environmental services throughout Western Australia. This includes baseline vegetation studies, threatened and priority flora surveys, weed surveys, rehabilitation and vegetation monitoring.	Flora scientific collection licence: SL012503 DRF permit: TFL 15-1920
Briana Wingfield	BSc. Conservation and Wildlife Biology and Environmental Science (Hons)	Briana has seven years' experience conducting fauna surveys across Western Australia, including basic fauna surveys and targeted black cockatoo habitat assessments.	N/A

3.2.2 Flora and Vegetation Survey

A Reconnaissance flora and vegetation survey was conducted in accordance with the Environmental Protection Authority (EPA) *Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016a).

A total of 15 relevés were established within the survey area (**Figure 2**). Broad vegetation communities were described with respect to dominant species, structure and overall condition. The following data was recorded within each relevé:

- Site details (site name, number, observer/s, date and location);
- Broad vegetation type survey based on an assessment of the dominant flora species for the three traditional strata (upper, mid and ground) and mapping extent; and
- Vegetation condition in accordance with the Keighery (1994) vegetation condition scale, as provided in the EPA Technical Guidance (EPA 2016a).

Suitable habitat within the survey area was searched to identify any conservation significant flora or communities potentially occurring, including:

- Threatened flora or TECs listed under the EPBC Act;
- Threatened (Declared Rare) flora listed under the latest Western Australia Wildlife Conservation (Rare Flora) Notice under the BC Act;
- PECs endorsed by the Western Australian Minister for the Environment; and
- Priority flora listed by Department of Biodiversity, Conservation and Attractions (DBCA).

In addition, any encountered Declared Pests listed under the State *Biosecurity and Agriculture Management Act 2007* (BAM Act) or Weeds of National Significance (WoNS) were recorded and mapped.

Survey methodology involved personnel walking meandering traverses across the survey area, with all relevant vegetation communities visited and areas of potential significant flora habitat traversed at an average spacing of 30 to 50 m, with spacing dependent on factors including suitable habitat, disturbance (e.g. cleared areas) and landform. Locations of survey traverses are presented in **Figure 2** below. Flora species able to be identified in the field were recorded, and specimens of unfamiliar species were collected for later identification. All collections were assigned a unique collecting number. For conservation significant flora species identified in the field, the following was recorded:

- A colour photograph;
- GPS location;
- Population size estimate;
- Location of population boundaries;
- Associated habitat/landscape element;
- Time and date observed;
- Observer details; and
- A specimen suitable for use as a reference specimen (where appropriate).

3.2.2.1 Flora Identification and Nomenclature

Flora specimen identification was undertaken by ELA Botanist Daniel Brassington. Species identification utilised taxonomic literature and keys, and where required specimens were confirmed using the Western Australian Herbarium (WAH) collection. Where considered appropriate, specimens that meet WAH specimen lodgement requirements (e.g. Threatened and Priority Flora, range extensions) may be submitted along with Threatened and Priority Report forms to DBCA. Nomenclature used for the flora species within this report follows the WA Plant Census as available on *FloraBase* (WAH 1998-).

3.2.3 Fauna Survey

3.2.3.1 Basic fauna survey

The Basic fauna survey was conducted in accordance with the EPA *Technical Guidance: Terrestrial vertebrate fauna surveys for environmental impact assessment* (EPA 2020). An assessment of fauna habitat in terms of its ability to support and sustain populations of fauna, along with an assessment of the likelihood of occurrence of conservation significant fauna species, was undertaken during the survey. The habitat characteristics and fauna database records used in assessing likelihood of occurrence for fauna included:

- Vegetation community, structure and condition;
- Soil and landform type;
- Extent and connectivity of bushland;
- Fauna species habitat preferences;
- Proximity of conservation significant fauna records; and
- Signs of species presence.

Opportunistic recordings of fauna species were made at all times during the field survey. These included visual sightings of active fauna such as: reptiles and birds; records of bird calls; and signs of species presence such as tracks, diggings, burrows, scats and any other signs of fauna activity.

Nomenclature used for the vertebrate fauna species within this report follows the WAM *Checklist of the Vertebrates of Western Australia* (WAM 2020). Where common names were not stated for certain species, the following references were consulted:

- Amphibians and reptiles: Bush et al. (2010);
- Reptiles: Wilson and Swan (2010);
- Birds: Morcombe (2003); and
- Mammals: Menkhorst and Knight (2011).

3.2.3.2 Targeted conservation significant fauna species survey

CARNABY'S COCKATOO HABITAT ASSESSMENT

An assessment of Carnaby's Cockatoo habitat was undertaken in accordance with the Department of Sustainability, Environment, Water, Population and Communities (SEWPaC) *EPBC Act referral guidelines for three threatened black cockatoo species* (SEWPaC 2012). This involved assessing all significant tree species known to support potential suitable breeding, roosting and foraging habitat. Significant breeding trees are defined as trees of suitable species with a Diameter at Breast Height (DBH) greater than 500 mm; >300 mm for Salmon Gum (*Eucalyptus salmonophloia*) and Wandoo (*Eucalyptus wandoo*); SEWPaC 2012). Trees with a DBH greater than 500 mm (or >300 mm for Salmon Gum and Wandoo) are large enough to potentially contain hollows suitable for nesting Carnaby's Cockatoo or have the potential to develop suitable hollows over the next 50 years. Trees of this size may also be large enough to provide roosting habitat (i.e. trees which provide a roost or rest area for the birds). All potential breeding trees with a DBH of 500 mm (300 mm for Salmon Gum and Wandoo) or greater encountered within the survey area were recorded with a handheld GPS unit.

Hollows were considered 'suitable' if the entrance was >100 mm in diameter, >300 mm deep and aligned near vertical. If it was not possible to determine if a hollow was suitable it was categorised as 'potentially suitable'. Hollows that did not meet any of the requirements were categorised as 'unsuitable'. Trees that met the required measurements were inspected with binoculars from the ground to assess suitability of hollows for nesting and/or roosting and evidences of current or previous occupancy, including wear and chew marks around the entrance.

Vegetation present within the survey area was assessed for its potential to provide foraging and roosting habitat for Carnaby's Cockatoo as per the SEWPaC (2012) guidelines, and the extent of potential suitable habitat within the survey area was mapped. Observations were also made of any Carnaby's Cockatoo foraging activity or feeding residue such as chewed *Banksia*, Jarrah (*Eucalyptus marginata*) and Marri (*Corymbia* calophylla) nuts, and any individuals within the survey area.

WESTERN SPINY-TAILED SKINK AND SHIELD-BACKED TRAPDOOR SPIDER

Potential habitat was identified by Cardno (2014) for two other conservation significant species, the Western Spiny-tailed Skink (*Egernia stokesii* subsp. *badia*) and Shield-backed Trapdoor Spider (*Idiosoma nigrum*) within the survey area. Therefore, basic habitat assessments for these species was undertaken during the field survey but did not include targeted searches for individuals. This was undertaken in accordance with:

- EPA *Technical Guidance: Terrestrial vertebrate fauna surveys for environmental impact assessment* (2020);
- SEWPaC *Survey Guidelines for Australia's threatened reptiles* (2011); and
- EPA *Technical Guidance: Sampling of short range endemic invertebrate fauna* (EPA 2016b).

3.3 Limitations

The EPA *Technical Guide: Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016a) recommends including discussion of the constraints and limitations of the survey methods used. Constraints and limitations for the survey are summarised in **Table 6**. One potential constraint was identified for this survey.

Table 6: Survey Limitations

Potential survey limitation	Impact on survey
Sources of information and availability of contextual information (i.e. pre-existing background versus new material).	**Not a constraint**. Broad-scale vegetation mapping at a scale of 1:1,000,000 was available. Land system mapping at a scale of 1:2,000,000 and soil and landform mapping was also available. DBCA database searches were undertaken within appropriate buffers. Available information was sufficient to provide context at varying scales and therefore was not considered a limitation.
Scope (i.e. what life forms, etc., were sampled).	**Not a constraint**. The survey requirement of a Reconnaissance flora and vegetation survey, a Basic fauna survey and a Targeted conservation significant fauna species survey in accordance with relevant State and Federal legislation and EPA guidance documents was adequately met.
Proportion of flora collected and identified (based on sampling, timing and intensity).	**Not a constraint**. A Reconnaissance level survey records the dominant and abundant species, with little requirement for a comprehensive account of species richness. Data recorded were sufficient for this level of survey.
Completeness and further work which might be needed (i.e. was the relevant survey area fully surveyed).	**Not a constraint**. The survey area coverage met the requirements of a Reconnaissance level flora and vegetation survey, as outlined in the scope of work.
Mapping reliability.	**Not a constraint**. Map coverage of the survey area was considered to be good. High quality aerial maps were used for both the survey and subsequent vegetation mapping. Due to the nature of vegetation in the survey area, mapping boundaries of individual communities were discrete, and thus are considered accurate.
Timing, weather, season, cycle.	**Potential constraint**. The field survey was undertaken at an appropriate time, as specified by the EPA *Technical Guidance*: *Flora and Vegetation Surveys for Environmental Impact Assessment* (2016). Rainfall in the three months prior to the survey was significantly below the long-term average, limiting the presence and flowering of species present. This did not impact the ability to describe the dominant species present to the level of survey required. Two targeted orchid species (*Caladenia drakeoides* and *Caladenia cristata*) have suitable habitat present within the survey area. They are known from WAH records to flower in September (WAH 1998-), therefore they may have not been able to be identified in the field survey.
Disturbances (fire, flood, accidental human intervention, etc.).	**Not a constraint**: Disturbances within the survey area included due to agricultural and transport infrastructure, with historical clearing in large portions of the survey area, and weeds dominating the understory in areas. Disturbances did not impact the ability to meet the requirements of the survey.
Intensity (in retrospect, was the intensity adequate).	**Not a constraint**. The survey effort was appropriate for a Reconnaissance flora and vegetation survey, Basic fauna survey and Targeted conservation significant fauna species survey.

Potential survey limitation	Impact on survey
Resources (i.e. were there adequate resources to complete the survey to the required standard).	**Not a constraint**. The number of personnel conducting this field survey in the given time was adequate to perform the required level of survey. Additional resources, including equipment available, additional support and personnel were adequate.
Access problems (i.e. ability to access survey area).	**Not a constraint**. All relevant areas within the survey area were able to be accessed and surveyed.
Experience levels (e.g. degree of expertise in plant identification to taxon level).	**Not a constraint**. The personnel conducting this field survey were both suitably qualified to identify specimens, having multiple years of field experience in flora and fauna surveys across Western Australia.

Figure 2: Survey effort

Legend

- Survey area
- GPS Track
- Relevé

Service Layer Credits: Google

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Metres

Datum/Projection:
GDA 1994 MGA Zone 50

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4. Results

4.1 Desktop assessment

Database searches identified 51 conservation significant flora species as possibly occurring within the survey area (Figure 3[1]); this figure is based on the database searches undertaken in Section 3.1.1 and using criteria outlined in **Appendix B**. These taxa comprise 27 species listed under the EPBC Act and/or BC Act as Threatened flora, and 24 species listed as Priority flora by DBCA. The flora likelihood of occurrence assessment is presented in **Appendix C**.

Database searches identified 23 conservation significant fauna species as possibly occurring within the survey area (Figure 4[2]). These taxa comprise 12 species listed under the EPBC Act and/or BC Act as Threatened and/or Migratory fauna, and 11 species listed as Priority fauna by DBCA. The fauna likelihood of occurrence assessment is presented in **Appendix D**.

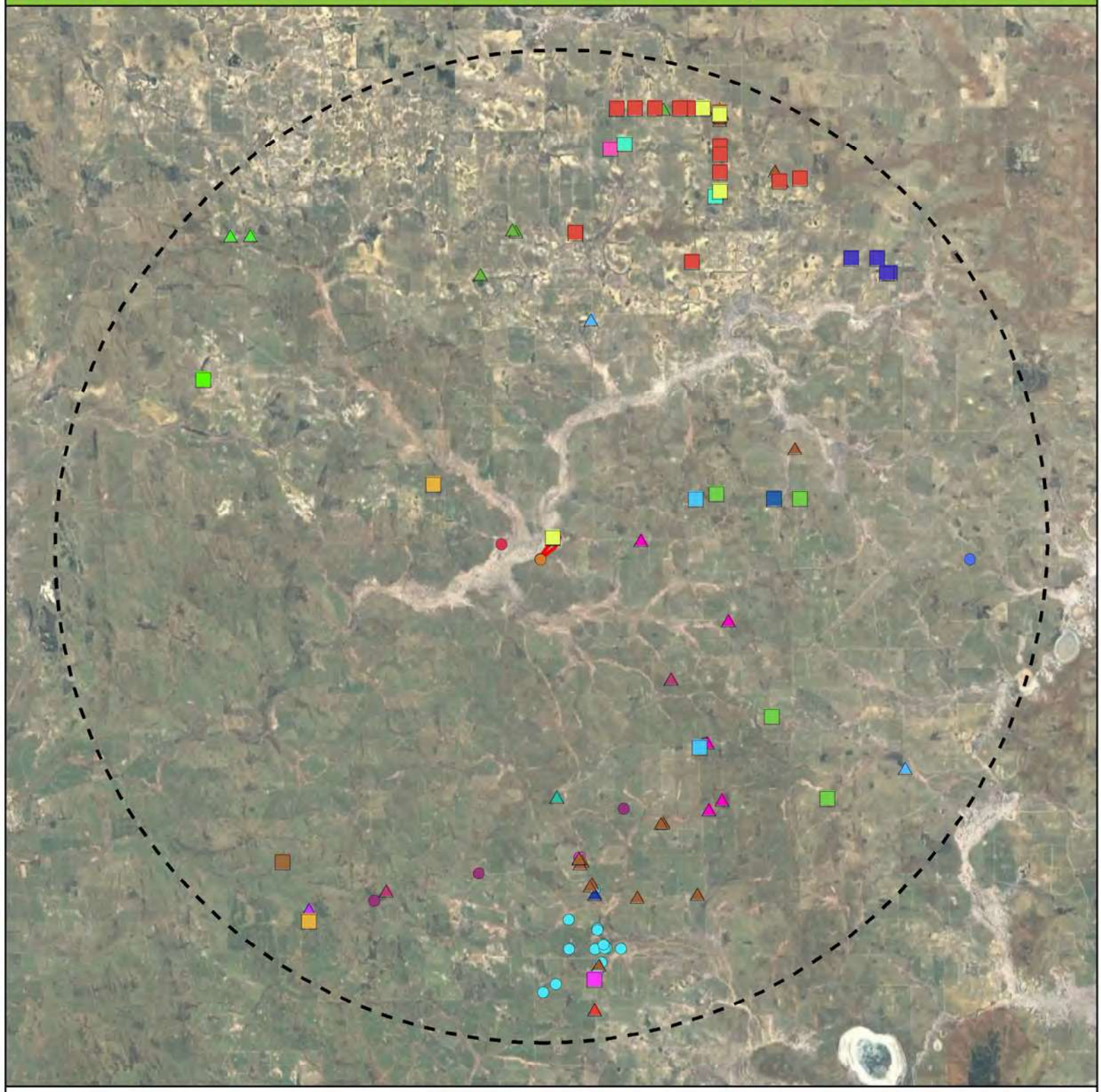
One TEC, *Eucalyptus Woodlands of the Western Australian Wheatbelt* (CR under the EPBC Act and P3 by DBCA), was identified by the database searches as potentially occurring near the survey area (Figure 5[3]). Two additional TECs, *Salmon Gum Woodlands of the Wheatbelt* and *York Gum Woodlands of the Wheatbelt* (both CR under the EPBC Act and P3 by DBCA) also occurred approximately 20 km away from the survey area.

[1] This figure only shows generalised Threatened and Priority flora locations at a low resolution in line with DBCA's *Threatened and Priority Flora Data Interpretation* (DBCA 2020d)

[2] This figure only shows generalised Threatened and Priority fauna locations at a low resolution in line with DBCA's *Threatened, Specially Protected and Priority Fauna Conditions of Data Supply* (DBCA 2020e)

[3] This figure only shows generalised Threatened and Priority ecological communities' locations in line with DBCA's *Threatened and Priority Ecological Communities Information Conditions in Respect of Supply of Information* (DBCA 2020f)

Figure 3: Conservation significant flora species recorded in the vicinity of the survey area



Legend

- Survey area
- 30 km buffer

Conservation significant flora

- *Acacia arcuatilis*
- *Acacia lirellata subsp. compressa*
- *Acacia trinalis*
- *Acacia vassalii*
- *Androcalva fragifolia*
- *Caladenia cristata*
- *Caladenia drakeoides*
- *Calothamnus accedens*
- *Chorizema humile*
- *Dampiera glabrescens*
- *Daviesia debilior subsp. sinuans*
- *Daviesia dielsii*
- *Eucalyptus macrocarpa x pyriformis*
- *Eucalyptus x carnabyi*
- *Gastrolobium appressum*
- *Gastrolobium hamulosum*
- *Gastrolobium rotundifolium*
- *Grevillea asparagoides*
- *Grevillea bracteosa subsp. bracteosa*
- *Grevillea christineae*
- *Grevillea haplantha subsp. recedens*
- *Grevillea pinifolia*
- *Grevillea pythara*
- *Jacksonia pungens*
- *Melaleuca sclerophylla*
- *Persoonia sulcata*
- *Stylidium periscelianthum*
- *Thryptomene shirleyae*
- *Urodon capitatus*
- *Verticordia dasystylis subsp. oestopoia*
- *Verticordia huegelii var. tridens*
- *Verticordia venusta*

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Service Layer Credits: Google

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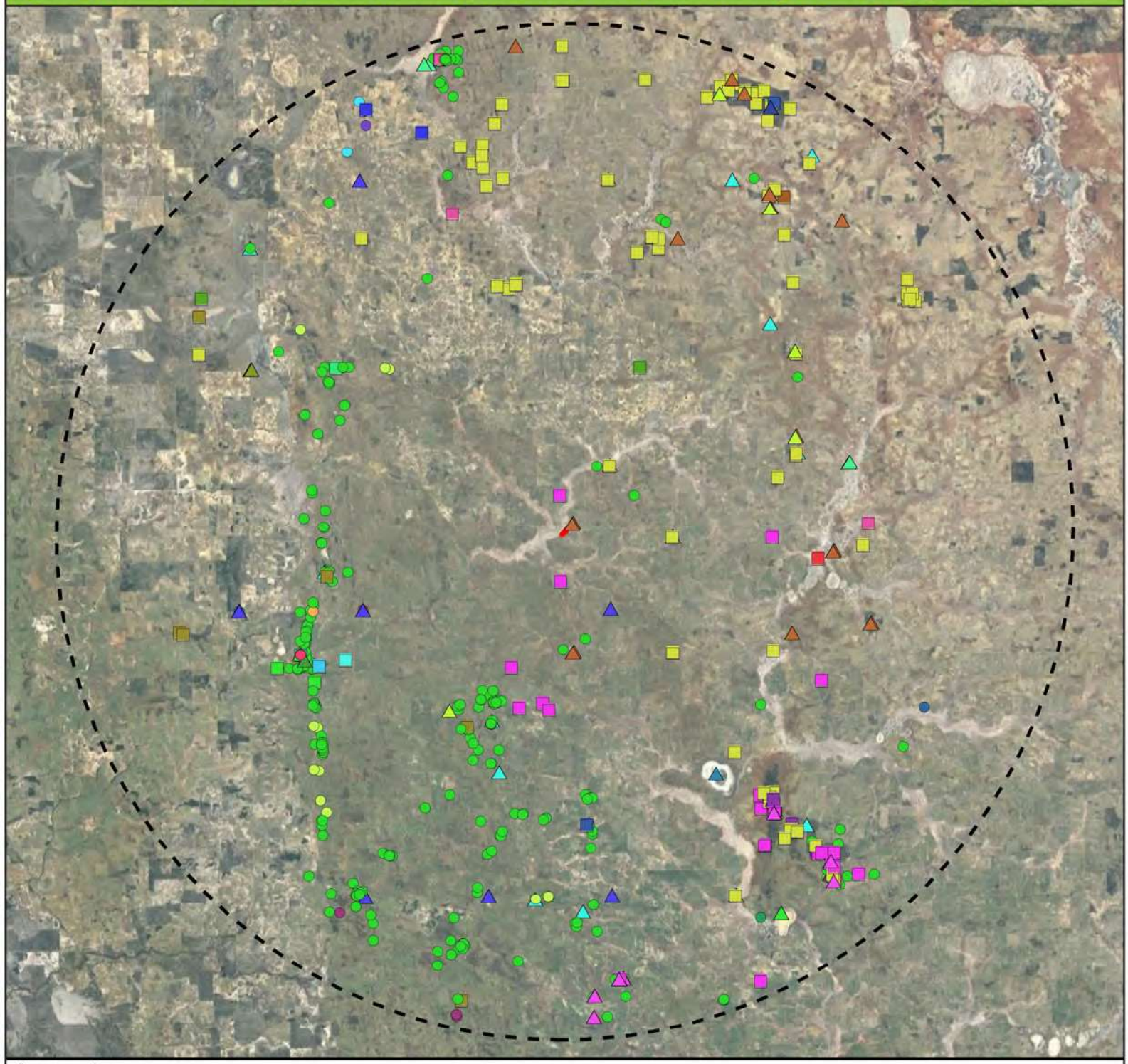
Figure 4: Conservation significant fauna species recorded in the vicinity of the survey area



Legend

- Survey area
- 65 km buffer

Conservation significant fauna

- Australasian bittern
- Australian painted snipe
- Blue-billed duck
- Carnaby's cockatoo
- Chuditch, western quoll
- Common Sandpiper
- Common greenshank, greenshank
- Dandaragan Plateau shield-backed trapdoor spider
- Glossy ibis
- Hooded plover, hooded dotterel
- Julimar shield-backed trapdoor spider
- Lake Goorly shield-backed trapdoor spider
- Malleefowl
- Peregrine falcon
- Red-necked stint
- Sharp-tailed sandpiper
- Shield-backed trapdoor spider
- South-western brush-tailed phascogale, wambenger
- Water-rat, rakali
- Western spiny-tailed skink
- White-tailed black cockatoo
- Woma (southwest subpop.)
- Wood sandpiper
- a brine shrimp (Wheatbelt)
- a water flea (inland south west)
- an Idiosoma trapdoor spider
- barking owl (southwest subpop.)
- blue-billed duck
- chuditch, western quoll
- forest red-tailed black cockatoo
- hooded plover, hooded dotterel
- malleefowl
- pectoral sandpiper
- peregrine falcon
- quenda, southwestern brown bandicoot
- shield-backed trapdoor spider
- tree-stem trapdoor spider
- water-rat, rakali
- western brush wallaby
- western rosella (inland)
- white-tailed black cockatoo
- woma (southwest subpop.)

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Datum/Projection: GDA 1994 MGA Zone 50

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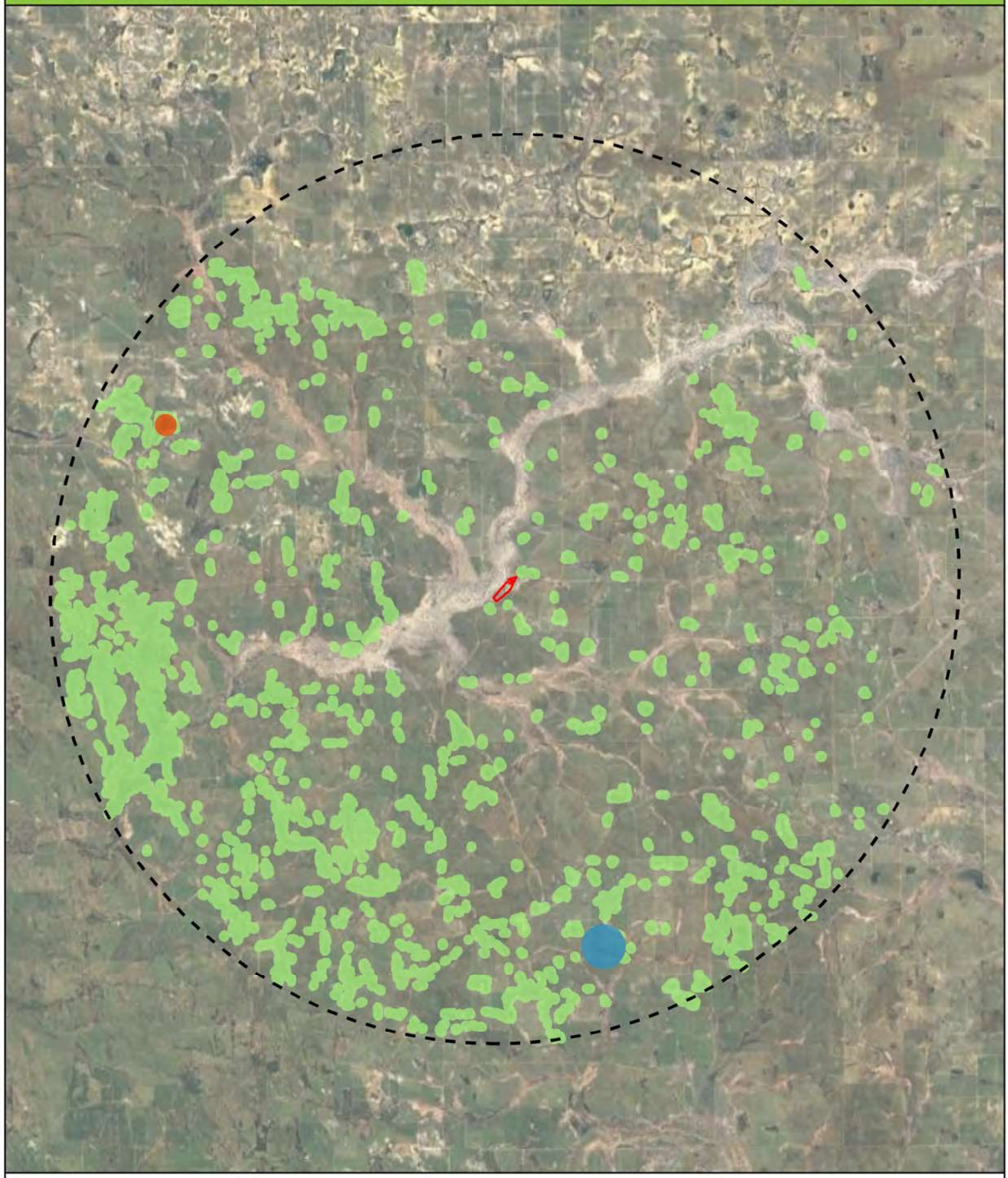
Figure 5: Conservation significant ecological communities mapped in the vicinity of the survey area



Legend

- Survey area
- 20 km buffer

Ecological Communities

- Eucalypt woodlands of the Western Australian Wheatbelt
- Salmon Gum Woodlands of the wheatbelt
- York Gum Woodlands of the wheatbelt

Service Layer Credits: Google

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Kilometres

Datum/Projection: GDA 1994 MGA Zone 50

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4.2 Flora

4.2.1 Flora overview

A total of 79 flora species, representing 23 families and 60 genera were recorded from a combination of 15 relevés and opportunistic collections. Families with the highest number of species recorded were Poaceae (15 species), Chenopodiaceae (14 species) and Asteraceae (10 species). The best represented genera were *Acacia* (five species), *Atriplex* (four species) and *Eucalyptus* (three species). A full species list is provided in **Appendix E**, species by relevé matrix is provided in **Appendix F** and details of the relevés are presented in **Appendix G**.

4.2.2 Conservation significant flora

No Threatened flora species listed under the EPBC Act or the BC Act, or listed by DBCA were recorded within the survey area during the field survey.

Of the 51 conservation significant flora species identified from the desktop assessment as possibly occurring within the survey area (**Appendix C**), one species was identified with the Potential to occur*;* *Urodon capitatus* (P3 by DBCA), and two species were identified as Likely to occur; *Caladenia drakeoides* (listed as Endangered [EN] under the EPBC Act and CR under the BC Act) and *Caladenia cristata* (P1 by DBCA). Suitable habitat was present for both of these species, however majority of WAH records indicate these species flower in September (WAH 1998-), therefore they may not have been able to be identified in the field survey.

4.2.3 Introduced flora

A total of 27 introduced (weed) flora species were recorded in the survey area. One species, **Echium plantagineum* (Paterson's curse), is listed as a Declared Pest (s22(2)) under the BAM Act (Western Australian Organism List [WAOL]); this was recorded at 10 locations (Figure 6). The remaining 26 species are listed on the WAOL database as s11 (permitted) species, indicating that no specific management of these species is required. The full list of introduced species is included within **Appendix E**.

4.2.4 Vegetation communities

A total of six vegetation communities (23.23 ha), comprising two eucalypt woodland communities (VC1 and VC6), three mixed shrubland communities (VC3, VC4 and VC5) and one samphire shrubland community (VC2), were delineated and mapped within the survey area (**Table 7**, **Figure 6**). The most widespread community was VC2, which covered 9.44 ha (27.85%) of the survey area. Cleared areas, including roads and tracks, cover the majority (10.65 ha, 31.43%) of the survey area.

4.2.5 Conservation significant ecological communities

Two vegetation communities delineated within the survey area comprise eucalypt woodlands that have the potential to represent floristic and structural aspects of the Wheatbelt Woodlands TEC, as indicated in the Department of the Environment and Energy (DotEE; now DAWE) *Approved Conservation Advice (including listing advice) for the Eucalypt Woodlands of the Western Australian Wheatbelt* (Approved Conservation Advice; DotEE 2015).

In summary, the Wheatbelt Woodlands TEC is composed of eucalypt-dominated woodlands in the Western Australian Wheatbelt region as defined by the IBRA Avon Wheatbelt 1 and 2 and Western Mallee subregions, with the specific exceptions of woodlands and forests dominated by Jarrah (*Eucalyptus marginata*) or Marri (*Corymbia calophylla*) where they occur without York Gum (*Eucalyptus loxophleba*) present; and non-woodland communities dominated by eucalypts, specifically those

dominated by eucalypts with a mallee growth form. The community is defined primarily by its structure as a woodland. The presence in the canopy layer of eucalypt trees - most commonly Salmon Gum (*E. salmonophloia*), York Gum (*E. loxophleba*), Red Morrel (*E. longicornis*) or Gimlet (*E. salubris*) defines the Wheatbelt woodlands. Several of the other emergent eucalypt species which may be present as a defining species (e.g. Kondinin Blackbutt [*E. kondininensis*], *E. myriadena*, Salt River Gum [*E. sargentii*], Silver Mallet [*E. ornata*] and Mallet [*E. singularis*]) are found only in the Western Australian Wheatbelt.

An assessment, presented in **Appendix H**, was undertaken utilising key diagnostic characteristics of the Wheatbelt Woodlands TEC (DotEE 2015). This key diagnostic assessment concluded that whilst some characteristics represented the Wheatbelt Woodlands TEC, others did not. Whilst crown cover was greater than 10%, VC1 (*Eucalyptus loxophleba* low open mallee woodland) was dominated by a mallee eucalypt. And whilst VC6 (*E. loxophleba* open woodland) contained mature trees, the crown cover was less than 10% (2-5%). Therefore, no vegetation community within the survey area represents the Wheatbelt Woodland TEC.

It is noted that conclusions relating to the presence of this TEC within the survey area are based on results from a Reconnaissance level survey. Given the limitations of such a survey (e.g. relevé data etc.) further work may be required to determine presence/absence with a greater degree of certainty (e.g. single season Detailed flora and vegetation survey utilising quadrat data).

4.2.6 Vegetation condition

Vegetation of the survey area ranged from Completely Degraded to Very Good condition, based on the Keighery (1994) vegetation condition scale provided in EPA (2016) (**Figure 7**). The majority of the survey area was classed as Good condition (11.99 ha, 35.38%). The remaining categories include; Very Good (0.47 ha, 1.39%), Degraded (1.98 ha, 5.84%) and Completely Degraded (8.8 ha, 25.97%). Cleared areas, including roads and tracks, cover 31.43% (10.65 ha) of the survey area.

Primary disturbances within the survey area included clearing for agriculture and infrastructure and the presence of introduced (weed) species.

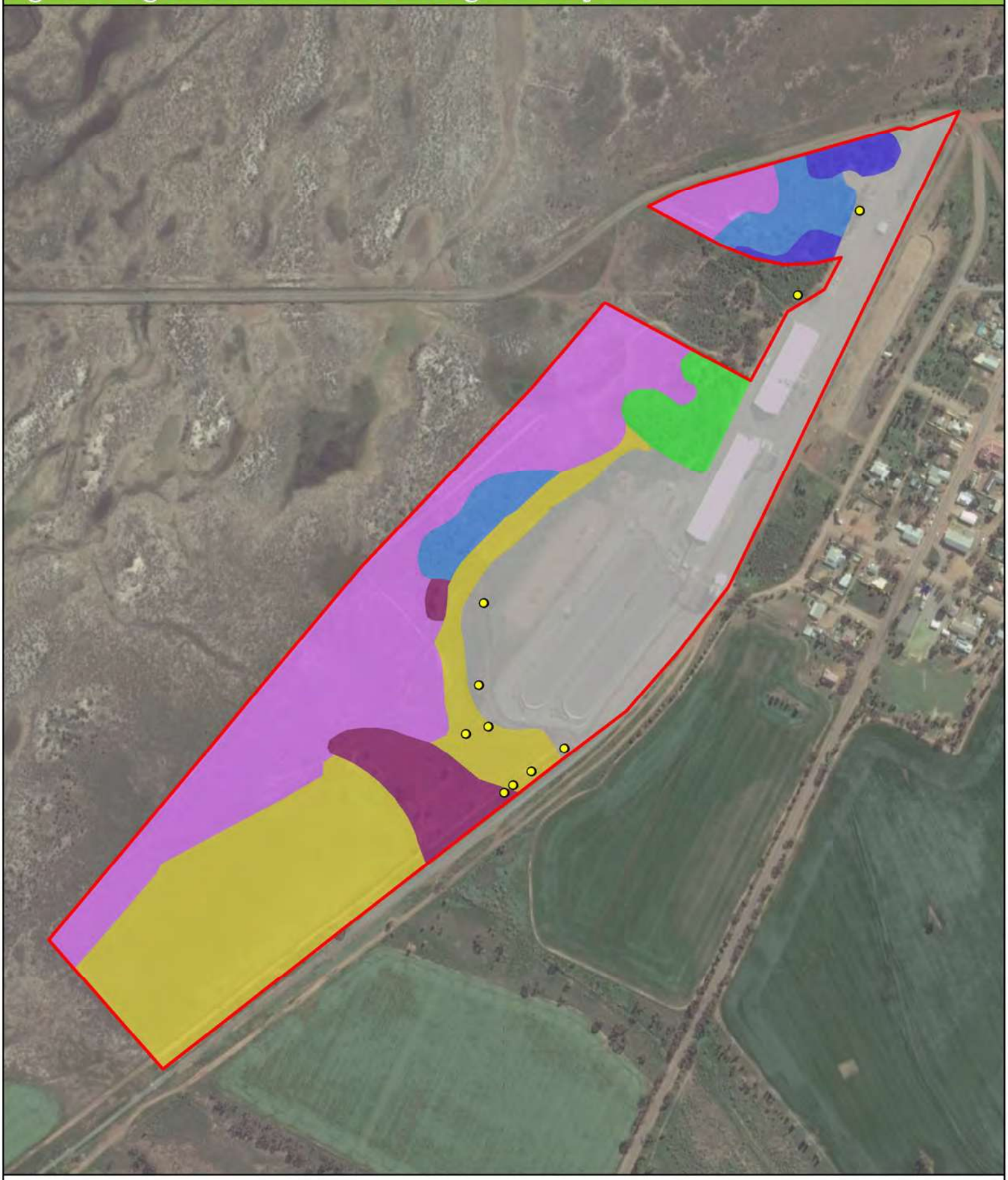
Table 7: Vegetation communities recorded within the survey area

Photo	Vegetation community	Description	Relevé/s	Total area (ha)	Proportion of the survey area (%)
	**VC1**: *Eucalyptus loxophleba* low open mallee woodland	*Eucalyptus loxophleba* low open mallee woodland over *Melaleuca stereophloia*, *Santalum acuminatum* tall sparse shrubland over *Austrostipa elegantissima* and **Avena barbata* low sparse grassland. Other species forming components of the vegetation in areas include **Mesembryanthemum nodiflorum*, *Ptilotus polystachyus* and *Sclerolaena diacantha*.	ELA01, ELA15	0.64	1.89
	**VC2**: *Tecticornia undulata* and *T. pergranulata* low open samphire shrubland	*Tecticornia undulata* and *T. pergranulata* low open samphire shrubland with **Lolium rigidum* low sparse grassland and **Mesembryanthemum nodiflorum* low sparse forbland. Other common species include *Austrostipa elegantissima*, *Enchylaena tomentosa*, *Eragrostis dielsii*, *Siloxerus multiflorus* and **Vulpia myuros* forma *megalura*.	ELA03, ELA07, ELA09	9.44	27.85

Photo	Vegetation community	Description	Relevé/s	Total area (ha)	Proportion of the survey area (%)
	**VC3**: *Acacia hemiteles* isolated shrubs over *Maireana brevifolia* and *Salsola australis* low open chenopod shrubland	*Acacia hemiteles* mid isolated shrubs over *Maireana brevifolia*, *Salsola australis*, *Atriplex* spp. low open chenopod shrubland over **Hordeum leporinum* low open grassland and **Mesembryanthemum nodiflorum*, **Oncosiphon piliferum* low open forbland. Other common species include **Avena barbata, Chloris truncata, Eragrostis dielsii, *Hypochaeris glabra, *Lolium rigidum, Ptilotus exaltatus, P. polystachyus* and **Sonchus oleraceus*. This vegetation was cleared agricultural pasture lands that has remained undisturbed for an estimated 10 years or greater and is in the early stages of ecological recovery.	ELA10, ELA11, ELA12	8.73	25.76
	**VC4**: *Casuarina obesa*, *Hakea preissii*, *Melaleuca lateriflora* and *M. stereophloia* tall shrubland	*Casuarina obesa, Hakea preissii, Melaleuca lateriflora* and *M. stereophloia* tall shrubland over *Rhagodia drummondii, Comesperma integerrimum* mid isolated shrubs over *Austrostipa elegantissima*, **Lolium rigidum* open grassland. The *Casuarina* and *Melaleuca* components of this shrubland can form dense small monoculture stands within this vegetation community.	ELA04, ELA05, ELA06	1.1	3.25

Photo	Vegetation community	Description	Relevé/s	Total area (ha)	Proportion of the survey area (%)
	**VC5**: *Acacia lineolata* subsp. *lineolata, Melaleuca lateriflora* and *Hakea preissii* tall sparse shrubland	*Acacia lineolata* subsp. *lineolata, Melaleuca lateriflora* and *Hakea preissii* tall sparse shrubland over *Rhagodia drummondii, Maireana brevifolia* and *Tecticornia pergranulata* mid open chenopod shrubland over *Austrostipa elegantissima , Eragrostis dielsii, *Vulpia myuros* forma *megalura* low sparse grassland and **Mesembryanthemum nodiflorum, Siloxerus multiflorus* low sparse forbland. This community occurs fringing the margins or occupying low rises within the saline flats supporting the samphire shrubland.	ELA02, ELA08	1.73	5.10
	**VC6**: *Eucalyptus loxophleba* open Woodland over mixed low Chenopod Shrubland	*Eucalyptus loxophleba* low open woodland over *Hakea preissii* tall isolated tall shrubs over *Atriplex amnicola, Maireana brevifolia* and *Tecticornia pergranulata* mid open chenopod shrubland and , **Hordeum leporinum, *Lolium rigidum* low open grassland and **Mesembryanthemum nodiflorum*, **Oncosiphon piluliferum* and **Sonchus oleraceus* low open forbland.	ELA13, ELA14	1.59	4.69
Cleared (roads, tracks)			NA	10.65	31.43
Total				**33.89**	**100**

Figure 6: Vegetation communities and significant species



Legend

- Survey area
- Cleared

Significant Species

- Paterson's curse (*Echium plantagineum*)

Vegetation communities

- VC1 - *Eucalyptus loxophleba* low open mallee woodland
- VC2 - *Tecticornia undulata* and *T. pergranulata* low open samphire shrubland
- VC3 - *Acacia hemiteles* isolated shrubs over *Maireana brevifolia* and *Salsola australis* low open chenopod shrubland
- VC4 - *Casuarina obesa, Hakea preissii, Melaleuca lateriflora* and *M. stereophloia* tall shrubland
- VC5 - *Acacia lineolata* subsp. *lineolata, Melaleuca lateriflora* and *Hakea preissii* tall sparse shrubland
- VC6 - *E. loxophleba* open woodland

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Metres

Datum/Projection:
GDA 1994 MGA Zone 50

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Figure 7: Vegetation condition

Legend

- Survey area
- Cleared

Vegetation Condition

- Very Good
- Good
- Degraded
- Completely degraded

Service Layer Credits: Google

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Metres

Datum/Projection:
GDA 1994 MGA Zone 50

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4.3 Fauna

4.3.1 Fauna overview

A total of 27 vertebrate fauna species were recorded within the survey area, comprising 23 birds, three mammals and one reptile (**Appendix I**). No evidence of Threatened or Priority fauna species listed under the EPBC Act or the BC Act, or listed by DBCA were recorded within the survey area.

Of the 23 conservation significant fauna species identified from the desktop assessment as possibly occurring within the survey area (**Appendix D**), three species were identified as having the Potential to occur based on the availability of suitable habitat and close proximity of recent records; Carnaby's Cockatoo (*Calyptorhynchus latirostris*; listed as EN under the EPBC Act and BC Act), Western Spiny-tailed Skink (*Egernia stokesii* subsp. *badia*; listed as EN under the EPBC Act and VU under the BC Act), and Shield-backed Trapdoor Spider (*Idiosoma nigrum*; listed as VU under the EPBC Act and EN under the BC Act). These species are discussed in more detail in Section 4.3.3, 4.3.4 and 4.3.5.

The remaining 20 fauna species are considered as unlikely to occur or do not occur within the survey area, based on lack of suitable habitat for these species and proximity of previous records. Aquatic and marine species were not considered in the likelihood of occurrence assessment as the survey area does not contain core habitat that these species solely rely on for survival.

One introduced (pest) fauna species was recorded within the survey area, namely Cattle (**Bos taurus*) indirect evidence (scats).

4.3.2 Fauna habitat

A total of four fauna habitats were recorded within the survey area, covering a total of approximately 68.55% (2.83 ha) of the survey area (**Table 8,** Figure 8). The most widespread habitat was samphire shrubland, which covered 9.44 ha (27.85%) of the survey area. Cleared areas, including roads and tracks, covered the majority (10.65 ha, 31.43%) of the survey area.

Table 8: Fauna habitat within the survey area

Description	Total area (ha)	Proportion of the survey area (%)
Eucalyptus loxophleba woodland	2.23	6.58
Samphire shrubland	9.44	27.85
Mixed low shrubland	8.73	25.76
Hakea and *Melaleuca* shrubland	2.83	8.35
Cleared (roads, tracks)	10.65	31.43
Total	**33.89**	**100.00**

Figure 8: Fauna habitat recorded within the survey area

Legend

- Survey area
- Cleared

Vegetation communities

- *Eucalyptus loxophleba* woodland
- Samphire Shrubland
- Mixed low shrubland
- *Hakea* and *Melaleuca* shrubland

Service Layer Credits: Google

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Metres

Datum/Projection:
GDA 1994 MGA Zone 50

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4.3.3 Carnaby's Cockatoo habitat assessment

4.3.3.1 Foraging habitat

Foraging habitat for black cockatoos is generally defined as the availability of plant food sources within an area (Finn 2012). Food availability for black cockatoos is a function of the diversity, abundance, distribution, energetic and nutritional qualities, and seasonality (phenology) of the food sources within a particular area. Carnaby's Cockatoo foraging habitat within the survey area has been determined using vegetation associations defined in the vegetation assessment and from ground-truthing in the field. The quality of foraging habitat for Carnaby's Cockatoo within the survey area (as defined in **Table 9**) has been assessed based on the availability and density of plant food sources as observed on site.

Table 9: Definition and extent of black cockatoo foraging habitat quality within the survey area

Foraging quality	Justification	Extent (ha) within survey area	% of survey area
Good	High density of species suitable for foraging by black cockatoos (i.e. foliage cover of suitable species >60%) but food sources only present at one or two strata (e.g. canopy and midstorey).	0	0
Moderate	Moderate foraging value density of species suitable for foraging by black cockatoos (i.e. foliage cover of suitable species 20-40%) and food sources only present at one or two strata (e.g. canopy and midstorey).	0	0
Poor	Low density of species suitable for foraging by black cockatoos (i.e. foliage cover of suitable species 10-20%) and presence of food sources at only one stratum (i.e. canopy)	5.06	14.93
Nil	Cleared areas or no suitable vegetation present.	28.82	85.04
Total		**33.89**	**100**

Some vegetation within the survey area, comprising 5.06 ha, is considered as providing 'Poor' quality foraging habitat for Carnaby's Cockatoo due to a low density of suitable or preferred foraging species. This included the fauna habitats *Eucalyptus loxophleba* woodland and *Hakea* and *Melaleuca* shrubland, due to the presence of *Eucalyptus loxophleba* and *Hakea preissii* (Groom 2011). Cleared areas and unsuitable vegetation, comprising 28.82 ha, provide 'Nil' foraging habitat for Carnaby's Cockatoo. Habitat foraging quality is presented in **Figure 9**. No evidence of foraging by Carnaby's Cockatoo was observed within the survey area.

4.3.3.2 Breeding and roosting habitat

The Carnaby's Cockatoo breeding habitat assessment identified three potentially suitable breeding trees within the survey area comprising three *Eucalyptus* sp. (planted) (**Figure 9**; **Appendix J**). All potential breeding trees recorded in the survey area also provide potential suitable roosting habitat for Carnaby's Cockatoo as defined by the referral guidelines (SEWPaC 2012). Of these, none contained hollows or potentially suitable hollows (over 100 mm in diameter).

Figure 9: Potential suitable Carnaby's Cockatoo habitat within the survey area

Legend

Survey area

Carnaby's Cockatoo trees

Eucalyptus sp. (planted), DBH > 50cm, No hollow

Carnaby's Cockatoo habitat

Poor

Nil

Service Layer Credits: Google

0 50 100

Metres

Datum/Projection: GDA 1994 MGA Zone 50

N

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4.3.4 Western Spiny-tailed Skink habitat assessment

No Western Spiny-tailed Skink individuals or secondary signs were recorded in the survey area. In the wheatbelt, most records of the Western Spiny-tailed Skink are in York Gum (*Eucalyptus loxophleba*) woodland in clayey soils predominantly within the Avon Wheatbelt IBRA bioregion (DEC 2012). In the survey area, 'Poor' quality habitat (2.23 ha, 6.58%) was recorded in association with the *Eucalyptus loxophleba* woodland fauna habitat (DEC 2012, How et al. 1999) (**Figure 10**). The low quality is due to the lack of shelter present in the survey area, namely fallen logs and tree stumps, and grazing present by cattle (How et al. 1999).

4.3.5 Shield-backed Trapdoor Spider habitat assessment

No Shield-backed Trapdoor Spider individuals or secondary signs were recorded in the survey area. In the wheatbelt, the Shield-backed Trapdoor Spider inhabits open York Gum (*Eucalyptus loxophleba*) woodland in clayey soils (ACC 2007). In the survey area, 'Poor' quality habitat (2.23 ha, 6.58%) was recorded in association with the *Eucalyptus loxophleba* woodland fauna habitat (ACC 2007) (**Figure 11**). The low quality is due to the lack of ground litter for foraging present in the survey area (ACC 2007).

Figure 10: Potential suitable Western Spiny-tailed Skink habitat within the survey area

Legend

Survey area

Western Spiny-tailed Skink habitat

Poor

Nil

Service Layer Credits: Google

0 50 100

Metres

Datum/Projection: GDA 1994 MGA Zone 50

N

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Figure 11: Potential suitable Shield-backed Trapdoor Spider habitat within the survey area

Legend

Survey area

Shield-backed Trapdoor Spider habitat

Poor

Nil

Service Layer Credits: Google

0 50 100

Metres

Datum/Projection: GDA 1994 MGA Zone 50

N

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Prepared by: SC Date: 16/02/2021

5. Discussion and Recommendations

5.1 Flora

A total of 79 flora species, representing 23 families and 60 genera were recorded from a combination of 15 relevés and opportunistic collections. Of these species, 27 introduced (weed) flora species were recorded during the field survey. This forms a high proportion (35%) of the total number of species recorded during this survey and was largely expected, given the surrounding pastoral land use. The introduced taxa included one Declared Pest, **Echium plantagineum* (Paterson's curse), which represents a risk to the structure and composition of native vegetation communities present. Whilst this species is subject to s22(2) of the BAM Act, it is not required to be controlled under the Biosecurity and Agriculture Management Regulations 2013.

No Threatened or Priority flora species listed under the EPBC Act or the BC Act, or listed by DBCA were recorded within the survey area. Of the 51 conservation significant flora species identified from the desktop assessment as possibly occurring within the survey area, one species was identified with the Potential to occur*; Urodon capitatus*, and two species were identified as Likely to occur (*Caladenia drakeoides* and *Caladenia cristata*).

Caladenia drakeoides, listed as EN under the EPBC Act and CR under the BC Act, is known regionally from 42 records, over a range of 255 km, from Coorow in the north-west to Mukinbudin in the east to Goomalling in the south (DBCA 2007-2021). Majority of WAH's records (9 of 11) flowered in the first two weeks of September (WAH 1998-), therefore they may not have been able to be identified in the field survey. Habitat for this species is tall to medium shrubland dominated by *Melaleuca* and *Acacia* species over low shrubs and annuals (Brown et al. 2003), which corresponds to VC5 within the survey area. This species is also known from the edge of salt flats (WAH 1998-). The survey area occurs on the margins of the same lake system that the previous records were recorded in (DBCA 2020a).

Caladenia cristata, listed as P1 by DBCA, is known regionally from 17 records, over a range of 105 km, from Coorow in the north-east to Dalwallinu in the south-east (DBCA 2007-2021). Majority of WAH's records (8 of 10) flowered in September (WAH 1998-), therefore they may not have been able to be identified in the field survey. Habitat for this species includes sandy rises on the edge of salt flats and ephemeral waterbodies, which corresponds to VC2 and VC5 within the survey area.

5.2 Vegetation

A total of six vegetation communities were delineated and mapped within the survey area, comprising two eucalypt woodland communities (VC1 and VC6), three mixed shrubland communities (VC3, VC4 and VC5) and one samphire shrubland community (VC2). All communities are disjunct remnant patches along the road, rather than contiguous suites of native vegetation.

Two eucalypt woodland communities potentially show characteristics associated with the Wheatbelt Woodlands TEC as indicated in the *Approved Conservation Advice (including listing advice) for the Eucalypt Woodlands of the Western Australian Wheatbelt* (DotEE 2015). This key diagnostic assessment concluded that whilst some characteristics represented the Wheatbelt Woodlands TEC, others did not. Whilst crown cover was greater than 10%, VC1 (*Eucalyptus loxophleba* low open mallee woodland) was dominated by a mallee eucalypt. And whilst VC6 (*E. loxophleba* open woodland) contained mature trees, the crown cover was less than 10% (2-5%). Therefore, no vegetation community within the survey area represents the Wheatbelt Woodland TEC.

It is noted that conclusions relating to the presence of this TEC within the survey area are based on a Reconnaissance level survey. Given the limitations of such a survey (e.g. relevé data etc.) further work may be required to determine presence/absence of the Wheatbelt Woodlands TEC with a greater degree of certainty (e.g. single season Detailed flora and vegetation survey utilising quadrat data).

5.3 Fauna

A total of 27 vertebrate fauna species were recorded within the survey area during the Basic fauna survey. No evidence of Threatened or Priority fauna species listed under the EPBC Act or the BC Act, or listed by DBCA were recorded within the survey area.

Of the 23 conservation significant fauna species identified from the desktop assessment as possibly occurring within the survey area, three species were identified as having the Potential to occur based on the availability of suitable habitat and close proximity of recent records; Carnaby's Cockatoo (*Calyptorhynchus latirostris*; listed as EN under the EPBC Act and BC Act), Western Spiny-tailed Skink (*Egernia stokesii* subsp. *badia*; listed as EN under the EPBC Act and VU under the BC Act), and Shield-backed Trapdoor Spider (*Idiosoma nigrum*; listed as VU under the EPBC Act and EN under the BC Act). These species were identified in Cardno (2014) as unlikely (Western Spiny-tailed Skink and Carnaby's Cockatoo) and possible (Shield-backed Trapdoor Spider), however this survey area is larger and likelihoods have been reassessed based on fauna habitats and foraging flora species present.

The survey area is in the breeding range of the Carnaby's Cockatoo (DotEE 2017) and the habitat assessment identified three potentially suitable breeding trees within the survey area, none of which contained hollows or potentially suitable hollows (over 100 mm in diameter). Some of the vegetation within the survey area, is considered as providing 'Poor' quality foraging habitat for Carnaby's Cockatoo due to a low density of suitable or preferred foraging species. This included the fauna habitats *Eucalyptus loxophleba* woodland and *Hakea* and *Melaleuca* shrubland, due to the presence of *Eucalyptus loxophleba* and *Hakea preissii*. Cleared areas and unsuitable vegetation provide 'Nil' foraging habitat for Carnaby's Cockatoo. No evidence of foraging by Carnaby's Cockatoo was observed within the survey area.

Western Spiny-tailed Skink and Shield-backed Trapdoor Spider inhabit in York Gum (*Eucalyptus loxophleba*) woodland in clayey soils. Vegetation associated with the *Eucalyptus loxophleba* woodland fauna habitat provides low quality habitat for both species. The low quality is due to the lack of shelter (e.g. fallen logs and tree stumps) for the Western Spiny-tailed Skink, and lack of ground litter for the Shield-backed Trapdoor Spider.

Four fauna habitats were recorded within the survey area; *Eucalyptus loxophleba* woodland, Samphire shrubland, Mixed low shrubland and *Hakea* and *Melaleuca* shrubland.

6. References

Avon Catchment Council (ACC). 2007. Shield-backed Trapdoor Spider (Idiosoma nigrum) Conservation Plan. Avon Catchment Council, Western Australia.

Beard, J.S. 1975. *The vegetation survey of Western Australia.* Explanatory notes to Sheet 4, 1:1,000,000 Series Vegetation Survey of Western Australia. University of Western Australia Press, Nedlands, WA.

Beecham, B. 2001. Avon Wheatbelt 2 (AW2 – Re-juvenated Drainage subregion). In 'A Biodiversity Audit of Western Australia's 53 Biogeographical Subregions in 2002'. Department of Conservation and Land Management, Kensington, WA.

Brown, A., E. Holland & K. Kershaw. 2003. Hinged Dragon Orchid (*Caladenia drakeoides*) Interim Recovery Plan 2003-2008. Interim Recovery Plan No. 141. Department of Conservation and Land Management, Western Australia.

Bureau of Meteorology 2021. *Climate Data Online*. Available from: http://www.bom.gov.au/climate/data/index.shtml

Bush, B., Maryan, B., Browne-Cooper, R. and Robinson, D. 2010. *Field Guide to Reptiles and Frogs of the Perth Region.* Western Australian Museum, Perth, WA.

Cardno. 2014. Level 1 Flora and Fauna Survey. Prepared for CBH Miling.

Department of Agriculture, Water and the Environment 2021a. Australia's bioregions (IBRA). Available from: https://www.environment.gov.au/land/nrs/science/ibra

Department of Agriculture, Water and the Environment 2021b. *EPBC Act Protected Matters Search Tool*. Available from: http://www.environment.gov.au/epbc/pmst/index.html

Department of Biodiversity, Conservation and Attractions (DBCA). 2020a. Threatened and Priority Flora database search. Reference number 34-1020FL. Department of Biodiversity, Conservation and Attractions, Perth.

Department of Biodiversity, Conservation and Attractions (DBCA). 2020b. Threatened and Priority Fauna database search. Reference number FAUNA#6500. Department of Biodiversity, Conservation and Attractions, Perth.

Department of Biodiversity, Conservation and Attractions (DBCA). 2020c. Threatened and Priority Communities database search. Reference number 11-1120EC. Department of Biodiversity, Conservation and Attractions, Perth.

Department of Biodiversity, Conservation and Attractions (DBCA). 2020d. Threatened and Priority Flora Data Interpretation (provided with database search).

Department of Biodiversity, Conservation and Attractions (DBCA). 2020e. Threatened, Specially Protected and Priority Fauna Conditions of Data Supply (provided with database search).

Department of Biodiversity, Conservation and Attractions (DBCA). 2020f. Threatened and Priority Ecological Communities Information Conditions in Respect of Supply of Information (provided with database search).

Department of Biodiversity, Conservation and Attractions (DBCA). 2007-2021. *NatureMap*. Department of Biodiversity, Conservation and Attractions. Available at: https://naturemap.dpaw.wa.gov.au/default.aspx

Department of Environment and Conservation (DEC). 2012. Western Spiny-tailed Skink (*Egernia stokesii*) National Recovery Plan. Perth, Western Australia.

Department of the Environment and Energy (DotEE) 2015. *Approved Conservation Advice (including listing advice) for the Eucalypt Woodlands of the Western Australian Wheatbelt*. Department of the Environment and Energy, Canberra, ACT. Available from: http://www.environment.gov.au/biodiversity/threatened/communities/pubs/128-conservation-advice.pdf

Department of the Environment and Energy (DotEE). 2017. *Revised draft referral guideline for three threatened black cockatoo species: Carnaby's Cockatoo, Baudin's Cockatoo and the Forest Red-tailed Black Cockatoo*. Commonwealth of Australia.

Department of Sustainability, Environment, Water, Populations and Communities (SEWPaC). 2012. *EPBC Act referral guidelines for three threatened black cockatoo species: Carnaby's Cockatoo (Endangered) Calyptorhynchus latirostris, Baudin's Cockatoo (Vulnerable) Calyptorhynchus baudinii, Forest Red-tailed Black cockatoo (Vulnerable) Calyptorhynchus banksii naso.* Australian Government Department of Sustainability, Environment, Water, Populations and Communities, Canberra, ACT.

Department of Sustainability, Environment, Water, Populations and Communities (SEWPaC). 2011. Survey Guidelines for Australia's threatened reptiles. Commonwealth of Australia.

Environmental Protection Authority (EPA). 2020. *Technical Guidance: Terrestrial vertebrate fauna surveys for environmental impact assessment*. Perth, Western Australia.

Environmental Protection Authority (EPA). 2016a. *Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment.* Perth, Western Australia.

Environmental Protection Authority (EPA). 2016a. *Technical Guidance: Sampling of short range endemic invertebrate fauna.* Perth, Western Australia.

Finn, H. 2012. *Assessment of habitat values for black-cockatoos within selected sites at Newmont Boddington Gold Mine*. Report prepared for Newmont Boddington Gold Pty Ltd.

Groom, C. 2011. Plants Used by Carnaby's Black Cockatoo. Department of Environment and Conservation, Perth, Western Australia.

Government of Western Australia. 2019. *2018 Statewide Vegetation Statistics incorporating the CAR Reserve Analysis (Full Report). Current as of March 2019.* WA Department of Biodiversity, Conservation and Attractions, Perth, WA. Available from https://catalogue.data.wa.gov.au/dataset/dbca-statewide-vegetation-statistics

How, R.A., Dell, J. and Aplin, K.P. 1999. Assessment of the central wheatbelt populations of the endangered skink, Egernia stokesii badia. Unpublished report to the Department of Conservation and Land Management, Perth.

Keighery, B. J. 1994. *Bushland Plant Survey: A guide to plant community survey for the community.* Wildflower Society of Western Australia, Nedlands, WA.

Landgate 2021. *Locate v5*. The Western Australian Land Information Authority. Available from https://www0.landgate.wa.gov.au/maps-and-imagery/interactive-maps/locate

Menkhorst, P. and Knight, F. 2011. *Field Guide to Mammals of Australia.* Third Edition. Oxford University Press Australia, Melbourne, VIC.

Morcombe, M. 2003. *Field Guide to Australian Birds*. Revised edition. Steve Parish Publications, Brisbane, QLD.

Purdie, B R, Tille, P J, and Schoknecht, N R. 2004. *Soil-landscape mapping in south-Western Australia: an overview of methodology and outputs*. Report 280, Department of Agriculture and Food Western Australia, Perth, WA.

Shepherd, D. P., Beeston, G. R. and Hopkins, A. J. M. 2002. *Native vegetation in Western Australia - extent, type and status.* Resource Management Technical Report 249. Department of Agriculture, South Perth, WA.

Western Australian Herbarium (WAH). 1998- . *FloraBase—the Western Australian Flora*. Department of Biodiversity, Conservation and Attractions. Available from: https://florabase.dpaw.wa.gov.au/

Western Australian Museum (WAM). 2020. *Checklist of the Terrestrial Vertebrate Fauna of Western Australia*. Updated November 2020. Government of Western Australia. Available from Checklist of the Terrestrial Vertebrate Fauna of Western Australia | Western Australian Museum.

Wilson, S., and Swan, G. 2010. *A Complete Guide to Reptiles of Australia*. Third Edition. New Holland Publishers, Sydney, NSW.

Appendix A Framework for conservation significant flora and fauna ranking

CATEGORIES OF THREATENED SPECIES UNDER THE ENVIRONMENT PROTECTION AND BIODIVERSITY CONSERVATION ACT 1999 (EPBC ACT)

Threatened fauna and flora may be listed in any one of the following categories as defined in Section 179 of the EPBC Act. Species listed as 'conservation dependent' and 'extinct' are not Matters of National Environmental Significance and therefore do not trigger the EPBC Act.

Category	Definition
Extinct (EX)	There is no reasonable doubt that the last member of the species has died.
Extinct in the Wild (EW)	Taxa known to survive only in captivity or as a naturalised population well outside its past range; or taxa has not been recorded in its known and/or expected habitat at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.
Critically Endangered (CR)	Taxa considered to be facing an extremely high risk of extinction in the wild.
Endangered (EN)	Taxa considered to be facing a very high risk of extinction in the wild.
Vulnerable (VU)	Taxa considered to be facing a high risk of extinction in the wild.
Near Threatened (NT)	Taxa has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future.
Least Concern (LC)	Taxa has been evaluated against the criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened. Widespread and abundant taxa are included in this category.
Data Deficient (DD)	There is inadequate information to make a direct, or indirect, assessment of taxa's risk extinction based on its distribution and/or population status.
Not Evaluated (NE)	Taxa has not yet been evaluated against the criteria.
Migratory (M)	Not an IUCN category. Species are defined as migratory if they are listed in an international agreement approved by the Commonwealth Environment Minister, including: • the Bonn Convention (Convention on the Conservation of Migratory Species of Wild Animal) for which Australia is a range state; • the agreement between the Government of Australian and the Government of the People's Republic of China for the Protection of Migratory Birds and their environment (CAMBA); • the agreement between the Government of Japan and the Government of Australia for the Protection of Migratory Birds and Birds in Danger of Extinction and their Environment (JAMBA); or • the agreement between Australia and the Republic of Korea to develop a bilateral migratory bird agreement similar to the JAMBA and CAMBA in respect to migratory bird

Category	Definition
	conservation and provides a basis for collaboration on the protection of migratory shorebirds and their habitat (ROKAMBA).

CONSERVATION CODES FOR WESTERN AUSTRALIA FLORA AND FAUNA

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

Specially protected fauna or flora are species 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.

Threatened species (T)

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 BC Act.

Threatened fauna is that subset of 'Specially Protected Fauna' listed under schedules 1 to 3 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018 for Threatened Fauna.

Threatened flora is that subset of 'Rare Flora' listed under schedules 1 to 3 of the Wildlife Conservation (Rare Flora) Notice 2018 for Threatened Flora.

The assessment of the conservation status of these species is based on their national extent and ranked according to their level of threat using IUCN Red List categories and criteria as detailed below.

Category	Code	Description
Critically Endangered species	CR	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. Published under schedule 1 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018 for critically endangered fauna or the Wildlife Conservation (Rare Flora) Notice 2018 for critically endangered flora.
Endangered species	EN	Threatened species considered to be "facing a very high risk of extinction in the wild in the near future, as determined in accordance with criteria set out in the ministerial guidelines". Listed as endangered under section 19(1)(b) of the BC Act in accordance with the criteria set out in section 21 and the ministerial guidelines. Published under schedule 2 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018 for endangered fauna or the Wildlife Conservation (Rare Flora) Notice 2018 for endangered flora.
Vulnerable species	VU	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.

Category	Code	Description
		Published under schedule 3 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018 for vulnerable fauna or the Wildlife Conservation (Rare Flora) Notice 2018 for vulnerable flora.

Extinct species

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

Category	Code	Description
Extinct species	EX	Species which have been adequately searched for and there is no reasonable doubt that the last individual has died. Published as Specially Protected under the Wildlife Conservation Act 1950, in Schedule 4 of the Wildlife Conservation (Specially Protected Fauna) Notice for Presumed Extinct Fauna and Wildlife Conservation (Rare Flora) Notice for Presumed Extinct Flora.
Extinct in the wild species	EW	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 threatened fauna or threatened flora species listed as extinct in the wild. If listing of a species as extinct in the wild occurs, then a schedule will be added to the applicable notice.

Specially protected species

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

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

Categories are detailed below.

Category	Code	Description
Migratory species	M	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

Category	Code	Description
		species and that binds the Commonwealth; and listing is otherwise in accordance with the ministerial guidelines (section 15 of the BC Act). Includes birds that are subject to an agreement between the government of Australia and the governments of Japan (JAMBA), China (CAMBA) and The Republic of Korea (ROKAMBA), and fauna subject to the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention), an environmental treaty under the United Nations Environment Program. Migratory species listed under the BC Act are a subset of the migratory animals that are known to visit Western Australia, protected under the international agreements or treaties, excluding species that are listed as Threatened species. Published as migratory birds protected under an international agreement under schedule 5 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018.
Species of special conservation interest (conservation dependent fauna)	CD	Fauna of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as threatened, and listing is otherwise in accordance with the ministerial guidelines (section 14 of the BC Act). Published as conservation dependent fauna under schedule 6 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018.
Other specially protected species	OS	Fauna 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). Published as other specially protected fauna under schedule 7 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018.

Priority species (P)

Possibly threatened species that do not meet survey criteria, or are otherwise data deficient, are added to the Priority Fauna or Priority Flora Lists under Priorities 1, 2 or 3. These three categories are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as threatened fauna or flora.

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

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

Category	Code	Definition
Priority 1	P1	*Poorly-known species* Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for

Category	Code	Definition
		conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.
Priority 2	P2	*Poorly-known species* Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.
Priority 3	P3	*Poorly-known species* Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.
Priority 4	P4	*Rare, Near Threatened and other species in need of monitoring* (a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection but could be if present circumstances change. These species are usually represented on conservation lands. (b) Near Threatened. Species that are considered to have been adequately surveyed and that are close to qualifying for vulnerable but are not listed as Conservation Dependent. (c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

Appendix B Likelihood of occurrence assessment criteria

Likelihood rating	Criteria
Recorded	The species has previously been recorded within survey area from DBCA database search results and/or from previous surveys of the survey area, and/or the species has been confirmed through a current vouchered specimen at WAH.
Likely	The species has not previously been recorded from within the survey area. However, (to qualify requires one or more criteria to be met): • the species has been recorded in close proximity to the survey area, and occurs in similar habitat to that which occurs within the survey area • core habitat and suitable landforms for the species occurs within the survey area either year-round or seasonally. In relation to fauna species, this could be that a host plant is seasonally present on site, or habitat features such as caves are present that may be used during particular times during its life cycle e.g. for breeding. In relation to both flora and fauna species, it may be there are seasonal wetlands present • there is a medium to high probability that a species uses the survey area
Potential	The species has not previously been recorded from within the survey area. However, (one or more criteria requires to be met): • targeted surveys may locate the species based on records occurring in proximity to the survey area and suitable habitat occurring in the survey area • the survey area has been assessed as having potentially suitable habitat through habitat modelling • the species is known to be cryptic and may not have been detected despite extensive surveys • the species is highly mobile and has an extensive foraging range so may not have been detected during previous surveys The species has been recorded in the survey area by a previous consultant survey or there is historic evidence of species occurrence within the survey area. However, (one or more criteria requires to be met) • doubt remains over taxonomic identification, or the majority of habitat does not appear suitable (although presence cannot be ruled out due to factors such as species ecology or distribution) • coordinates are doubtful
Unlikely	The species has been recorded locally through DBCA database searches. However, it has not been recorded within the survey area and • it is unlikely to occur due to the site lacking critical habitat, having at best marginally suitable habitat, and/or being severely degraded • it is unlikely to occur due to few historic record/s and no other current collections in the local area. The species has been recorded within the bioregion based on literature review but has not been recorded locally or within the survey area through DBCA database searches. The species has not been recorded in the survey area despite adequate survey efforts, such as a standardised methodology or targeted searching within potentially suitable habitat.
Does not occur	The species is not known to occur within the IBRA bioregion based on current literature and distribution. The conspicuous species has not been recorded in the survey area despite adequate survey efforts at an appropriate time of year to detect the species within potentially suitable habitat.

Likelihood rating	Criteria
	The survey area lacks important habitat for a species that has highly selective habitat requirements. The species has been historically recorded within survey area or locally; however, it is considered locally extinct due to significant habitat changes such as land clearing and/or introduced predators.

Appendix C Flora likelihood of occurrence assessment

Scientific name	Conservation status		Habitat	Source	Likelihood of occurrence and justification
	EPBC Act	BC Act / DBCA			
Acacia cochlocarpa subsp. velutinosa	CR	CR	Velutinous, sprawling shrub, growing to 1.5m. Occurs on sandy clay or laterite.	PMST	**Unlikely** No suitable habitat, no nearby records.
Dasymalla axillaris	CR	CR	Shrub, growing to 1.5m high. Occurs in yellow sand.	PMST	**Unlikely** No suitable habitat, no nearby records.
Gyrostemon reticulatus	CR	CR	Shrub, growing up to 1m high.	PMST	**Unlikely** No suitable habitat, no nearby records.
Acacia cochlocarpa subsp. cochlocarpa	EN	CR	Glaborous, sprawling shrub, growing to 1.5m. Occurs in clayey, sandy, often gravelly soils.	PMST	**Unlikely** No suitable habitat, no nearby records.
Acacia vassalii	EN	CR	Semi-prostrate, spreading, rounded shrub, growing to 0.3m high. Occurs on grey/brown or yellow sand, sandy loam.	DBCA 2020a, NatureMap, PMST	**Unlikely** No suitable habitat, no nearby records.
Caladenia drakeoides	EN	CR	Tuberous, perennial herb, growing to 0.3m high. Occurs on the margins of salt lakes in grey clayey sand or red sandy loam.	DBCA 2020a, NatureMap, PMST	**Likely** Closest record 0.5 km south-west of the survey area. Suitable habitat is present (VC5).

Scientific name	Conservation status		Habitat	Source	Likelihood of occurrence and justification
	EPBC Act	BC Act / DBCA			
					Majority of WAH's records (9 of 11) flowered in the first two weeks of September, therefore they may not have been able to be identified in the field survey.
Chorizema humile	EN	CR	Sprawling, prostrate shrub. Occurs on plains in sandy clay or loam.	DBCA 2020a, NatureMap, PMST	**Unlikely** No suitable habitat, no nearby records.
Daviesia euphorbioides	EN	CR	Shrub, growing to 0.8m high. Occurs on flats, sandplains, in clayey sand, sandy gravel.	PMST	**Unlikely** No suitable habitat, no nearby records.
Eremophila pinnatifida	EN	CR	Shrub, growing up to 0.6m high. Occurs on loam.	PMST	**Unlikely** No suitable habitat, no nearby records.
Eremophila scaberula	EN	CR	Low compact or sprawling shrub, growing up to 1.5m high. Occurs on winter-wet plains, inundated areas, in clay, sandy clay or loam.	PMST	**Unlikely** No suitable habitat, no nearby records.
Gastrolobium hamulosum	EN	CR	Low shrub, growing to 0.45m. Occurs on flats, slopes, ridges in sandy, often gravelly soils or clay.	DBCA 2020a, PMST	**Unlikely** No suitable habitat, no nearby records.
Grevillea pythara	EN	CR	Suckering shrub, growing to 0.3m high. Occurs in sand or sandy loam with gravel.	DBCA 2020a, PMS	**Unlikely**

Scientific name	Conservation status		Habitat	Source	Likelihood of occurrence and justification
	EPBC Act	BC Act / DBCA			
					No suitable habitat, no nearby records.
Hemiandra gardneri	EN	CR	Prostrate, pungent shrub, growing to 0.2m high. Occurs on sandplains, in grey or yellow sand, clayey sand.	PMST	**Unlikely** No suitable habitat, no nearby records.
Jacksonia pungens	EN	CR	Rounded shrub, growing to 0.8m high. Occurs on undulating areas, in yellow sand, gravelly lateritic soils.	DBCA 2020a, NatureMap, PMST	**Unlikely** No suitable habitat, no nearby records.
Verticordia staminosa subsp. staminosa	EN	CR	Spreading shrub, growing to 0.6m high. Occurs on granite outcrops, in soil pockets.	PMST	**Unlikely** No suitable habitat, no nearby records.
Acacia ataxiphylla subsp. magna	EN	EN	Spreading to ascending shrub, growing to 0.6m high. Occurs on lateritic ironstone rises, flats, in sandy soils.	PMST	**Unlikely** No suitable habitat, no nearby records.
Conospermum densiflorum subsp. unicephalatum	EN	EN	Much-branched shrub, growing to 0.6m high. Occurs in low-lying areas in clay soils.	PMST	**Unlikely** No suitable habitat, no nearby records.
Daviesia dielsii	EN	EN	Divaricate shrub, growing to 0.9m high. Occurs on sandy, often gravelly soils.	DBCA 2020a, NatureMap, PMST	**Unlikely** No suitable habitat, no nearby records.
Eremophila viscida	EN	EN	Shrub, growing to 4m high. Occurs on stony gullies, sandplains, in granitic soils, sandy loam.	PMST	**Unlikely**

Scientific name	Conservation status		Habitat	Source	Likelihood of occurrence and justification
	EPBC Act	BC Act / DBCA			
					No suitable habitat, no nearby records.
Grevillea bracteosa subsp. *bracteosa*	EN	EN	Shrubs, growing up to 2m high. Occurs in red clay loam over laterite.	DBCA 2020a, NatureMap	**Unlikely** No suitable habitat, no nearby records.
Grevillea christineae	EN	EN	Wiry shrub, growing to 0.6m high. Occurs in clay loam, sandy clay, often moist.	DBCA 2020a, PMST	**Unlikely** No suitable habitat, no nearby records.
Eucalyptus recta	EN	VU	Tree, growing to 15m high.	PMST	**Unlikely** No suitable habitat, no nearby records.
Frankenia conferta	EN	VU	Small shrub.	PMST	**Unlikely** No suitable habitat, no nearby records.
Grevillea dryandroides subsp. hirsuta	EN	VU	Prostrate, vigorously sucking shrub, growing to 0.3m. Occurs in white or yellow sand, laterite.	PMST	**Unlikely** No suitable habitat, no nearby records.
Roycea pycnophylloides	EN	VU	Perennial, herb, forming densely branched, silvery mats, growing up to 1m high. Occurs on saline flats, in sandy soils.	PMST	**Unlikely** No suitable habitat, no nearby records.

Scientific name	Conservation status		Habitat	Source	Likelihood of occurrence and justification
	EPBC Act	BC Act / DBCA			
Gastrolobium appressum	VU	EN	Shrub, growing to 0.3m high. Occurs on sandplains, low rises, in white/yellow sand with quartz gravel.	DBCA 2020a, NatureMap, PMST	**Unlikely** One historic record occurs 50m from the northern boundary of the survey area. If present, this reasonably conspicuous species would have been identified.
Eucalyptus rhodantha var. rhodantha	VU	VU	Spreading mallee, growing to 4m high. Occurs on undulating country, hillslopes.	DBCA 2020a	**Unlikely** No suitable habitat, no nearby records.
Acacia trinalis	-	P1	Dense, rounded, bushy shrub or tree, growing to 4m high. Occurs in salt lakes and flats, swampy areas, with brown sand or clay loam.	DBCA 2020a, NatureMap	**Unlikely** One historic record occurs 50m from the northern boundary of the survey area. If present, this large shrub/tree would have been identified.
Androcalva fragifolia	-	P1	Shrub, growing up to 0.8m high. Occurs in pale brown loamy sand.	DBCA 2020a, NatureMap	**Unlikely** No suitable habitat, no nearby records.
Caladenia cristata	-	P1	Tuberous, perennial herb, growing up to 0.4m high. Occurs on sandy rise above salt flats, on sandy clay.	DBCA 2020a, NatureMap	**Likely** Closest record 50m from the northern boundary of the survey area. One record also occurs 0.5 km

Scientific name	Conservation status		Habitat	Source	Likelihood of occurrence and justification
	EPBC Act	BC Act / DBCA			
					south-west of the survey area. Suitable habitat is present (VC2 and 5). Majority of WAH's records (8 of 10) flowered in September, therefore they may not have been able to be identified in the field survey.
Dampiera glabrescens	-	P1	Perennial herb, growing to 0.9m high. Occurs on gravel pits, roadsides, in white or grey/yellow sand.	DBCA 2020a	**Unlikely** No suitable habitat, no nearby records.
Grevillea pinifolia	-	P1	Much-branched shrub, growing to 0.9m high. Occurs on yellow sand, gravel.	DBCA 2020a, NatureMap	**Unlikely** No suitable habitat, no nearby records.
Verticordia dasystylis subsp. oestopoia	-	P1	Spreading shrub, growing to 0.4m high. Occurs on outcrops in gritty soils over granite.	DBCA 2020a	**Unlikely** No suitable habitat, no nearby records.
Acacia arcuatilis	-	P2	Rounding, spreading shrub, growing to 1.5m high. Occurs on sand or sandy loam, sometimes with lateritic gravel, on undulating plains, rises.	DBCA 2020a	**Unlikely** No suitable habitat, no nearby records.
Acacia lirellata subsp. compressa	-	P2	Bushy procumbent, spreading shrub, growing to 1.2m high. Occurs on sandplains, in yellow sand, clayey loam.	DBCA 2020a	**Unlikely** No suitable habitat, no nearby records.

Scientific name	Conservation status		Habitat	Source	Likelihood of occurrence and justification
	EPBC Act	BC Act / DBCA			
Guichenotia glandulosa	-	P2	Multi-stemmed shrub, growing to 0.4m high. Occurs in creek lines, littered soil.	NatureMap	**Unlikely** No suitable habitat, no nearby records.
Thryptomene shirleyae	-	P2	Shrub, growing to 0.7m high. Occurs in yellow sand.	DBCA 2020a	**Unlikely** No suitable habitat, no nearby records.
Acacia anarthros	-	P3	Prostrate, spinose shrub, growing to 0.5m high. Occurs in lateritic gravelly soils, slopes.	DBCA 2020a	**Unlikely** No suitable habitat, no nearby records.
Daviesia debilior subsp. sinuans	-	P3	Straggling shrub, growing to 0.8m high. Occurs in gravelly lateritic clay.	DBCA 2020a	**Unlikely** No suitable habitat, no nearby records.
Eucalyptus macrocarpa x pyriformis	-	P3	Open mallee tree, growing to 6m high. Occurs on hills, rocky ironstone ridges, sandplains, in sand, lateritic sandy soils.	DBCA 2020a	**Unlikely** No suitable habitat, no nearby records.
Gastrolobium rotundifolium	-	P3	Bushy shrub, growing up to 0.8m high. Occurs in low rises, breakaways, in heavy clay or loam soils, granite, sandstone and quartzite.	DBCA 2020a, NatureMap	**Unlikely** One historic record occurs 50m from the northern boundary of the survey area. If present, this reasonably conspicuous species would have been identified.

Scientific name	Conservation status		Habitat	Source	Likelihood of occurrence and justification
	EPBC Act	BC Act / DBCA			
Grevillea asparagoides	-	P3	Dense prickly shrub, growing up to 2m high. Occurs on gravelly loam, white or yellow sand.	DBCA 2020a, NatureMap	**Unlikely** No suitable habitat, no nearby records.
Grevillea haplantha subsp. recedens	-	P3	Spreading shrub, growing to 1m high. Occurs on sand, sandy loam.	DBCA 2020a	**Unlikely** No suitable habitat, no nearby records.
Melaleuca sclerophylla	-	P3	Spreading to prostrate shrub, growing to 0.9m high. Occurs on granite outcrops, rises, in gravelly sand, clayey sand.	DBCA 2020a, NatureMap	**Unlikely** No suitable habitat, no nearby records.
Stylidium periscelianthum	-	P3	Bulb-forming perennial herb, growing to 0.15m high. Occurs on wet flats, low granitic hills, in loamy clay, moist soils pockets.	DBCA 2020a, NatureMap	**Unlikely** No suitable habitat, no nearby records.
Urodon capitatus	-	P3	Low spreading or upright shrub, growing to 1.2m. Occurs in sandy gravelly soils on plains.	DBCA 2020a, NatureMap	**Potential** Closest record 50m from the northern boundary of the survey area. Suitable habitat may be present.
Verticordia huegelii var. tridens	-	P3	Shrub, growing to 0.6m high. Occurs in winter-wet areas, low hills, in sandy or gravelly loam.	DBCA 2020a	**Unlikely** No suitable habitat, no nearby records.
Verticordia venusta	-	P3	Spreading shrub, growing to 2m. Occurs in yellow sand, sandy gravels on sandplains.	DBCA 2020a, NatureMap	**Potential** Closest record 50m from the northern boundary of

Scientific name	Conservation status		Habitat	Source	Likelihood of occurrence and justification
	EPBC Act	BC Act / DBCA			
					the survey area. Suitable habitat may be present.
Calothamnus accedens	-	P4	Slender shrub, growing up to 1.8m. Occurs on road verges in sandy soils over laterite.	DBCA 2020a, NatureMap	**Unlikely** No suitable habitat, no nearby records.
Eucalyptus x carnabyi	-	P4	Mallee, growing up to 6m. Occurs lateritic ridges, in grey sand, sandy loam.	DBCA 2020a, NatureMap	**Unlikely** No suitable habitat, no nearby records.
Persoonia sulcata	-	P4	Spreading to decumbent, growing to 1m high. Occurs in lateritic or granitic soils.	DBCA 2020a	**Unlikely** No suitable habitat, no nearby records.

Appendix D Fauna likelihood of occurrence assessment

Scientific name	Common name	Conservation status		Habitat	Source	Likelihood of occurrence and justification
		EPBC Act	BC Act / DBCA			
Pezoporus occidentalis	Night Parrot	EN	CR	The Night Parrot is a highly elusive nocturnal ground dwelling parrot found in the arid and semi-arid zones of Australia.	PMST	**Unlikely** This species is highly elusive and no suitable habitat occurs within the survey area.
Botaurus poiciloptilus	Australasian Bittern	EN	EN	The Australasian bittern is a secretive, stocky, heron-like bird, living in wetlands where it forages.	DBCA 2020b	**Unlikely** No suitable habitat occurs within the survey area.
Calyptorhynchus latirostris	Carnaby's Cockatoo	EN	EN	Carnaby's Cockatoo occurs in uncleared or remnant native eucalypt woodlands and in shrubland or kwongan heathland. Forages seasonally in pine plantations, around Perth metropolitan, and forests containing Marri, Karri and Jarrah.	DBCA 2020b, NatureMap, PMST	**Potential** Two records present 10 km north-east and east of the survey area. Low quality foraging habitat present within the survey area.
Idiosoma kopejtkaorum	Lake Goorly shield-backed trapdoor spider	EN	EN	-	DBCA 2020b	**Unlikely** No suitable habitat occurs within the survey area.
Egernia stokesii subsp. *badia*	Western Spiny-tailed Skink	EN	VU	The Western Spiny-tailed Skink is known to occur in a broad semi-arid area in south-west WA, between Shark Bay and Minnivale and east to Cue. Much the wheatbelt has been cleared since the 1960s and suitable microhabitat is now far less abundant, although an increasing number of skinks are being located in altered habitat under piles of wood, scrap metal or under buildings on private property.	DBCA 2020b, NatureMap, PMST	**Potential** Two records less than 1 km north-east of the survey area. Low quality habitat present within the survey area.

Scientific name	Common name	Conservation status		Habitat	Source	Likelihood of occurrence and justification
		EPBC Act	BC Act / DBCA			
Idiosoma nigrum	Shield-backed Trapdoor Spider	VU	EN	In the Wheatbelt, the Shield-backed Trapdoor Spider typically inhabits clay soils. Leaf litter and twigs are extremely important to the species as it provides material for the burrows, reduced soil moisture loss and increased prey availability.	DBCA 2020b, NatureMap, PMST	**Potential** Two records less than 6 km north and south of the survey area. Low quality habitat present within the survey area.
Calyptorhynchus banksii naso	Forest Red-tailed Black Cockatoo	VU	VU	Inhabits dense Jarrah, Karri and Marri forests which receive more than 600 mm average annual rainfall. Known to feed in more open agricultural areas and metropolitan Perth.	DBCA 2020	**Unlikely** No suitable habitat occurs within the survey area. Records are 40 km to the west of the survey area.
Dasyurus geoffroii	Chuditch, Western Quoll	VU	VU	Chuditch use a range of habitats including forest, mallee shrublands, woodland and desert. The most dense populations have been found in riparian jarrah forest. Chuditch require adequate numbers of suitable den and refuge sites (horizontal hollow logs or earth burrows) and sufficient prey biomass (large invertebrates, reptiles and small mammals) to survive.	DBCA 2020b, PMST	**Unlikely** No suitable habitat occurs within the survey area. Records are 45 km to the west of the survey area.
Falco hypoleucos	Grey Falcon	VU	VU	Usually confined to the arid inland. It inhabits *Triodia* grassland, *Acacia* shrubland, and lightly timbered arid woodland.	PMST	**Unlikely** Species is rare with a very wide distribution
Leipoa ocellata	Malleefowl	VU	VU	Occurs in scrubland and woodland dominated by mallee and wattle species. In Western Australia they are also found in some shrublands dominated by *Acacia*, and occasionally in woodlands dominated by eucalypts such as Wandoo (*E. wandoo*), Marri (*Corymbia calophylla*) and Mallet (*E. astringens*).	DBCA 2020b, NatureMap, PMST	**Unlikely** No suitable habitat occurs within the survey area

Scientific name	Common name	Conservation status		Habitat	Source	Likelihood of occurrence and justification
		EPBC Act	BC Act / DBCA			
Falco peregrinus	Peregrine Falcon	-	OS	The Peregrine Falcon is found across Australia, but is not common anywhere.	DBCA 2020b	**Unlikely** Very wide distribution and varying habitat requirements
Phascogale tapoatafa wambenger	South-western Brush-tailed Phascogale	-	CD	This subspecies has been observed in dry sclerophyll forests and open woodlands that contain hollow-bearing trees but a sparse ground cover.	DBCA 2020b	**Unlikely** No suitable habitat occurs within the survey area
Aspidites ramsayi (southwest subpop.)	Woma (southwest subpop.)	-	P1	The Woma is found in subhumid to arid interior. Woodlands, shrublands, and heath, often with spinifex.	DBCA 2020b	**Unlikely** No suitable habitat occurs within the survey area
Idiosoma dandaragan	Dandaragan Plateau shield-backed trapdoor spider	-	P2	-	DBCA 2020b	**Unlikely** No suitable habitat occurs within the survey area
Idiosoma mcclementsorum	Julimar shield-backed trapdoor spider	-	P2	-	DBCA 2020b	**Unlikely** No suitable habitat occurs within the survey area
Ninox connivens connivens	Barking owl (southwest)	-	P3	Barking Owls are found in open woodlands and the edges of forests, often adjacent to farmland.	DBCA 2020b	**Unlikely** No suitable habitat occurs within the survey area
Aganippe castellum	Tree-stem trapdoor spider		P4	-	DBCA 2020b	**Unlikely** No suitable habitat occurs within the survey area

Scientific name	Common name	Conservation status		Habitat	Source	Likelihood of occurrence and justification
		EPBC Act	BC Act / DBCA			
Hydromys chrysogaster	Water-rat, Rakali	-	P4	The Water-rat generally occurs in permanent fresh or brackish water, although it can also be found in marine environments.	DBCA 2020b	**Unlikely** No suitable habitat occurs within the survey area
Isoodon fusciventer	Quenda	-	P4	This species prefers areas of scrubby vegetation (often swampy areas) with a dense cover of up to one metre in height. They often forage in adjacent forest and woodland areas that is burnt regularly and in pastures and crops.	DBCA 2020b	**Unlikely** No suitable habitat occurs within the survey area
Notamacropus irma	Western Brush Wallaby	-	P4	Inhabits open forests or woodlands, preference to open, seasonally wet flats with low grasses and open scrubby thickets.	DBCA 2020b	**Unlikely** No suitable habitat occurs within the survey area
Oxyura australis	Blue-billed Duck	-	P4	The Blue-billed Duck is endemic to Australia, being found in the temperate wetlands of the south-east and south-west parts of the continent.	DBCA 2020b	**Unlikely** No suitable habitat occurs within the survey area
Platycercus icterotis xanthogenys	Western Rosella (inland)	-	P4	Western Rosellas are found in open eucalypt forest and timbered areas, including cultivated land and orchards.	DBCA 2020b	**Unlikely** No suitable habitat occurs within the survey area
Thinornis rubricollis	Hooded Plover	-	P4	In the south-west, Hooded Plovers occur on inland salt lakes	DBCA 2020b	**Unlikely** No suitable habitat occurs within the survey area

Appendix E Flora species list

Family	Species
Aizoaceae	**Mesembryanthemum nodiflorum*
Amaranthaceae	*Ptilotus exaltatus*
	Ptilotus polystachyus
Asparagaceae	*Acanthocarpus canaliculatus*
	Lomandra effusa
	Lomandra sp.
	Thysanotus sp.
Asteraceae	**Arctotheca calendula*
	**Hypochaeris glabra*
	**Monoculus monstrosus*
	**Oncosiphon piluliferum*
	**Sonchus asper*
	**Sonchus oleraceus*
	Erymophyllum ramosum
	Hyalochlamys globifera
	Podolepis capillaris
	Siloxerus multiflorus
Boraginaceae	**Echium plantagineum*
	Heliotropium curassavicum
Brassicaceae	**Brassica tournefortii*
	**Raphanus raphanistrum*
Casuarinaceae	*Casuarina obesa*
Chenopodiaceae	*Atriplex amnicola*
	Atriplex codonocarpa
	Atriplex hymenotheca
	Atriplex semibaccata
	Didymanthus roei

Family	Species
	Enchylaena tomentosa
	Maireana brevifolia
	Maireana carnosa
	Rhagodia drummondii
	Salsola australis
	Sclerolaena diacantha
	Sclerolaena eriacantha
	Tecticornia pergranulata
	Tecticornia undulata
Convolvulaceae	*Wilsonia humilis*
Cyperaceae	*Lepidosperma* sp.
Fabaceae	**Lupinus angustifolius*
	**Trifolium campestre*
	**Trifolium glomeratum*
	Acacia acuminata
	Acacia aestivalvis
	Acacia colletioides
	Acacia hemiteles
	Acacia lineolata subsp. *lineolata*
	Templetonia sulcata
Geraniaceae	*Erodium cygnorum*
Hemerocallidaceae	*Dianella revoluta*
Iridaceae	**Romulea rosea*
Myrtaceae	*Eucalyptus comitae-vallis*
	Eucalyptus horistes
	Eucalyptus loxophleba
	Melaleuca lateriflora
	Melaleuca stereophloia
Plumbaginaceae	**Limonium sinuatum*

Family	Species
Poaceae	**Aira cupaniana*
	**Avena barbata*
	**Bromus diandrus*
	**Bromus rubens*
	**Cynodon dactylon*
	**Ehrharta longiflora*
	**Eragrostis curvula*
	**Hordeum leporinum*
	**Lolium rigidum*
	**Triticum aestivum*
	**Vulpia myuros* forma *megalura*
	Austrostipa elegantissima
	Chloris truncata
	Eragrostis dielsii
	Vulpia myuros forma. *megalura*
Polygalaceae	*Comesperma integerrimum*
Polygonaceae	**Rumex hypogaeus*
Proteaceae	*Grevillea biternata*
	Hakea preissii
Santalaceae	*Santalum acuminatum*
Sapindaceae	*Dodonaea bursariifolia*
	Dodonaea inaequifolia
Surianaceae	*Stylobasium australe*

Appendix F Species by relevé matrix

Family	Species	ELA01	ELA02	ELA03	ELA04	ELA05	ELA06	ELA07	ELA08	ELA09	ELA10	ELA11	ELA12	ELA13	ELA14	ELA15
Aizoaceae	**Mesembryanthemum nodiflorum*	x	x	x	x			x	x	x	x	x	x	x	x	
Amaranthaceae	*Ptilotus exaltatus*										x	x				
Amaranthaceae	*Ptilotus polystachyus*										x		x	x		x
Asparagaceae	*Acanthocarpus canaliculatus*	x														
Asparagaceae	*Lomandra effusa*															x
Asparagaceae	*Thysanotus* sp.		x													
Asteraceae	**Arctotheca calendula*						x					x		x	x	
Asteraceae	**Hypochaeris glabra*						x					x	x			
Asteraceae	**Monoculus monstrosus*	x		x							x	x	x			x
Asteraceae	**Oncosiphon piluliferum*								x		x	x	x	x	x	
Asteraceae	**Sonchus asper*									x						
Asteraceae	**Sonchus oleraceus*						x	x			x	x	x	x	x	
Asteraceae	*Erymophyllum ramosum*	x														
Asteraceae	*Hyalochlamys globifera*			x												
Asteraceae	*Podolepis capillaris*	x	x													
Asteraceae	*Siloxerus multiflorus*		x					x	x	x						
Brassicaceae	**Brassica tournefortii*	x										x				
Casuarinaceae	*Casuarina obesa*					x	x									
Chenopodiaceae	*Atriplex amnicola*												x	x		
Chenopodiaceae	*Atriplex codonocarpa*	x			x				x		x		x	x		
Chenopodiaceae	*Atriplex hymenotheca*		x						x	x						
Chenopodiaceae	*Atriplex semibaccata*	x									x	x	x	x	x	
Chenopodiaceae	*Didymanthus roei*									x						
Chenopodiaceae	*Enchylaena tomentosa*							x	x	x					x	
Chenopodiaceae	*Maireana brevifolia*				x		x		x		x	x	x	x	x	
Chenopodiaceae	*Maireana carnosa*	x	x													
Chenopodiaceae	*Rhagodia drummondii*	x	x		x	x	x		x	x					x	x
Chenopodiaceae	*Salsola australis*			x					x		x	x	x			x

Family	Species	ELA01	ELA02	ELA03	ELA04	ELA05	ELA06	ELA07	ELA08	ELA09	ELA10	ELA11	ELA12	ELA13	ELA14	ELA15
Chenopodiaceae	*Sclerolaena diacantha*	x														x
Chenopodiaceae	*Sclerolaena eriacantha*										x					
Chenopodiaceae	*Tecticornia pergranulata*		x		x			x	x	x					x	
Chenopodiaceae	*Tecticornia undulata*			x				x								
Convolvulaceae	*Wilsonia humilis*				x											
Fabaceae	**Trifolium campestre*					x										
Fabaceae	**Trifolium glomeratum*										x					
Fabaceae	*Acacia acuminata*															x
Fabaceae	*Acacia hemiteles*										x	x	x			
Fabaceae	*Acacia lineolata* subsp. *lineolata*		x						x							
Fabaceae	*Templetonia sulcata*		x													
Geraniaceae	*Erodium cygnorum*										x					
Hemerocallidaceae	*Dianella revoluta*	x														x
Iridaceae	**Romulea rosea*				x				x							
Myrtaceae	*Eucalyptus horistes*															x
Myrtaceae	*Eucalyptus loxophleba*	x												x	x	x
Myrtaceae	*Melaleuca lateriflora*				x		x		x	x					x	
Myrtaceae	*Melaleuca stereophloia*	x	x		x	x	x									x
Poaceae	**Aira cupaniana*										x					x
Poaceae	**Avena barbata*	x	x		x						x	x	x			x
Poaceae	**Bromus diandrus*											x				
Poaceae	**Bromus rubens*										x					
Poaceae	**Cynodon dactylon*												x		x	
Poaceae	**Ehrharta longiflora*															x
Poaceae	**Eragrostis curvula*					x	x									
Poaceae	**Hordeum leporinum*							x	x		x	x	x	x	x	
Poaceae	**Lolium rigidum*			x		x	x	x	x	x	x	x	x	x	x	
Poaceae	**Vulpia myuros* forma *megalura*			x	x				x	x	x	x				
Poaceae	*Austrostipa elegantissima*	x	x	x	x	x	x			x	x			x	x	x
Poaceae	*Chloris truncata*										x	x	x			

Family	Species	ELA01	ELA02	ELA03	ELA04	ELA05	ELA06	ELA07	ELA08	ELA09	ELA10	ELA11	ELA12	ELA13	ELA14	ELA15
Poaceae	*Eragrostis dielsii*							x	x	x	x	x	x		x	
Polygalaceae	*Comesperma integerrimum*	x	x		x	x	x									x
Polygonaceae	**Rumex hypogaeus*											x				
Proteaceae	*Grevillea biternata*					x										
Proteaceae	*Hakea preissii*		x		x	x	x		x					x	x	
Santalaceae	*Santalum acuminatum*															x
Sapindaceae	*Dodonaea bursariifolia*	x														
Surianaceae	*Stylobasium australe*					x										

Appendix G Relevé details

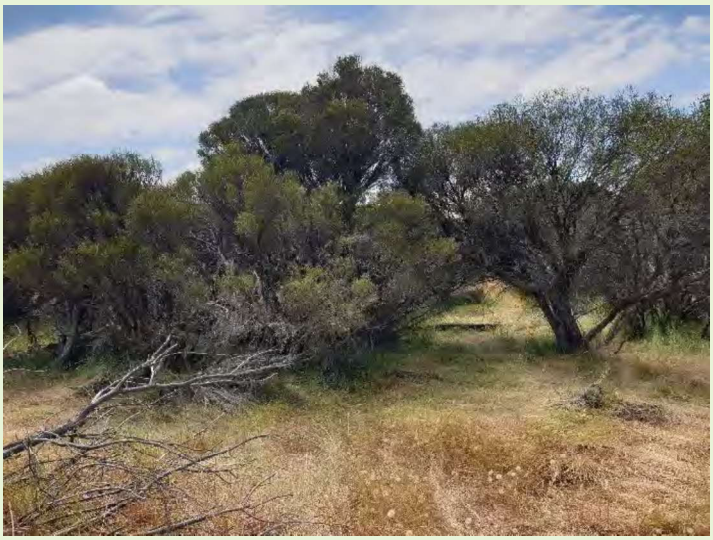
Relevé:	ELA01					
Date:	21/10/2020	**Site:**	CBH Miling			
Vegetation Unit:	VC1	**Location (UTM):**	50 J	**Dominant species**	**Cover (%)**	**Height (m)**
Condition:	Good		438692 m E	*Eucalyptus loxophleba*	15	6-8
			6626937 m S	*Rhagodia drummondii*	5	1
Photograph:				*Austrostipa elegantissima*	5	1
				*Sclerolaena diacantha*	3	0.2
				Other species		
				**Avena barbata*		
				**Brassica tournefortii*		
				**Mesembryanthemum nodiflorum*		
				**Monoculus monstrosus*		
				Acanthocarpus canaliculatus		
				Atriplex codonocarpa		
				Atriplex semibaccata		
				Comesperma integerrimum		
				Dianella revoluta		
				Dodonaea bursariifolia		
				Erymophyllum ramosum		
				Maireana carnosa		
				Melaleuca stereophloia		
				Podolepis capillaris		

Relevé:	ELA02					
Date:	21/10/2020	**Site:**	CBH Miling			
Vegetation Unit:	VC5	**Location (UTM):**	50 J	**Dominant species**	**Cover (%)**	**Height (m)**
Condition:	Good		438629 m E	*Hakea preissii*	5-10	3-4
			6626916 m S	*Acacia lineolata subsp. lineolata*	10	2
Photograph:				*Austrostipa elegantissima*	5	1
				*Rhagodia drummondii*	3	1
				Tecticornia pergranulata	1	1
				Other species		
				**Avena barbata*		
				**Mesembryanthemum nodiflorum*		
				Atriplex hymenotheca		
				Comesperma integerrimum		
				Maireana carnosa		
				Melaleuca stereophloia		
				Podolepis capillaris		
				Siloxerus multiflorus		
				Templetonia sulcata		
				Thysanotus sp.		

Relevé:	ELA03					
Date:	21/10/2020	**Site:**	CBH Miling			
Vegetation Unit:	VC2	**Location (UTM):**	50 J	**Dominant species**	**Cover (%)**	**Height (m)**
Condition:	Good		438629 m E	*Tecticornia undulata*	20	1
			6626916 m S	**Lolium rigidum*	1	1
Photograph:				**Mesembryanthemum nodiflorum*	15	0.1
				*Hyalochlamys globifera*	2	0.01
				Other species		
				**Monoculus monstrosus*		
				**Vulpia myuros forma megalura*		
				Austrostipa elegantissima		
				Salsola australis		

Relevé:	ELA04					
Date:	21/10/2020	**Site:**	CBH Miling			
Vegetation Unit:	VC4	**Location (UTM):**	50 J	**Dominant species**	**Cover (%)**	**Height (m)**
Condition:	Good		438542 m E	*Melaleuca lateriflora*	5-10	3
			6626895 m S	*Hakea preissii*	1	4
Photograph:				*Rhagodia drummondii*	5	0.5
				*Tecticornia pergranulata*	1	0.5
				Austrostipa elegantissima	1	1
				**Mesembryanthemum nodiflorum*	3	0.1
				Other species		
				**Avena barbata*		
				**Romulea rosea*		
				**Vulpia myuros forma megalura*		
				Atriplex codonocarpa		
				Comesperma integerrimum		
				Maireana brevifolia		
				Melaleuca stereophloia		
				Wilsonia humilis		

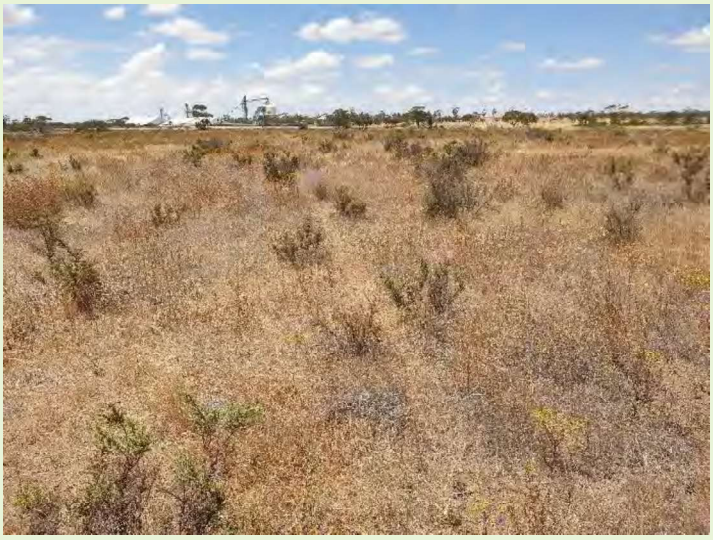
Relevé:	ELA05					
Date:	21/10/2020	**Site:**	CBH Miling			
Vegetation Unit:	VC4	**Location (UTM):**	50 J	**Dominant species**	**Cover (%)**	**Height (m)**
Condition:	Degraded/ Good		438535 m E	*Melaleuca stereophloia*	15	8
			6626681 m S	*Casuarina obesa*	3	6
Photograph:				*Hakea preissii*	0.5	3
				**Eragrostis curvula*	2	1
				**Lolium rigidum*	2	0.5
				Rhagodia drummondii	1	1
				Austrostipa elegantissima	1	1
				Other species		
				**Trifolium campestre*		
				Comesperma integerrimum		
				Grevillea biternata		
				Stylobasium australe		

Relevé:	ELA06					
Date:	21/10/2020	**Site:**	CBH Miling			
Vegetation Unit:	VC4	**Location (UTM):**	50 J	**Dominant species**	**Cover (%)**	**Height (m)**
Condition:	Degraded		438439 m E	*Melaleuca lateriflora*	40	4
			6626639 m S	*Melaleuca stereophloia*	5	4
Photograph:				*Casuarina obesa*	1	5
				**Lolium rigidum*	50	0.5
				**Arctotheca calendula*	1	0.2
				Other species		
				**Eragrostis curvula*		
				**Hypochaeris glabra*		
				**Sonchus oleraceus*		
				Austrostipa elegantissima		
				Comesperma integerrimum		
				Hakea preissii		
				Maireana brevifolia		
				Rhagodia drummondii		

Relevé:	ELA07					
Date:	21/10/2020	**Site:**	CBH Miling			
Vegetation Unit:	VC2	**Location (UTM):**	50 J	**Dominant species**	**Cover (%)**	**Height (m)**
Condition:	Good		438392 m E	*Tecticornia undulata*	15	1
			6626694 m S	**Lolium rigidum*	1	0.5
Photograph:				**Mesembryanthemum nodiflorum*	5-10	0.1
				*Tecticornia pergranulata*	5	0.2
				Other species		
				**Hordeum leporinum*		
				**Sonchus oleraceus*		
				Enchylaena tomentosa		
				Eragrostis dielsii		
				Siloxerus multiflorus		

Relevé:	ELA08					
Date:	21/10/2020	**Site:**	CBH Miling			
Vegetation Unit:	VC5	**Location (UTM):**	50 J	**Dominant species**	**Cover (%)**	**Height (m)**
Condition:	Very Good		438264 m E	*Melaleuca lateriflora*	10	4
			6626536 m S	*Tecticornia pergranulata*	5-10	0.6
Photograph:				*Maireana brevifolia*	2	0.6
				*Rhagodia drummondii*	3	1
				Austrostipa elegantissima	2	1
				**Mesembryanthemum nodiflorum*	5	0.1
				Eragrostis dielsii	2	0.1
				**Vulpia myuros forma megalura*	1	0.1
				Hakea preissii	5	3
				Other species		
				**Hordeum leporinum*		
				**Lolium rigidum*		
				**Oncosiphon piluliferum*		
				**Romulea rosea*		
				Acacia lineolata subsp. lineolata		
				Atriplex codonocarpa		
				Atriplex hymenotheca		
				Enchylaena tomentosa		
				Salsola australis		
				Siloxerus multiflorus		

Relevé:	ELA09					
Date:	21/10/2020	**Site:**	CBH Miling			
Vegetation Unit:	VC2	**Location (UTM):**	50 J	**Dominant species**	**Cover (%)**	**Height (m)**
Condition:	Good		438117 m E	*Tecticornia pergranulata*	20	0.5
			6626385 m S	*Rhagodia drummondii*	1	0.5
Photograph:				*Atriplex hymenotheca*	1	0.4
				**Lolium rigidum*	5	0.5
				**Mesembryanthemum nodiflorum*	5-10	0.1
				Other species		
				**Sonchus asper*		
				**Vulpia myuros forma megalura*		
				Austrostipa elegantissima		
				Didymanthus roei		
				Enchylaena tomentosa		
				Eragrostis dielsii		
				Melaleuca lateriflora		
				Siloxerus multiflorus		

Relevé:	ELA10					
Date:	21/10/2020	**Site:**	CBH Miling			
Vegetation Unit:	VC3	**Location (UTM):**	50 J	**Dominant species**	**Cover (%)**	**Height (m)**
Condition:	Degraded/ Completely Degraded		437931 m E	*Maireana brevifolia*		
			6626119 m S	*Salsola australis*		
Photograph:				**Oncosiphon piluliferum*		
				*Atriplex codonocarpa*	2	0.2
				**Lolium rigidum*	2	0.4
				**Hordeum leporinum*	1	0.2
				**Vulpia myuros forma megalura*	2	0.1
				Other species		
				**Aira cupaniana*		
				**Avena barbata*		
				**Bromus rubens*		
				**Mesembryanthemum nodiflorum*		
				**Monoculus monstrosus*		
				**Sonchus oleraceus*		
				**Trifolium glomeratum*		
				Acacia hemiteles		
				Atriplex semibaccata		
				Austrostipa elegantissima		
				Chloris truncata		
				Eragrostis dielsii		
				Erodium cygnorum		
				Ptilotus exaltatus		
				Ptilotus polystachyus		
				Sclerolaena eriacantha		

Relevé:	ELA11					
Date:	21/10/2020	**Site:**	CBH Miling			
Vegetation Unit:	VC3	**Location (UTM):**	50 J	**Dominant species**	**Cover (%)**	**Height (m)**
Condition:	Completely Degraded		437930 m E	*Maireana brevifolia*	5	1
			6626001 m S	*Salsola australis*	7	0.5
Photograph:				**Hordeum leporinum*	10	0.2
				*Eragrostis dielsii*	1	0.02
				Atriplex semibaccata	1	0.2
				**Mesembryanthemum nodiflorum*	2	0.1
				**Arctotheca calendula*	1	0.1
				Other species		
				**Oncosiphon piluliferum*		
				**Avena barbata*		
				**Brassica tournefortii*		
				**Bromus diandrus*		
				**Hypochaeris glabra*		
				**Lolium rigidum*		
				**Monoculus monstrosus*		
				**Rumex hypogaeus*		
				**Sonchus oleraceus*		
				**Vulpia myuros forma megalura*		
				Acacia hemiteles		
				Chloris truncata		
				Ptilotus exaltatus		

Relevé:	ELA12					
Date:	21/10/2020	**Site:**	CBH Miling			
Vegetation Unit:	VC3	**Location (UTM):**	50 J	**Dominant species**	**Cover (%)**	**Height (m)**
Condition:	Completely Degraded		438095 m E	*Maireana brevifolia*	2	0.6
			6626123 m S	*Salsola australis*	5	0.5
Photograph:				**Hordeum leporinum*	20	0.2
				**Mesembryanthemum nodiflorum*	1	0.1
				Atriplex codonocarpa	1	0.2
				Atriplex semibaccata	2	0.2
				Acacia hemiteles	1	0.4
				Other species		
				**Avena barbata*		
				**Cynodon dactylon*		
				**Hypochaeris glabra*		
				**Lolium rigidum*		
				**Monoculus monstrosus*		
				**Oncosiphon piluliferum*		
				**Sonchus oleraceus*		
				Atriplex amnicola		
				Chloris truncata		
				Eragrostis dielsii		
				Ptilotus polystachyus		

Relevé:	ELA13					
Date:	21/10/2020	**Site:**	CBH Miling			
Vegetation Unit:	VC6	**Location (UTM):**	50 J	**Dominant species**	**Cover (%)**	**Height (m)**
Condition:	Good		438167 m E	*Eucalyptus loxophleba*	2	10
			6626196 m S	*Maireana brevifolia*	4	1
Photograph:				*Atriplex amnicola*	4	1
				**Lolium rigidum*	1	0.4
				**Hordeum leporinum*	5	0.3
				**Arctotheca calendula*	1	0.1
				**Mesembryanthemum nodiflorum*	5-10	0.2
				Other species		
				Atriplex semibaccata		
				**Oncosiphon piluliferum*		
				**Sonchus oleraceus*		
				Atriplex codonocarpa		
				Austrostipa elegantissima		
				Hakea preissii		
				Ptilotus polystachyus		

Relevé:	ELA14					
Date:	21/10/2020	**Site:**	CBH Miling			
Vegetation Unit:	VC6	**Location (UTM):**	50 J	**Dominant species**	**Cover (%)**	**Height (m)**
Condition:	Good		438200 m E	*Eucalyptus loxophleba*	5	10
			6626428 m S	*Melaleuca lateriflora*	1	3
Photograph:				*Maireana brevifolia*	5	0.6
				*Tecticornia pergranulata*	10	0.5
				Rhagodia drummondii	2	0.6
				**Hordeum leporinum*	5	0.2
				**Oncosiphon piluliferum*	3	0.3
				Other species		
				**Arctotheca calendula*		
				**Cynodon dactylon*		
				**Lolium rigidum*		
				**Mesembryanthemum nodiflorum*		
				**Sonchus oleraceus*		
				Atriplex semibaccata		
				Austrostipa elegantissima		
				Enchylaena tomentosa		
				Eragrostis dielsii		
				Hakea preissii		

Relevé:	ELA15					
Date:	21/10/2020	**Site:**	CBH Miling			
Vegetation Unit:	VC1	**Location (UTM):**	50 J	**Dominant species**	**Cover (%)**	**Height (m)**
Condition:	Good		438613 m E	*Eucalyptus horistes*	5	5
			6626812 m S	*Santalum acuminatum*	5	3
Photograph:				*Melaleuca stereophloia*	5	2
				*Rhagodia drummondii*	2	1
				Ptilotus polystachyus	1	0.5
				Austrostipa elegantissima	1	1
				**Monoculus monstrosus*	2	0.3
				Eucalyptus loxophleba	5	5
				Other species		
				**Aira cupaniana*		
				**Avena barbata*		
				**Ehrharta longiflora*		
				Acacia acuminata		
				Comesperma integerrimum		
				Dianella revoluta		
				Lomandra effusa		
				Salsola australis		
				Sclerolaena diacantha		

Appendix H Assessment of the Eucalypt woodlands of the Western Australia wheatbelt ecological community

KEY DIAGNOSTIC CHARACTERISTICS

Key diagnostic characteristics (DotEE 2015)	Outcome
Indicators	
Location and physical environment The distribution of the ecological community is limited to these IBRA bioregions and subregions: • Avon Wheatbelt - subregions AVW01 Merredin and AVW02 Katanning; • Mallee - MAL02 Western Mallee only; and • Jarrah Forest – outlying patches in the eastern parts of JAF01 Northern Jarrah Forests and JAF02 Jarrah Forests adjacent to the Avon Wheatbelt, that are off the Darling Range, and receive less than 600 mm mean annual rainfall. They are effectively an extension of the Avon Wheatbelt landscape in that they comprise areas subject to similar climate, landscape and threats.	Yes. The survey area is located in the Avon Wheatbelt IBRA Bioregion and AVW02 Katanning subregion.
Structure The structure of the ecological community is a woodland in which the minimum crown cover of the tree canopy in a mature woodland is 10% (crowns measured as if they are opaque).	Yes. Crown cover in the woodland community VC1 is >10%. No. Crown cover in the woodland community VC6 is <10%, therefore doesn't fulfil the structure characteristic.
Presence of key species The key species of the tree canopy are species of *Eucalyptus* as identified in Table 2a (DotEE 2015). These are species that typically have a single trunk. One or more of the tree species in Table 2a are dominant or co-dominant within a patch of the ecological community. If other species are present in the tree canopy (e.g. species in Table 2b or other taxa) then these collectively do not occur as dominants in the tree canopy.	Yes. The dominant eucalypt in VC1 and VC6 is *Eucalyptus loxophleba*. There was not enough material to determine if the species was subsp. *Eucalyptus loxophleba* subsp. *loxophleba* (Table 2a) or *Eucalyptus loxophleba* subsp. *lissophloia*, *Eucalyptus loxophleba* subsp. *supralaevis* (Table 2b). Therefore, a precautionary approach was taken, in that the species is a key canopy species.
Presence of native understorey A native understorey is present but is of variable composition, being a combination of grasses, other herbs and shrubs, as specified in section 2.3.2 and in Table A1 of Appendix A (DotEE 2015).	Yes. Native understorey is present. 19 of the 51 native flora taxa recorded in the survey area occur within Table A1 of Appendix A (DotEE 2015). It should be noted that the plant species list in Tables A1 and A4 of Appendix A (DotEE 2015) do not include all plant species that may be encountered in the WA Wheatbelt woodland ecological community.

Key diagnostic characteristics (DotEE 2015)	Outcome
Contra-indicators	
Mallees dominant A dominant presence of eucalypts with a mallee growth form. However, mallee species can occur as an understorey or minor canopy component of the ecological community, as noted in the diagnostic features, above.	Yes. Mallee eucalypts were dominate in VC1. No. Mallee eucalypts are not dominant in vegetation community VC6.
Non-eucalypts dominant A dominant presence of non-eucalypt species in the tree canopy, for instance *Acacia acuminata* (jam) or *Allocasuarina huegeliana* (rock sheoak). However, these non-eucalypt species can be present as an understorey or minor canopy component of the ecological community.	No. Some non-eucalypt species are present but are not dominant in the tree canopy in vegetation community VC1 or VC6.
Shrublands or Herblands Shrublands or herblands in which the tree canopy layer is very sparse to absent, either naturally or maintained so through long-term disturbance. Native vegetation where a tree canopy was formerly present is often referred to as 'derived' or 'secondary' vegetation. These sites would fall below the 10 per cent minimum canopy cover threshold for a woodland, noted in the diagnostic features, above.	Yes. Vegetation community VC1 and VC6 have sparse tree canopy layers due to long term disturbance.
Adjacent bioregions Woodlands that have the same key eucalypt species but occur in adjacent bioregions, notably the Coolgardie, Esperance Sandplains, Yalgoo and Geraldton Sandplains bioregions. These are not part of the national ecological community. All woodlands that occur in bioregions outside the wheatbelt, as defined in this conservation advice, are not part of the WA Wheatbelt Woodland ecological community.	No. The survey area is not located in the Coolgardie, Esperance Sandplains, Yalgoo or Geraldton Sandplains bioregions.
Habitat-restricted eucalypt species Woodlands dominated by eucalypts that are restricted to granite outcrops and rocky rises, for instance *Eucalyptus caesia* (caesia or gungurru). However, some woodlands occur on the base around rock outcrops, but not on the actual outcrop, and these may be part of the ecological community, for instance York gum – jam woodlands.	No. The woodlands within the survey area do not occur on granite outcrops or rocky rises.
Condition thresholds and minimum patch size	
Where native vegetation meets the description and key diagnostic characteristics of the WA Wheatbelt Woodland ecological community, above, the condition thresholds and considerations in Table 3 (DotEE 2015) apply. There are four categories a patch can be classified as: Category A: Patches likely to correspond to a condition of Pristine / Excellent / Very Good (Keighery 1994) or a High Roadside Conservation Value (RCV; Roadside Conservation Committee of WA [RCC] 2014).	Parts of the woodland community VC1 meet the following criteria: Category C (for Good condition): • Mature trees either absent or when present have < 5 trees per 0.5 ha. • Roadside patch width ≥5 m.

Key diagnostic characteristics (DotEE 2015)	Outcome
Category B: Patches likely to correspond to a condition of Good (Keighery 1994) or a Medium-High RCV (RCC 2014), AND retains important habitat features. Category C: Patches likely to correspond to a condition of Good (Keighery 1994) or a Medium-High RCV (RCC 2014). Category D: Patches likely to correspond to a condition of Degraded to Good (Keighery 1994) or a Medium-Low to Medium-High RCV (RCC 2014) BUT retains important habitat features. The criteria for these categories are listed below.	Parts of woodland community VC6 meet the following criteria: Category C (for Good condition): • Exotic plant species account for more than 30, to 50% of total vegetation cover in the understorey layers (i.e. below the tree canopy). • Mature trees either absent or when present have < 5 trees per 0.5 ha. • Roadside patch width ≥5 m.

CONDITION THRESHOLDS

Cover of exotic plants (weeds) AND	Mature trees[1] AND	Minimum patch size (non-roadside patches)[2] OR	Minimum patch width (roadside patches only)[3]
Category A: Patches likely to correspond to a condition of Pristine / Excellent / Very good (Keighery 1994) or a High RCV (RCC 2014).			
Exotic plant species account for 0 to 30% of total vegetation cover in the understorey layers (i.e. below the tree canopy).	Mature trees may be present or absent.	2 hectares or more	5 metres or more
Category B: Patches likely to correspond to a condition of Good (Keighery 1994) or a Medium-High RCV (RCC 2014) AND retains important habitat features.			
Exotic plant species account for more than 30, to 50% of total vegetation cover in the understorey layers (i.e. below the tree canopy)	Mature trees are present with at least 5 trees per 0.5 ha.	2 hectares or more	5 metres or more
Category C: Patches likely to correspond to a condition of Good (Keighery 1994) or a Medium-High RCV (RCC 2014).			
Exotic plant species account for more than 30, to 50% of total vegetation cover in the understorey layers (i.e. below the tree canopy).	Mature trees either absent or less than 5 trees per 0.5 ha are present.	5 hectares or more	5 metres or more
Category D: Patches likely to correspond to a condition of Degraded to Good (Keighery 1994) or a Medium-Low to Medium-High RCV (RCC 2014) BUT retains important habitat features.			
Exotic plant species account for more than 50 to 70% of total vegetation cover in the understorey layers (i.e. below the tree canopy).	Mature trees are present with at least 5 trees per 0.5 ha.	5 hectares or more	5 metres or more

[1] Mature trees have a DBH of 30 cm or above. Trunk diameter varies among eucalypt species, for instance gimlet and mallets tend to have slender trunks (Gosper et al. 2013b, as cited in DotEE 2015). The DBH for mature trees aligns with the EPBC referral guidelines for the breeding habitat of threatened black cockatoo species (SEWPaC 2012). These note that, for salmon gum and wandoo trees, suitable nest hollows can develop in trees with a DBH of 30 cm or more. Note that larger trees may be killed by factors such as intense fire or flood, but the patch may still be in reasonable condition if there are immature trees regenerating.

[2] The minimum patch size thresholds apply to native vegetation remnants that do not occur along roadsides.

[3] Minimum patch width applies only to vegetation remnants along roadsides and tend to be long but narrow. This criterion recognises the importance of native vegetation remnants along road verges, e.g their value as wildlife corridors particularly if linking to other non-roadside remnants, habitat for threatened species and other reasons as detailed by Jackson (2002) and RCC (2015), as cited in DotEE (2015). The width here is based on the native understorey component rather than width of the tree canopy. Some allowance must be made for small breaks or variations in native species cover along linear patches. Given the generally open nature of the tree canopy and some understorey structures, a break in the continuity of native vegetation cover of 50 metres or more, is likely to indicate that separate patches are present. An exception is for main, often bitumen-covered, roads that bisect otherwise continuous vegetation; most local government roads in the Wheatbelt have a road reserve of 20 metres. In these cases, native vegetation along either side of the road is considered to be a separate patch.

Appendix I Fauna species list

Species	Common Name	Observation Type
Birds		
Acanthagenys rufogularis	Spiny-cheeked Honeyeater	Observed/heard
Anthus novaeseelandiae	Australasian Pipit	Observed/heard
Barnardius zonarius	Australian Ringneck	Observed/heard
Cacatua sanguinea	Little Corella	Observed/heard
Calamanthus campestris	Rufous Fieldwren	Observed/heard
Chrysococcyx basalis	Horsfield's Bronze-Cuckoo	Observed/heard
Corvus coronoides	Australian Raven	Observed/heard
Cracticus tibicen	Australian Magpie	Observed/heard
Eolophus roseicapilla	Galah	Observed/heard
Falco cenchroides	Nankeen Kestrel	Observed/heard
Grallina cyanoleuca	Magpie-lark	Observed/heard
Hirundo neoxena	Welcome Swallow	Observed/heard
Malurus leucopterus	White-winged Fairy Wren	Observed/heard
Manorina flavigula	Yellow-throated Miner	Observed/heard
Megalurus mathewsi	Rufous Songlark	Observed/heard
Melopsittacus undulatus	Budgerigar	Observed/heard
Microeca fascinans	Jacky Winter	Observed/heard
Motacilla alba	White Wagtail	Observed/heard
Ocyphaps lophotes	Crested Pigeon	Observed/heard
Purnella albifrons	White-fronted Honeyeater	Observed/heard
Rhipidura leucophrys	Willie Wagtail	Observed/heard
Smicrornis brevirostris	Weebill	Observed/heard
Spilopelia senegalensis	Laughing Dove	Observed/heard
Mammals		
**Bos taurus*	Cattle	Scats
Osphranter robustus	Common wallaroo (Euro)	Scats
Osphranter rufus	Red kangaroo	Observed
Reptiles		
Pseudonaja nuchalis	Western Brown Snake	Observed

Appendix J Black cockatoo potentially suitable trees recorded within the survey area

Tree ID	Species	DBH (mm)	Hollow	Hollow type (spout, branch, trunk)	Foraging, roosting, breeding evidence	Easting	Northing
1048	*Eucalyptus* sp. (planted)	>500	NA	NA	NA	438691	6626897
1049	*Eucalyptus* sp. (planted)	>500	NA	NA	NA	438691	6626885
1050	*Eucalyptus* sp. (planted)	>500	NA	NA	NA	438642	6626783

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Appendix D CBH Miling Grain Receival Site Expansion – Targeted Flora Survey

Summary

Eco Logical Australia Pty Ltd was engaged by CBH Group to undertake a targeted survey for three conservation significant flora species; *Caladenia drakeoides* (listed as Endangered under the *Environment Protection and Biodiversity Conservation Act 1999* [EPBC Act] and Critically Endangered under the *Biodiversity Conservation Act 2016* [BC Act]), *Caladenia cristata* and *Urodon capitatus* listed by the Department of Biodiversity, Conservation and Attractions (DBCA) as Priority 1 and Priority 3 respectively within the CBH Group Miling grain receival site expansion area (Figure 1).

The Miling grain receival site expansion area was determined likely to contain the significant flora *Caladenia drakeoides*, *Caladenia crispata* and potentially *Urodon capitatus* based on the results of an initial reconnaissance level and desktop flora assessment of the area.

A targeted flora survey was conducted by a single ELA botanist on the 6th September 2021 to determine the presence and abundance of these taxon within the survey area, utilising parallel traverses of the vegetation communities considered potential habitat for the targeted species. The timing was based on the known flowering period of the *Caladenia* species and rainfall in the year leading up to the survey was above average and considered adequate to initiate flowering in the relevant species at the time of the survey.

No significant flora were found to occur within the survey area at the time of the field survey. A long history of disturbance within the survey area related to pastoral activities and infrastructure was considered likely to have excluded the presence of the target *Caladenia* species. *Urodon* was found to lack appropriate habitat within the survey area, with the recorded location adjacent to the survey area also lacking appropriate habitat and potentially erroneous in location.

Overall, based on the findings of the targeted flora survey of the CBH Miling grain receival site expansion area, the three significant flora *Caladenia drakeoides*, *Caladenia crispata* and *Urodon capitatus* are unlikely to occur within the expansion area.

1. Introduction

Eco Logical Australia Pty Ltd (ELA) was engaged by CBH Group to undertake a targeted survey for three conservation significant flora species; *Caladenia drakeoides* (listed as Endangered under the *Environment Protection and Biodiversity Conservation Act 1999* [EPBC Act] and Critically Endangered under the *Biodiversity Conservation Act 2016* [BC Act]), *Caladenia cristata* and *Urodon capitatus* listed by the Department of Biodiversity, Conservation and Attractions (DBCA) as Priority 1 and Priority 3 respectively within the CBH Group Miling grain receival site expansion area, referred to in this report as the 'survey area' and displayed in Figure 1.

This survey scope aims to fill a gap in the ecological survey data identified in the *Miling Grain Receival Site Expansion Flora and Fauna Survey* report (ELA 2021a) and *17255 Miling Grain Receival Site expansion - environmental approvals advice* memo (ELA 2021b), which will support the environmental approvals for the development. As such, this report is intended to expand on ecological values identified and detailed within ELA (2021a) and is not intended to be a comprehensive accounting of values present at the site.

The survey area is a 33.9 hectare (ha) block within the townsite of Miling, approximately 200 kilometres (km) north-east of Perth, Western Australia.

Figure 1: Site Overview

Survey Area

N

0 75 150 300

Metres

Datum/Projection:
GDA 1994 MGA Zone 50

Project: 17255-DB Date: 29/09/2021

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2. Methods

The methodology for this survey was developed based on the Environmental Protection Authority (EPA) *Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016) and the *Draft Survey Guidelines for Threatened Orchids* (CoA 2013).

2.1. Survey preparation

Prior to the field survey, known vegetation communities were reviewed for likelihood of presence of the three conservation significant species. Based on the described known habitat of the target species, it was determined that vegetation communities (VC) 2, 5 and 6, as described in ELA 2021a, were likely to constitute potential habitat for the target species. These communities were described as:

- VC2: *Tecticornia undulata* and *T. pergranulata* low open samphire shrubland;
- VC5: *Acacia lineolata* subsp. *lineolata*, *Melaleuca lateriflora* and *Hakea preissii* tall sparse shrubland; and
- VC6: *Eucalyptus loxophleba* open woodland.

The community boundaries for these three targeted vegetation communities were uploaded to a Garmin GPSmap 62s device for spatial navigation in the field.

2.2. Field survey

The targeted flora survey was carried out by ELA Botanist Daniel Brassington on the 6th September 2021 under DBCA flora licences TFL 15-1920 and FB 62000196.

The targeted communities were systematically traversed by foot at between 10 m and 15 m interval parallel traverses. This interval was utilised due to the open nature of the vegetation, leading to good visibility and open lines of sight to spot any potential orchid species present. The GPS Track log was stored and represented on aerial photography, as shown below in Figure 2. For any individuals potentially representing Threatened or Priority flora that were identified in the field survey, the following data was collected:

- GPS coordinates of location (points for each individual plant);
- Number of individuals in the population (recording a range of co-ordinates if necessary);
- Reproductive phase (basal leaf, flowering etc.);
- Description of the vegetation community and associated species at each location;
- Details on landform, soil type and site conditions;
- Photographs of the plant in situ and broader habitat; and
- Relevant notes such as potential threats to individuals and/or populations (e.g. weeds, clearing, herbivory).

In the event an individual potentially representing Threatened or Priority flora could not be positively identified in the field, either a specimen or photographs sufficient to allow identification were taken for further analysis.

2.3. Survey timing

Survey guidelines for threatened orchids recommend that survey timing be selected to coincide with flowering periods to maximise the likelihood of detection and identification (CoA 2013; EPA 2016). Florabase records show the flowering of *Caladenia drakeoides* to have occurred between 23 August and 25 September and *C. cristata* to have occurred between 28 August and 04 October with the bulk in September (WAH 1998-). The survey was conducted well within the recorded flowering season, undertaken on the 6th September.

The Mindalla weather station (station number 8087, operational 1913 - present), located 12 km north-east of Miling, recorded above average rainfall in the 2021 year leading up to the survey with 353 mm of rainfall compared to the long term mean of 268 mm for the January to August period (BoM 2021). In the three months prior to the field works, a little under the average rainfall occurred, where June recorded 41.5 mm (mean of 63.2 mm), July recorded 97.3 mm (mean of 61.5 mm) and August recorded 16.7 mm (mean of 47.2 mm). In addition, 4.8 mm rainfall was recorded in the first few days of September prior to the field survey. Overall, sufficient rainfall occurred to meet the survey requirements.

2.4. Survey limitations

The EPA *Technical Guide: Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016) recommends including discussion of the constraints and limitations of the survey methods used. Constraints and limitations for the survey are summarised in **Table 1**. There were no constraints identified for this survey.

Table 1: Survey limitations

Potential survey limitation	Impact on survey
Sources of information and availability of contextual information (i.e. pre-existing background versus new material).	**Not a constraint**. Previous survey data including vegetation mapping (ELA 2021a), Broad-scale vegetation mapping at a scale of 1:1,000,000, Land system mapping at a scale of 1:2,000,000 and soil and landform mapping was available. DBCA database searches were undertaken within appropriate buffers. Available information was sufficient to provide context at varying scales and therefore was not considered a limitation.
Scope (i.e. what life forms, etc., were sampled).	**Not a constraint**. The survey requirement of a Targeted flora survey in accordance with relevant State and Federal legislation and EPA guidance documents was adequately met.
Proportion of flora collected and identified (based on sampling, timing and intensity).	**Not a constraint**. This survey targeted three species with the intent to identify and collect where required should they be found. As none of the target species were recorded there was no requirement for collecting any flora.
Completeness and further work which might be needed (i.e. was the relevant survey area fully surveyed).	**Not a constraint**. The survey area coverage met the requirements of a Targeted flora survey.
Mapping reliability.	**Not a constraint**. Map coverage of the survey area was considered to be good. High quality aerial maps were used for both the survey and subsequent vegetation mapping. Due to the nature of vegetation in the survey area, mapping boundaries of individual communities were discrete, and thus are considered accurate.
Timing, weather, season, cycle.	**Not a constraint**. The field survey was undertaken at an appropriate time, as specified by EPA (2016). Rainfall in the three months prior to the survey was very slightly below the

Potential survey limitation	Impact on survey
	long-term average, with rainfall in the 2021 year leading up to the survey above the long-term average. This allowed for suitable conditions for the presence of the two targeted orchid species (*Caladenia drakeoides* and *Caladenia cristata*). They are known from WAH records to flower in September (WAH 1998-), therefore can reasonably be expected to be present at the time of the field survey.
Disturbances (fire, flood, accidental human intervention, etc.).	**Not a constraint**: Disturbances within the survey area included due to agricultural and transport infrastructure, with historical clearing in large portions of the survey area, and weeds dominating the understory in areas. Disturbances did not impact the ability to meet the requirements of the survey.
Intensity (in retrospect, was the intensity adequate).	**Not a constraint**. The survey effort was appropriate for a Targeted conservation significant fauna species survey.
Resources (i.e. were there adequate resources to complete the survey to the required standard).	**Not a constraint**. The number of personnel conducting this field survey in the given time was adequate to perform the required level of survey. Additional resources, including equipment available, additional support and personnel were adequate.
Access problems (i.e. ability to access survey area).	**Not a constraint**. All relevant areas within the survey area were able to be accessed and surveyed.
Experience levels (e.g. degree of expertise in plant identification to taxon level).	**Not a constraint**. The personnel conducting this field survey were suitably qualified to identify specimens, having multiple years of field experience in flora surveys across Western Australia.

Figure 2: Survey Effort

Survey Area
GPS Track

Target Vegetation Community
VC2
VC5
VC6

0 50 100 200
Metres

Datum/Projection:
GDA 1994 MGA Zone 50

Project: 17255-DB Date: 29/09/2021

N

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3. Results

There were no flora identified during the field survey within the CBH Group Miling grain receival site expansion area that potentially represented the three targeted conservation significant flora species: *Caladenia drakeoides*, *Caladenia cristata* or *Urodon capitatus*.

3.1. *Caladenia drakeoides* (Hinged Dragon Orchid)

Caladenia drakeoides, shown in Figure 3, is listed as EN under the EPBC Act and CR under the BC Act and known regionally from 42 records over a range of 255 km from Coorow in the north-west to Goomalling in the south-east (WAH 1998-). Habitat for this species is tall to medium shrubland dominated by *Melaleuca* and *Acacia* species over low shrubs and annuals (Brown et al. 2003) and has been recorded from the edge of salt flats (WAH 1998-). The survey area occurs on the margins of the same lake system as previous records were recorded from (DBCA 2020). Florabase records show the flowering of *Caladenia drakeoides* to have occurred historically between 23 August and 25 September (WAH 1998-).

The habitat described by Brown (et al. 2003) corresponds with VC5 within the survey area, with the lake system in general represented by VC2 and VC5.

The closest record listed by the WAH (1998-) was collected in 1986, approximately 500 m south-west of the survey area. This area was visited but no presence of the species was recorded.

Figure 3: Caladenia drakeoides (WAH 1998-)

3.2. *Caladenia cristata* (Crested Spider Orchid)

Caladenia cristata, shown in Figure 4, is listed as Priority 1 by DBCA and known regionally from 17 records spread over a range of 105 km, from Coorow in the north-west to Ballidu in the south-east (WAH 1998-). Habitat for this species includes sandy rises on the edge of salt flats and ephemeral waterbodies.

The WAH (1998-) lists ten collections of the species, recorded between 28th August and the 4th October. Eight of the ten of records occurred in September with two of those being recorded within a kilometre of the survey area on the edges of the same lake system that is represented by VC2 within the survey area. These collections were taken in 1923 and 1986.

The habitat described corresponds with VC5 within the survey area and to a lesser extent, VC2, however no individuals were recorded.

Figure 4: *Caladenia cristata* (WAH 1998-)

3.3. Urodon capitatus

Urodon capitatus, shown below in Figure 5 is listed as Priority 3 by DBCA. The known population extends from Morawa in the north to Wyalkatchem in the south-east, with an additional record from near Harrismith further to the south. The WAH (1998-) records 36 collections of this species, dating back to 1848.

Urodon capitatus is described as a low spreading to upright shrub, growing to 1.2m high with orange flowers occurring from September to December. The habitat is described as sandy gravelly soils on plains (WAH 1998-).

One collection of the species from Round Hill at Miling is recorded with the WAH, collected in 1996. The indicative location provided by the WAH is approximately 50 m north-west of the survey area, however when the site was visited the taxon was not observed to occur. The vegetation present was representative of VC2 and VC5, neither of which correspond with the described habitat of the species.

The location given for the record is potentially erroneous as Round Hill is a historical townsite approximately 10 km west of the Miling townsite.

Figure 5: *Urodon capitatus* scanned specimen (WAH 1998-)

4. Discussion

ELA (2021a) recorded six vegetation communities, comprising two eucalypt woodland communities (VC1 and VC6), three mixed shrubland communities (VC3, VC4 and VC5) and one samphire shrubland community (VC2). A review of the preferred habitat of the three significant flora showed that they were associated with the rises and margins of the lake system that forms the upper reaches of Moore River North, with known location records occurring within the flats of the system. Communities associated with the system and its margins were considered to be VC2, VC5 and VC6.

Cardno (2014) conducted a level one flora survey over a portion of the current expansion area. The condition of the vegetation on the lake system corresponding with VC2 has improved over the intervening time from a mix of good and completely degraded to mostly good condition. This reflects the changed land-use over the years, where historically the area was utilised for farming, or pastoral activities. This can be seen in the field with old paddocks, fence lines and remnants of housing still present in the area.

The area has not been impacted by direct pastoral activities for an indeterminate number of years, as evidenced by VC3 which is a paddock in the early stages of auto-revegetation (ELA 2021a). The inference is that the whole area currently included in the grain receival expansion area was originally heavily impacted by pastoral activities which can be expected to have excluded species sensitive to disturbance, including many *Caladenia* taxa. The survey guidelines for threatened orchids (CoA 2013) describes orchids in general as sensitive to habitat change and reliant on external factors, such as symbiotic fungi and pollinators such as wasps. In the case of *C. drakeoides*, a male thynnid wasp is responsible for pollination and seed are dependent of fungal mycorrhiza for germination (Brown et al. 2003). Long term use of herbicides, pesticides and regular soil disturbance can remove these elements from an area.

For similar reasons, these sensitive taxa can also be expected to be absent from areas of current disturbance, such as infrastructure or heavy weed cover, represented in ELA (2021a) as in completely disturbed condition or lacking vegetation altogether.

The location given for the closest *Caladenia drakeoides* was found to be within a fenced patch of mature *Eucalyptus* Woodland. This area is likely to have been minimally impacted in the past by light grazing, earth movement by machinery and long term weed presence. The lower historical impacts to this area likely allowed for preservation of the population of *C. drakeoides* that was not possible within the survey area, which had been heavily grazed and cropped in the past.

While the vegetation condition of the survey area is improving over time, any *Caladenia drakeoides* or *C. cristata* populations that may have been present historically are highly unlikely to occur in the area now.

Urodon capitatus was found to lack appropriate habitat within the survey area, with the recorded location adjacent to the survey area also lacking appropriate habitat and potentially erroneous in location.

5. Conclusion

The CBH Miling grain receival site expansion area was determined likely to contain the significant flora *Caladenia drakeoides*, *Caladenia crispata* and *Urodon capitatus* based on the results of an initial reconnaissance level and desktop flora assessment of the area.

A targeted flora survey was conducted by a single ELA botanist on the 6th September 2021 to determine the presence and abundance of these taxon within the survey area, utilising parallel traverses of the vegetation communities considered potential habitat for the targeted species. The timing was based on the known flowering period of the *Caladenia* species and rainfall in the year leading up to the survey was above average and considered adequate to initiate flowering in the relevant species at the time of the survey.

No significant flora were found to occur within the survey area at the time of the field survey. A long history of disturbance within the survey area related to pastoral activities and infrastructure was considered likely to have excluded the presence of the target *Caladenia* species. *Urodon* was found to lack appropriate habitat within the survey area, with the recorded location adjacent to the survey area also lacking appropriate habitat and potentially erroneous in location.

Overall, based on the findings of the targeted flora survey of the CBH Miling grain receival site expansion area, the three significant flora *Caladenia drakeoides*, *Caladenia crispata* and *Urodon capitatus* are unlikely to occur within the survey area.

6. References

Brown, A., E. Holland & K. Kershaw. 2003. Hinged Dragon Orchid (*Caladenia drakeoides*) Interim Recovery Plan 2003-2008. Interim Recovery Plan No. 141. Department of Conservation and Land Management, Western Australia.

Bureau of Meteorology 2021. *Climate Data Online*. Available from: http://www.bom.gov.au/climate/data/index.shtml

Cardno. 2014. Level 1 Flora and Fauna Survey. Prepared for CBH Miling.

Commonwealth of Australia (CoA). 2013. Survey Guidelines for Australia's Threatened Orchids. Available at: https://www.environment.gov.au/resource/draft-survey-guidelines-australias-threatened-orchids

Department of Biodiversity, Conservation and Attractions (DBCA). 2007-2021. *NatureMap*. Department of Biodiversity, Conservation and Attractions. Available at: https://naturemap.dpaw.wa.gov.au/default.aspx

Department of Biodiversity, Conservation and Attractions (DBCA). 2020. Threatened and Priority Flora database search. Reference number 34-1020FL. Department of Biodiversity, Conservation and Attractions, Perth.

Eco Logical Australia (ELA). 2021a. *Miling Grain Receival Site Expansion Flora and Fauna Survey*. Consultant report for CBH Group.

Eco Logical Australia (ELA). 2021b. *17255 Miling Grain Receival Site expansion - environmental approvals advice*. Consultant memo for CBH Group.

Environmental Protection Authority (EPA). 2016. *Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment.* Perth, Western Australia.

Western Australian Herbarium (WAH). 1998–. *Florabase—the Western Australian Flora.* Department of Biodiversity, Conservation and Attractions. https://florabase.dpaw.wa.gov.au/

7. Appendices

Appendix A Framework for conservation significant flora and fauna ranking

CATEGORIES OF THREATENED SPECIES UNDER THE ENVIRONMENT PROTECTION AND BIODIVERSITY CONSERVATION ACT 1999 (EPBC ACT)

Threatened fauna and flora may be listed in any one of the following categories as defined in Section 179 of the EPBC Act. Species listed as 'conservation dependent' and 'extinct' are not Matters of National Environmental Significance and therefore do not trigger the EPBC Act.

Category	Definition
Extinct (EX)	There is no reasonable doubt that the last member of the species has died.
Extinct in the Wild (EW)	Taxa known to survive only in captivity or as a naturalised population well outside its past range; or taxa has not been recorded in its known and/or expected habitat at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.
Critically Endangered (CR)	Taxa considered to be facing an extremely high risk of extinction in the wild.
Endangered (EN)	Taxa considered to be facing a very high risk of extinction in the wild.
Vulnerable (VU)	Taxa considered to be facing a high risk of extinction in the wild.
Near Threatened (NT)	Taxa has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future.
Least Concern (LC)	Taxa has been evaluated against the criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened. Widespread and abundant taxa are included in this category.
Data Deficient (DD)	There is inadequate information to make a direct, or indirect, assessment of taxa's risk extinction based on its distribution and/or population status.
Not Evaluated (NE)	Taxa has not yet been evaluated against the criteria.
Migratory (M)	Not an IUCN category. Species are defined as migratory if they are listed in an international agreement approved by the Commonwealth Environment Minister, including: • the Bonn Convention (Convention on the Conservation of Migratory Species of Wild Animal) for which Australia is a range state; • the agreement between the Government of Australian and the Government of the People's Republic of China for the Protection of Migratory Birds and their environment (CAMBA); • the agreement between the Government of Japan and the Government of Australia for the Protection of Migratory Birds and Birds in Danger of Extinction and their Environment (JAMBA); or • the agreement between Australia and the Republic of Korea to develop a bilateral migratory bird agreement similar to the JAMBA and CAMBA in respect to migratory bird conservation and provides a basis for collaboration on the protection of migratory shorebirds and their habitat (ROKAMBA).

CONSERVATION CODES FOR WESTERN AUSTRALIA FLORA AND FAUNA

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

Specially protected fauna or flora are species 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.

Threatened species (T)

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 BC Act.

Threatened fauna is that subset of 'Specially Protected Fauna' listed under schedules 1 to 3 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018 for Threatened Fauna.

Threatened flora is that subset of 'Rare Flora' listed under schedules 1 to 3 of the Wildlife Conservation (Rare Flora) Notice 2018 for Threatened Flora.

The assessment of the conservation status of these species is based on their national extent and ranked according to their level of threat using IUCN Red List categories and criteria as detailed below.

Category	Code	Description
Critically Endangered species	CR	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. Published under schedule 1 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018 for critically endangered fauna or the Wildlife Conservation (Rare Flora) Notice 2018 for critically endangered flora.
Endangered species	EN	Threatened species considered to be "facing a very high risk of extinction in the wild in the near future, as determined in accordance with criteria set out in the ministerial guidelines". Listed as endangered under section 19(1)(b) of the BC Act in accordance with the criteria set out in section 21 and the ministerial guidelines. Published under schedule 2 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018 for endangered fauna or the Wildlife Conservation (Rare Flora) Notice 2018 for endangered flora.
Vulnerable species	VU	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. Published under schedule 3 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018 for vulnerable fauna or the Wildlife Conservation (Rare Flora) Notice 2018 for vulnerable flora.

Extinct species

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

Category	Code	Description
Extinct species	EX	Species which have been adequately searched for and there is no reasonable doubt that the last individual has died. Published as Specially Protected under the Wildlife Conservation Act 1950, in Schedule 4 of the Wildlife Conservation (Specially Protected Fauna) Notice for Presumed Extinct Fauna and Wildlife Conservation (Rare Flora) Notice for Presumed Extinct Flora.
Extinct in the wild species	EW	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 threatened fauna or threatened flora species listed as extinct in the wild. If listing of a species as extinct in the wild occurs, then a schedule will be added to the applicable notice.

Specially protected species

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

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

Categories are detailed below.

Category	Code	Description
Migratory species	M	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). Includes birds that are subject to an agreement between the government of Australia and the governments of Japan (JAMBA), China (CAMBA) and The Republic of Korea (ROKAMBA), and fauna subject to the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention), an environmental treaty under the United Nations Environment Program. Migratory species listed under the BC Act are a subset of the migratory animals that are known to visit Western Australia, protected under the international agreements or treaties, excluding species that are listed as Threatened species. Published as migratory birds protected under an international agreement under schedule 5 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018.
Species of special conservation interest	CD	Fauna of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as threatened, and listing is otherwise in accordance with the ministerial guidelines (section 14 of the BC Act).

Category	Code	Description
(conservation dependent fauna)		Published as conservation dependent fauna under schedule 6 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018.
Other specially protected species	OS	Fauna 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). Published as other specially protected fauna under schedule 7 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018.

Priority species (P)

Possibly threatened species that do not meet survey criteria, or are otherwise data deficient, are added to the Priority Fauna or Priority Flora Lists under Priorities 1, 2 or 3. These three categories are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as threatened fauna or flora.

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

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

Category	Code	Definition
Priority 1	P1	*Poorly-known species* Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.
Priority 2	P2	*Poorly-known species* Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.
Priority 3	P3	*Poorly-known species* Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.

Category	Code	Definition
Priority 4	P4	*Rare, Near Threatened and other species in need of monitoring* (a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection but could be if present circumstances change. These species are usually represented on conservation lands. (b) Near Threatened. Species that are considered to have been adequately surveyed and that are close to qualifying for vulnerable but are not listed as Conservation Dependent. (c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

Appendix B Likelihood of occurrence assessment criteria

Likelihood rating	Criteria
Recorded	The species has previously been recorded within survey area from DBCA database search results and/or from previous surveys of the survey area, and/or the species has been confirmed through a current vouchered specimen at WAH.
Likely	The species has not previously been recorded from within the survey area. However, (to qualify requires one or more criteria to be met): • the species has been recorded in close proximity to the survey area, and occurs in similar habitat to that which occurs within the survey area • core habitat and suitable landforms for the species occurs within the survey area either year-round or seasonally. In relation to fauna species, this could be that a host plant is seasonally present on site, or habitat features such as caves are present that may be used during particular times during its life cycle e.g. for breeding. In relation to both flora and fauna species, it may be there are seasonal wetlands present • there is a medium to high probability that a species uses the survey area
Potential	The species has not previously been recorded from within the survey area. However, (one or more criteria requires to be met): • targeted surveys may locate the species based on records occurring in proximity to the survey area and suitable habitat occurring in the survey area • the survey area has been assessed as having potentially suitable habitat through habitat modelling • the species is known to be cryptic and may not have been detected despite extensive surveys • the species is highly mobile and has an extensive foraging range so may not have been detected during previous surveys The species has been recorded in the survey area by a previous consultant survey or there is historic evidence of species occurrence within the survey area. However, (one or more criteria requires to be met) • doubt remains over taxonomic identification, or the majority of habitat does not appear suitable (although presence cannot be ruled out due to factors such as species ecology or distribution) • coordinates are doubtful
Unlikely	The species has been recorded locally through DBCA database searches. However, it has not been recorded within the survey area and • it is unlikely to occur due to the site lacking critical habitat, having at best marginally suitable habitat, and/or being severely degraded • it is unlikely to occur due to few historic record/s and no other current collections in the local area. The species has been recorded within the bioregion based on literature review but has not been recorded locally or within the survey area through DBCA database searches. The species has not been recorded in the survey area despite adequate survey efforts, such as a standardised methodology or targeted searching within potentially suitable habitat.
Does not occur	The species is not known to occur within the IBRA bioregion based on current literature and distribution. The conspicuous species has not been recorded in the survey area despite adequate survey efforts at an appropriate time of year to detect the species within potentially suitable habitat. The survey area lacks important habitat for a species that has highly selective habitat requirements. The species has been historically recorded within survey area or locally; however, it is considered locally extinct due to significant habitat changes such as land clearing and/or introduced predators.

Appendix C Flora likelihood of occurrence assessment

Scientific name	Conservation status		Habitat	Source	Likelihood of occurrence and justification	
	EPBC Act	BC Act / DBCA			Pre targeted survey	Post targeted survey
Acacia cochlocarpa subsp. velutinosa	CR	CR	Velutinous, sprawling shrub, growing to 1.5m. Occurs on sandy clay or laterite.	PMST	**Unlikely** No suitable habitat, no nearby records.	**Unlikely** No suitable habitat, no nearby records.
Dasymalla axillaris	CR	CR	Shrub, growing to 1.5m high. Occurs in yellow sand.	PMST	**Unlikely** No suitable habitat, no nearby records.	**Unlikely** No suitable habitat, no nearby records.
Gyrostemon reticulatus	CR	CR	Shrub, growing up to 1m high.	PMST	**Unlikely** No suitable habitat, no nearby records.	**Unlikely** No suitable habitat, no nearby records.
Acacia cochlocarpa subsp. cochlocarpa	EN	CR	Glabrous, sprawling shrub, growing to 1.5m. Occurs in clayey, sandy, often gravelly soils.	PMST	**Unlikely** No suitable habitat, no nearby records.	**Unlikely** No suitable habitat, no nearby records.
Acacia vassalii	EN	CR	Semi-prostrate, spreading, rounded shrub, growing to 0.3m high. Occurs on grey/brown or yellow sand, sandy loam.	DBCA 2020, NatureMap, PMST	**Unlikely** No suitable habitat, no nearby records.	**Unlikely** No suitable habitat, no nearby records.
Caladenia drakeoides	EN	CR	Tuberous, perennial herb, growing to 0.3m high. Occurs on the margins of salt lakes in grey clayey sand or red sandy loam.	DBCA 2020, NatureMap, PMST	**Likely** Closest record 0.5 km south-west of the survey area. Suitable habitat is present (VC5). Majority of WAH's records (9 of 11) flowered in the first two weeks of September, therefore	**Unlikely** No presence at known location or within survey area, long periods of disturbance within survey area likely excluding possibility of presence.

Scientific name	Conservation status		Habitat	Source	Likelihood of occurrence and justification	
	EPBC Act	BC Act / DBCA			Pre targeted survey	Post targeted survey
					they may not have been able to be identified in the field survey.	
Chorizema humile	EN	CR	Sprawling, prostrate shrub. Occurs on plains in sandy clay or loam.	DBCA 2020, NatureMap, PMST	**Unlikely** No suitable habitat, no nearby records.	**Unlikely** No suitable habitat, no nearby records.
Daviesia euphorbioides	EN	CR	Shrub, growing to 0.8m high. Occurs on flats, sandplains, in clayey sand, sandy gravel.	PMST	**Unlikely** No suitable habitat, no nearby records.	**Unlikely** No suitable habitat, no nearby records.
Eremophila pinnatifida	EN	CR	Shrub, growing up to 0.6m high. Occurs on loam.	PMST	**Unlikely** No suitable habitat, no nearby records.	**Unlikely** No suitable habitat, no nearby records.
Eremophila scaberula	EN	CR	Low compact or sprawling shrub, growing up to 1.5m high. Occurs on winter-wet plains, inundated areas, in clay, sandy clay or loam.	PMST	**Unlikely** No suitable habitat, no nearby records.	**Unlikely** No suitable habitat, no nearby records.
Gastrolobium hamulosum	EN	CR	Low shrub, growing to 0.45m. Occurs on flats, slopes, ridges in sandy, often gravelly soils or clay.	DBCA 2020, PMST	**Unlikely** No suitable habitat, no nearby records.	**Unlikely** No suitable habitat, no nearby records.
Grevillea pythara	EN	CR	Suckering shrub, growing to 0.3m high. Occurs in sand or sandy loam with gravel.	DBCA 2020, PMS	**Unlikely** No suitable habitat, no nearby records.	**Unlikely** No suitable habitat, no nearby records.
Hemiandra gardneri	EN	CR	Prostrate, pungent shrub, growing to 0.2m high. Occurs on sandplains, in grey or yellow sand, clayey sand.	PMST	**Unlikely** No suitable habitat, no nearby records.	**Unlikely** No suitable habitat, no nearby records.
Jacksonia pungens	EN	CR	Rounded shrub, growing to 0.8m high. Occurs on undulating areas, in yellow sand, gravelly lateritic soils.	DBCA 2020, NatureMap, PMST	**Unlikely**	**Unlikely**

Scientific name	Conservation status		Habitat	Source	Likelihood of occurrence and justification	
	EPBC Act	BC Act / DBCA			Pre targeted survey	Post targeted survey
					No suitable habitat, no nearby records.	No suitable habitat, no nearby records.
Verticordia staminosa subsp. staminosa	EN	CR	Spreading shrub, growing to 0.6m high. Occurs on granite outcrops, in soil pockets.	PMST	**Unlikely** No suitable habitat, no nearby records.	**Unlikely** No suitable habitat, no nearby records.
Acacia ataxiphylla subsp. magna	EN	EN	Spreading to ascending shrub, growing to 0.6m high. Occurs on lateritic ironstone rises, flats, in sandy soils.	PMST	**Unlikely** No suitable habitat, no nearby records.	**Unlikely** No suitable habitat, no nearby records.
Conospermum densiflorum subsp. unicephalatum	EN	EN	Much-branched shrub, growing to 0.6m high. Occurs in low-lying areas in clay soils.	PMST	**Unlikely** No suitable habitat, no nearby records.	**Unlikely** No suitable habitat, no nearby records.
Daviesia dielsii	EN	EN	Divaricate shrub, growing to 0.9m high. Occurs on sandy, often gravelly soils.	DBCA 2020, NatureMap, PMST	**Unlikely** No suitable habitat, no nearby records.	**Unlikely** No suitable habitat, no nearby records.
Eremophila viscida	EN	EN	Shrub, growing to 4m high. Occurs on stony gullies, sandplains, in granitic soils, sandy loam.	PMST	**Unlikely** No suitable habitat, no nearby records.	**Unlikely** No suitable habitat, no nearby records.
Grevillea bracteosa subsp. *bracteosa*	EN	EN	Shrubs, growing up to 2m high. Occurs in red clay loam over laterite.	DBCA 2020, NatureMap	**Unlikely** No suitable habitat, no nearby records.	**Unlikely** No suitable habitat, no nearby records.
Grevillea christineae	EN	EN	Wiry shrub, growing to 0.6m high. Occurs in clay loam, sandy clay, often moist.	DBCA 2020, PMST	**Unlikely** No suitable habitat, no nearby records.	**Unlikely** No suitable habitat, no nearby records.
Eucalyptus recta	EN	VU	Tree, growing to 15m high.	PMST	**Unlikely**	**Unlikely**

Scientific name	Conservation status		Habitat	Source	Likelihood of occurrence and justification	
	EPBC Act	BC Act / DBCA			Pre targeted survey	Post targeted survey
					No suitable habitat, no nearby records.	No suitable habitat, no nearby records.
Frankenia conferta	EN	VU	Small shrub.	PMST	**Unlikely** No suitable habitat, no nearby records.	**Unlikely** No suitable habitat, no nearby records.
Grevillea dryandroides subsp. hirsuta	EN	VU	Prostrate, vigorously sucking shrub, growing to 0.3m. Occurs in white or yellow sand, laterite.	PMST	**Unlikely** No suitable habitat, no nearby records.	**Unlikely** No suitable habitat, no nearby records.
Roycea pycnophylloides	EN	VU	Perennial, herb, forming densely branched, silvery mats, growing up to 1m high. Occurs on saline flats, in sandy soils.	PMST	**Unlikely** No suitable habitat, no nearby records.	**Unlikely** No suitable habitat, no nearby records.
Gastrolobium appressum	VU	EN	Shrub, growing to 0.3m high. Occurs on sandplains, low rises, in white/yellow sand with quartz gravel.	DBCA 2020, NatureMap, PMST	**Unlikely** One historic record occurs 50m from the northern boundary of the survey area. If present, this reasonably conspicuous species would have been identified.	**Unlikely** One historic record occurs 50m from the northern boundary of the survey area. If present, this reasonably conspicuous species would have been identified.
Eucalyptus rhodantha var. rhodantha	VU	VU	Spreading mallee, growing to 4m high. Occurs on undulating country, hillslopes.	DBCA 2020	**Unlikely** No suitable habitat, no nearby records.	**Unlikely** No suitable habitat, no nearby records.
Acacia trinalis	-	P1	Dense, rounded, bushy shrub or tree, growing to 4m high. Occurs in salt lakes and flats, swampy areas, with brown sand or clay loam.	DBCA 2020, NatureMap	**Unlikely** One historic record occurs 50m from the northern boundary of the survey area. If present, this large shrub/tree would have been identified.	**Unlikely** One historic record occurs 50m from the northern boundary of the survey area. If present, this large shrub/tree would have been identified.

Scientific name	Conservation status		Habitat	Source	Likelihood of occurrence and justification	
	EPBC Act	BC Act / DBCA			Pre targeted survey	Post targeted survey
Androcalva fragifolia	-	P1	Shrub, growing up to 0.8m high. Occurs in pale brown loamy sand.	DBCA 2020, NatureMap	**Unlikely** No suitable habitat, no nearby records.	**Unlikely** No suitable habitat, no nearby records.
Caladenia cristata	-	P1	Tuberous, perennial herb, growing up to 0.4m high. Occurs on sandy rise above salt flats, on sandy clay.	DBCA 2020, NatureMap	**Likely** Closest record 50m from the northern boundary of the survey area. One record also occurs 0.5 km south-west of the survey area. Suitable habitat is present (VC2 and 5). Majority of WAH's records (8 of 10) flowered in September, therefore they may not have been able to be identified in the field survey.	**Unlikely** No presence at known location or within survey area, long periods of disturbance within survey area likely excluding possibility of presence. Location of closest record potentially erroneous.
Dampiera glabrescens	-	P1	Perennial herb, growing to 0.9m high. Occurs on gravel pits, roadsides, in white or grey/yellow sand.	DBCA 2020	**Unlikely** No suitable habitat, no nearby records.	**Unlikely** No suitable habitat, no nearby records.
Grevillea pinifolia	-	P1	Much-branched shrub, growing to 0.9m high. Occurs on yellow sand, gravel.	DBCA 2020, NatureMap	**Unlikely** No suitable habitat, no nearby records.	**Unlikely** No suitable habitat, no nearby records.
Verticordia dasystylis subsp. oestopoia	-	P1	Spreading shrub, growing to 0.4m high. Occurs on outcrops in gritty soils over granite.	DBCA 2020	**Unlikely** No suitable habitat, no nearby records.	**Unlikely** No suitable habitat, no nearby records.
Acacia arcuatilis	-	P2	Rounding, spreading shrub, growing to 1.5m high. Occurs on sand or sandy loam, sometimes with lateritic gravel, on undulating plains, rises.	DBCA 2020	**Unlikely** No suitable habitat, no nearby records.	**Unlikely** No suitable habitat, no nearby records.

Scientific name	Conservation status		Habitat	Source	Likelihood of occurrence and justification	
	EPBC Act	BC Act / DBCA			Pre targeted survey	Post targeted survey
Acacia lirellata subsp. compressa	-	P2	Bushy procumbent, spreading shrub, growing to 1.2m high. Occurs on sandplains, in yellow sand, clayey loam.	DBCA 2020	**Unlikely** No suitable habitat, no nearby records.	**Unlikely** No suitable habitat, no nearby records.
Guichenotia glandulosa	-	P2	Multi-stemmed shrub, growing to 0.4m high. Occurs in creek lines, littered soil.	NatureMap	**Unlikely** No suitable habitat, no nearby records.	**Unlikely** No suitable habitat, no nearby records.
Thryptomene shirleyae	-	P2	Shrub, growing to 0.7m high. Occurs in yellow sand.	DBCA 2020	**Unlikely** No suitable habitat, no nearby records.	**Unlikely** No suitable habitat, no nearby records.
Acacia anarthros	-	P3	Prostrate, spinose shrub, growing to 0.5m high. Occurs in lateritic gravelly soils, slopes.	DBCA 2020	**Unlikely** No suitable habitat, no nearby records.	**Unlikely** No suitable habitat, no nearby records.
Daviesia debilior subsp. sinuans	-	P3	Straggling shrub, growing to 0.8m high. Occurs in gravelly lateritic clay.	DBCA 2020	**Unlikely** No suitable habitat, no nearby records.	**Unlikely** No suitable habitat, no nearby records.
Eucalyptus macrocarpa x pyriformis	-	P3	Open mallee tree, growing to 6m high. Occurs on hills, rocky ironstone ridges, sandplains, in sand, lateritic sandy soils.	DBCA 2020	**Unlikely** No suitable habitat, no nearby records.	**Unlikely** No suitable habitat, no nearby records.
Gastrolobium rotundifolium	-	P3	Bushy shrub, growing up to 0.8m high. Occurs in low rises, breakaways, in heavy clay or loam soils, granite, sandstone and quartzite.	DBCA 2020, NatureMap	**Unlikely** One historic record occurs 50m from the northern boundary of the survey area. If present, this reasonably conspicuous species would have been identified.	**Unlikely** No suitable habitat, nearby record location potentially erroneous.
Grevillea asparagoides	-	P3	Dense prickly shrub, growing up to 2m high. Occurs on gravelly loam, white or yellow sand.	DBCA 2020, NatureMap	**Unlikely**	**Unlikely**

Scientific name	Conservation status		Habitat	Source	Likelihood of occurrence and justification	
	EPBC Act	BC Act / DBCA			Pre targeted survey	Post targeted survey
					No suitable habitat, no nearby records.	No suitable habitat, no nearby records.
Grevillea haplantha subsp. recedens	-	P3	Spreading shrub, growing to 1m high. Occurs on sand, sandy loam.	DBCA 2020	**Unlikely** No suitable habitat, no nearby records.	**Unlikely** No suitable habitat, no nearby records.
Melaleuca sclerophylla	-	P3	Spreading to prostrate shrub, growing to 0.9m high. Occurs on granite outcrops, rises, in gravelly sand, clayey sand.	DBCA 2020, NatureMap	**Unlikely** No suitable habitat, no nearby records.	**Unlikely** No suitable habitat, no nearby records.
Stylidium periscelianthum	-	P3	Bulb-forming perennial herb, growing to 0.15m high. Occurs on wet flats, low granitic hills, in loamy clay, moist soils pockets.	DBCA 2020, NatureMap	**Unlikely** No suitable habitat, no nearby records.	**Unlikely** No suitable habitat, no nearby records.
Urodon capitatus	-	P3	Low spreading or upright shrub, growing to 1.2m. Occurs in sandy gravelly soils on plains.	DBCA 2020, NatureMap	**Potential** Closest record 50m from the northern boundary of the survey area. Suitable habitat may be present.	**Unlikely** No suitable habitat, location of closest record potentially erroneous.
Verticordia huegelii var. tridens	-	P3	Shrub, growing to 0.6m high. Occurs in winter-wet areas, low hills, in sandy or gravelly loam.	DBCA 2020	**Unlikely** No suitable habitat, no nearby records.	**Unlikely** No suitable habitat, no nearby records.
Verticordia venusta	-	P3	Spreading shrub, growing to 2m. Occurs in yellow sand, sandy gravels on sandplains.	DBCA 2020, NatureMap	**Potential** Closest record 50m from the northern boundary of the survey area. Suitable habitat may be present.	**Unlikely** No suitable habitat, location of closest record potentially erroneous.
Calothamnus accedens	-	P4	Slender shrub, growing up to 1.8m. Occurs on road verges in sandy soils over laterite.	DBCA 2020, NatureMap	**Unlikely**	**Unlikely**

Scientific name	Conservation status		Habitat	Source	Likelihood of occurrence and justification	
	EPBC Act	BC Act / DBCA			Pre targeted survey	Post targeted survey
					No suitable habitat, no nearby records.	No suitable habitat, no nearby records.
Eucalyptus x carnabyi	-	P4	Mallee, growing up to 6m. Occurs lateritic ridges, in grey sand, sandy loam.	DBCA 2020, NatureMap	**Unlikely** No suitable habitat, no nearby records.	**Unlikely** No suitable habitat, no nearby records.
Persoonia sulcata	-	P4	Spreading to decumbent, growing to 1m high. Occurs in lateritic or granitic soils.	DBCA 2020	**Unlikely** No suitable habitat, no nearby records.	**Unlikely** No suitable habitat, no nearby records.

Appendix E Desktop assessment and targeted survey for Western Spiny-tailed Skink for the CBH Miling Expansion Project

Desktop assessment and targeted survey for Western Spiny-tailed Skink for the CBH Miling Expansion Project, Western Australia

CBH Group

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DOCUMENT TRACKING

Project Name	Desktop assessment and targeted survey for Western Spiny-tailed Skink for the CBH Miling Expansion Project, Western Australia
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Project Manager	Rebecca Hide
Prepared by	Briana Wingfield
Reviewed by	Jeff Cargill, Rebecca Hide
Approved by	Jeff Cargill
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Template 2.8.1

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Abbreviations

Abbreviation	Description
BC Act	Biodiversity Conservation Act 2016 (Western Australia)
BoM	Bureau of Meteorology
CBH	CBH Group
DAWE	Department of Agriculture, Water and the Environment
DBCA	Department of Biodiversity, Conservation and Attractions (Western Australia)
DEC	Department of Environment and Conservation
ECA	Environmental Consultants Association
ELA	Eco Logical Australia
EPA	Environmental Protection Authority (Western Australia)
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999
IBRA	Interim Biogeographic Regionalisation for Australia
DSEWPaC	Department of Sustainability, Environment, Water, Population and Communities
WAM	Western Australian Museum
WSTS	Western Spiny-tailed Skink

Executive Summary

CBH Group has undertaken biological assessments to support revision of the Miling Environmental Management Plan and future expansion of the Miling Grain Receival Site (the Project). The Project is located to the west of Miling townsite in the Shire of Moora, approximately 200 km north-east of Perth, Western Australia. The survey area totals approximately 34 ha.

Eco Logical Australia (ELA) was engaged by CBH to undertake a desktop assessment followed by a targeted Western Spiny-tailed Skink (*Egernia stokesii* subsp. *badia*) survey. This species is listed as Endangered under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* and Vulnerable under the State *Biodiversity Conservation Act 2016*.

Basic habitat assessments for the Western Spiny-tailed Skink were undertaken in July 2014 (Cardno 2014) and October 2020 (ELA 2021) but did not include targeted searches for individuals. A targeted Western Spiny-tailed Skink survey was undertaken over one day on 22nd July 2021 in accordance with Environmental Protection Authority *Technical Guidance: Terrestrial vertebrate fauna surveys for environmental impact assessment* (EPA 2020) and *Survey Guidelines for Australia's threatened reptiles* (DSEWPaC 2011).

The targeted survey recorded no WSTS individuals or secondary signs (e.g., latrines) from the survey area. The survey area was found to be disturbed with minor earthworks, dumping of building waste and vehicle tracks present in most areas.

Most records of the Western Spiny-tailed Skink are in York Gum (*Eucalyptus loxophleba*) woodland in clayey soils predominantly within the Avon Wheatbelt IBRA bioregion. In the survey area, ELA (2021) identified the presence of 'Poor' quality habitat associated with the *Eucalyptus loxophleba* woodland fauna habitat. The 'Poor' habitat quality rating was due to the lack of shelter present within the survey area, namely fallen logs and tree stumps, and grazing present by cattle.

ELA (2021) identified the Western Spiny-tailed Skink as having the Potential to occur based on the availability of suitable habitat, albeit 'Poor' quality, and close proximity of recent records. Based on the current targeted survey however, Western Spiny-tailed Skink has been reassessed as being Unlikely to occur in the survey. The species has not been recorded in the survey area, despite adequate survey efforts, and no further surveys are required to be undertaken to meet the EPA Technical Guidance (EPA 2020).

1. Introduction

1.1. Project Background

CBH Group (CBH) has undertaken biological assessments to support revision of the Miling Environmental Management Plan and future expansion of the Miling Grain Receival Site (the Project). The Project is located to the west of Miling townsite in the Shire of Moora, approximately 200 km north-east of Perth, Western Australia. The survey area totals approximately 34 ha (Figure 1).

Eco Logical Australia (ELA) was engaged by CBH to undertake a desktop assessment followed by a targeted Western Spiny-tailed Skink (*Egernia stokesii* subsp. *badia*; WSTS) survey. This species is listed as Endangered under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and Vulnerable under the State *Biodiversity Conservation Act 2016* (BC Act).

Basic habitat assessments for the WSTS were undertaken in July 2014 (subset area of 5 ha; Cardno 2014) and October 2020 (total survey area of 34 ha; ELA 2021) but did not include targeted searches for individuals.

1.2. Environmental setting

1.2.1. Regional context

Environmental values for the region relevant to the survey area are presented in Table 1.

Table 1: Environmental values of the region

Existing environmental attributes	Information
Interim Biogeographical Regionalisation for Australia (IBRA) Bioregion	Avon Wheatbelt bioregion (AVW); AVW02 – Katanning subregion (DAWE 2021a)
Geology, landform and soils	The Avon Wheatbelt bioregion is described as a dissected plateau of Tertiary laterite in the Yilgarn Craton with a semi-arid (dry) warm Mediterranean climate (Beecham 2001). The AVW02 subregion is further described as comprised of gently undulating rises to low hills with abrupt breakaways; its drainage is rejuvenated and comprises continuous stream channels that flow in most years. Residual lateritic uplands and derived sandplains are covered by areas of proteaceous scrub-heaths (which are rich in endemic species) and quaternary surfaces of erosional slopes and valley floors support woodlands of Wandoo, York gum, Jam and Casuarina (Beecham 2001).
Climate	The Avon Wheatbelt region is described as having a semi-arid (dry) and warm Mediterranean Climate (Beecham 2001).
Hydrology	The survey area is located in the Moore-Hill Rivers Basin, within the Moore River catchment. No major or minor drainages run through or are adjacent to the survey area.
Regional vegetation	Two vegetation associations occur within the survey area, namely Victoria Plains 142 and Victoria Plains 631 (Beard 1975). Victoria Plains 142 consist of medium woodland; York gum & salmon gum, and Victoria Plains 631 consists of succulent steppe with woodland and thicket; York gum over *Melaleuca thyoides* & samphire.

1.2.2. Western Spiny-tailed Skink

The WSTS is a large skink that grows to about 28 cm and is covered by short dorsal spines and has a short spiny tail (How et al. 2003). The diet is not known, but the species (*Egernia stokesii*) is known to be omnivorous, with juveniles feeding mainly on insects, and adults largely consuming plant material (Duffield and Bull 1998).

The WSTS lives in spatially and temporally stable groups of up to 17 individuals. Of particular interest is its behaviour of depositing faecal pellets in a pile in close proximity to their refuge (i.e., latrine) (ECA/DBCA 2016).

The WSTS is known from a number of disconnected populations in the wheatbelt region[1] of Western Australia. Most records of the Western Spiny-tailed Skink are found in York Gum (*Eucalyptus loxophleba)* woodland in clayey soils predominantly within the Avon Wheatbelt IBRA bioregion (DEC 2012). Populations have persisted in woodland patches as small as 1 ha, with some such patches completely isolated by cleared crop paddocks (Lee-Steere 2013). Sites with the greatest number of individuals contain numerous fallen logs and were subjected to low intensity grazing by domestic stock (How et al. undated).

[1] The wheatbelt spans across 154,862 km^2 and contains four IBRA subregions; AVW01 – Merredin, AVW02 – Katanning, MAL02 – Western Mallee, COO02 – Southern Cross

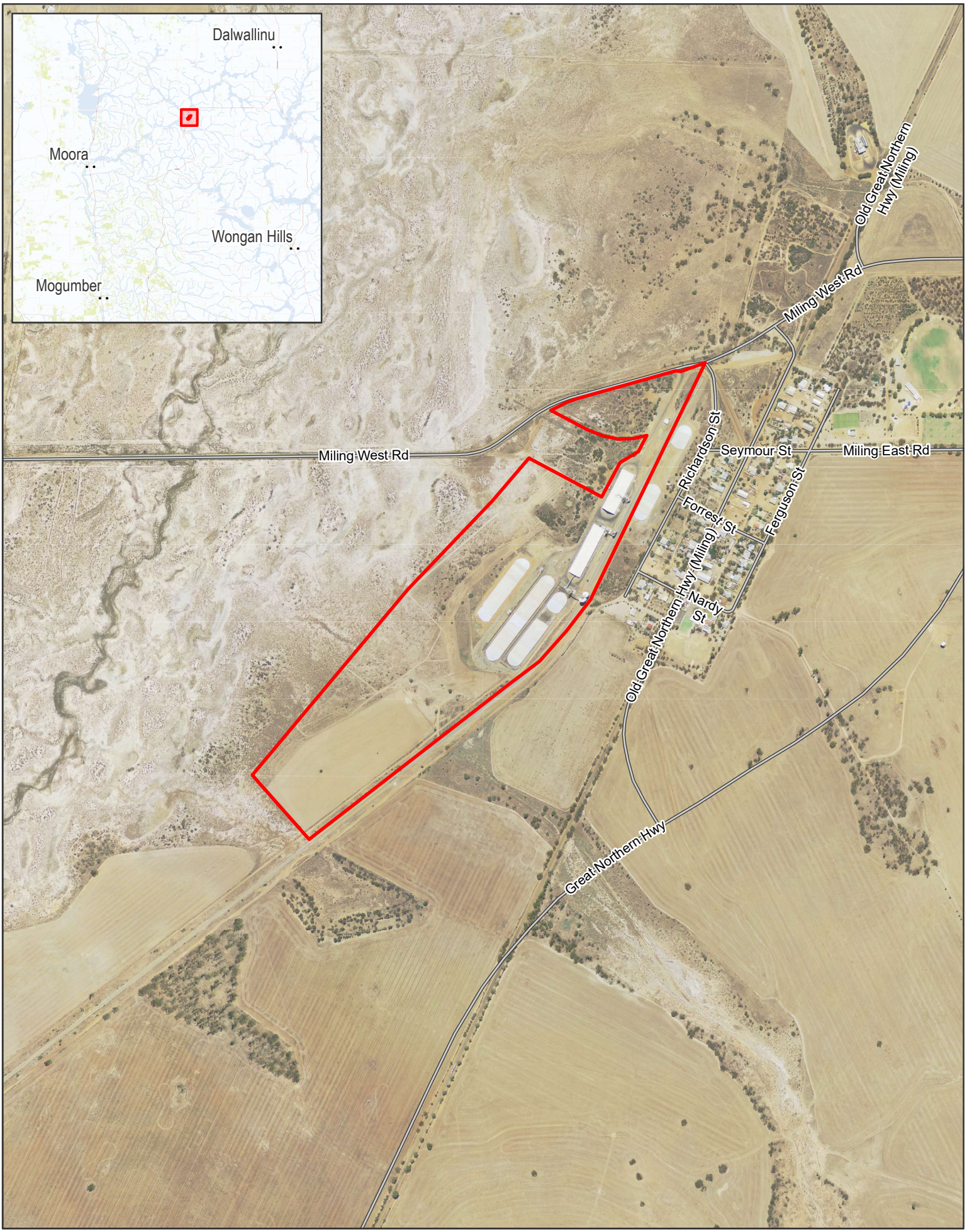

Figure 1: Site overview

Survey Area

Road

N

0 100 200 400

Metres

Datum/Projection:
GDA 1994 MGA Zone 50

Project: 17255-GM Date: 13/09/2021

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2. Methodology

2.1. Desktop Assessment

2.1.1. Database searches

ELA (2021) undertook Commonwealth and State database searches for existing data and information relevant to conservation significant fauna (provided in Table 2). As the DBCA (2020) search was undertaken in November 2020 and DAWE (2021b) and DBCA (2007-2021) undertaken in February 2021, they are considered sufficiently current to be used in this report.

Table 2: Database searches undertaken for the survey area

Database	Reference	Radius of search area (km)
EPBC Act Protected Matters Search Tool for Threatened species and communities listed under the EPBC Act.	DAWE 2021b	20
DBCA and Western Australian Museum (WAM) NatureMap online database for fauna.	DBCA 2007-2021	20
DBCA Threatened and Priority fauna database searches for Threatened fauna listed under the EPBC Act or BC Act and Priority Fauna.	DBCA 2020	65

2.1.2. Literature review

Basic habitat assessments for the WSTS were undertaken in July 2014 (Cardno 2014) and October 2020 (ELA 2021) but did not include targeted searches for individuals. Most WSTS records are in York Gum (*Eucalyptus loxophleba*) woodland in clayey soils predominantly within the Avon Wheatbelt IBRA bioregion (DEC 2012). Cardno (2014) and ELA (2021) both mapped the suitable *Eucalyptus loxophleba* woodland fauna habitat.

2.2. Field Survey

2.2.1. Survey team and timing

A targeted WSTS survey was undertaken over one day on 22nd July 2021. This involved walking over areas with suitable habitat by an experienced ecologist:

- Briana Wingfield *BSc. Conservation and Wildlife Biology and Environmental Science (Hons)*

Survey work was undertaken under the collection licence issued by the Department of Biodiversity, Conservation and Attractions (DBCA):

- TFA 2021-0074; Licensee Briana Wingfield (ELA); Valid 23/06/2021

A total of 0.4 mm rainfall was recorded at a nearby weather station (Dalwallinu, station number: 008297; BoM 2021) on the day of the survey. Two days prior, the weather station recorded the highest rainfall for the month, at 18.6 mm. Therefore, standing water was present over the survey area during the survey.

2.2.2. Targeted Western Spiny-tailed Skink survey

The targeted survey involved personnel hand searching likely sheltering sites (hollow logs and roots, piles of timber, and hollow trees/branches, and rock outcrops) and looking for latrines (faecal pellet piles) close to sheltering sites within suitable habitat of the survey area. The survey methodology considered appropriate literature, including:

- Environmental Protection Authority (EPA) *Technical Guidance: Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment* (EPA 2020);
- Survey guidelines for Australia's threatened reptiles (DSEWPaC 2011); and
- Western Spiny-tailed Skink (*Egernia stokesii* subsp. *badia*) Best Practice Survey Guidelines - draft (ECA/DBCA 2016).

WSTS is diurnal and thought to be active most of year, except during the winter months. The greatest activity is like to be in spring/summer, coinciding with the breeding season. However, because individuals are mostly likely to be encountered in sheltering sites, survey timing is unlikely to significantly affect the success of surveys (DSEWPaC 2011) and therefore surveys can be undertaken at any time.

2.3. Likelihood of occurrence assessment

ELA (2021) undertook a likelihood of occurrence assessment to identify conservation significant fauna species that possibly occurred within the survey area. This likelihood of occurrence assessment was undertaken again, specifically for WSTS, after the desktop assessment and targeted survey. Criteria used for the assessment are presented in **Appendix A**.

2.4. Limitations

The EPA Technical Guidance (EPA 2020) recommends including discussion of the constraints and limitations of the survey methods used. Constraints and limitations are summarised in Table 3.

Table 3: Survey limitations

Potential survey limitation	Impact on survey
Sources of information and availability of contextual information (i.e. pre-existing background versus new material).	**Not a constraint**. Broad-scale vegetation mapping at a scale of 1:1,000,000 was available. Land system mapping at a scale of 1:2,000,000 and soil and landform mapping was also available. The DBCA database search was undertaken within an appropriate buffer. Available information was sufficient to provide context at varying scales.
Scope (i.e. what life forms, etc., were sampled).	**Not a constraint**. The survey requirement of a targeted WSTS survey in accordance with EPA technical guidance was adequately met.
Completeness and further work which might be needed (i.e. was the relevant survey area fully surveyed).	**Not a constraint.** The survey area coverage met the requirements of a targeted WSTS survey, as outlined in the scope of work.
Timing, weather, season, cycle.	**Not a constraint**. WSTS is diurnal and thought to be active most of year, except during the winter months. The greatest activity is like to be in spring/summer, coinciding with the breeding season. However, because individuals are mostly likely to be encountered in sheltering sites, survey timing is unlikely to significantly affect the success of surveys (DSEWPaC 2011) and therefore surveys can be undertaken at any time.

Potential survey limitation	Impact on survey
Disturbances (fire, flood, accidental human intervention, etc.).	**Not a constraint**. The survey area had received a significant amount of rainfall prior to the survey, therefore standing water was present over the survey area. This did not impact the ability to meet the requirements of the survey.
Intensity (in retrospect, was the intensity adequate).	**Not a constraint**. The survey effort was appropriate for a targeted WSTS survey.
Resources (i.e. were there adequate resources to complete the survey to the required standard).	**Not a constraint**. The number of personnel conducting this field survey in the given time was adequate to perform the required level of survey.
Access problems (i.e. ability to access survey area).	**Not a constraint**. All relevant areas within the survey area were able to be accessed and surveyed.
Experience levels (e.g. degree of expertise in plant identification to taxon level).	**Not a constraint**. The personnel conducting this field survey were suitably qualified to identify WSTS, having multiple years of field experience in fauna surveys across Western Australia.

3. Results

3.1. Desktop assessment

The WSTS was identified in all three database searches (DAWE 2021b, DBCA 2007-2021, DBCA 2020). At a regional level, WSTS are known from 314 records across the Avon Wheatbelt and Murchison bioregions (DBCA 2007-2021). At a local scale, the DBCA (2020) database search (over a 65 km search radius from the survey area) identified 28 records of the WSTS (Figure 2). The closest records occurred 1 km north-east of the survey area; comprising two historical records (1940 and 1954) and three vouchered specimens (year unknown). These records now occur on cleared pastoral land.

In the survey area, ELA (2021) identified 'Poor' quality habitat (2.23 ha) associated with the *Eucalyptus loxophleba* woodland fauna habitat (Figure 3). The 'Poor' quality habitat rating was due to lack of shelter present in the survey area, namely fallen logs and tree stumps, and grazing present by cattle.

3.2. Targeted Western Spiny-tailed Skink survey

The targeted survey recorded no WSTS individuals or secondary signs (e.g., latrines) from the survey area. The survey area was found to be disturbed with minor earthworks, dumping of building waste and vehicle tracks present in most areas (Plate 1).

Plate 1: Disturbance within the 'Poor' quality WSTS habitat in the survey area (top: tracks, bottom: minor earthworks)

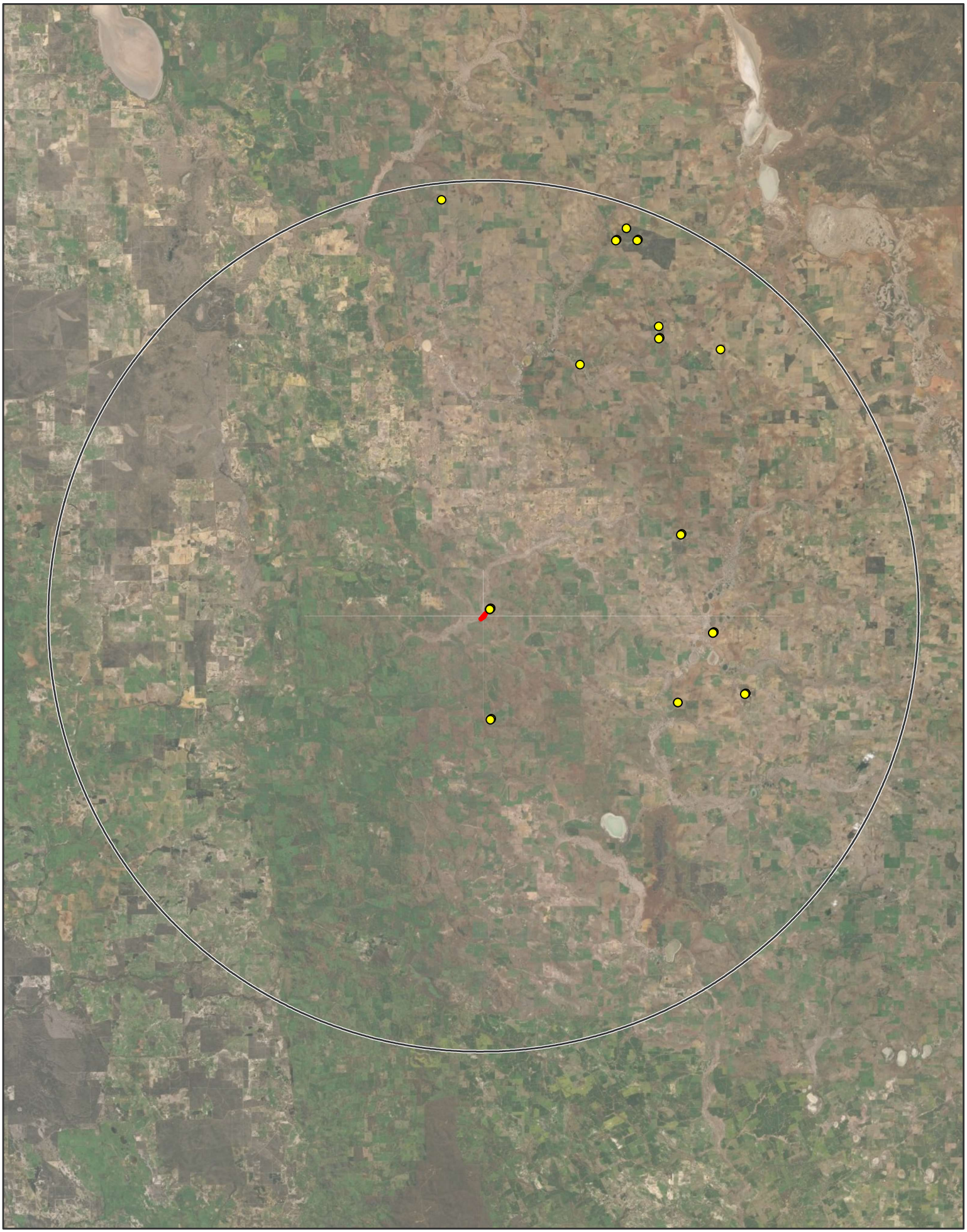

Figure 2: DBCA database records of Western Spiny-tailed Skink in the vicinity of the survey area

Survey Area

65km Buffer

Western Spiny-tailed Skink (*Egernia stokesii* subsp. *badia*)

N

0 5 10 20

Kilometers

Datum/Projection:
GDA 1994 MGA Zone 50

Project: 17255-GM Date: 13/09/2021

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Figure 3: Potential suitable Western Spiny-tailed Skink habitat within the survey area

Survey Area

Potential suitable Western Spiny-tailed Skink habitat

Potentially suitable (*Eucalyptus loxophleba* woodland)

Not suitable

N

0 50 100 200

Metres

Datum/Projection:
GDA 1994 MGA Zone 50

Project: 17255-GM Date: 13/09/2021

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4. Discussion

The WSTS is listed as Endangered under the EPBC Act, meaning the taxa is considered to be facing a very high risk of extinction in the wild, and Vulnerable under the BC Act, meaning the species is facing a high risk of extinction in the wild in the medium-term future.

The WSTS is known to occur in a broad semi-arid area in south-west WA, between Shark Bay and Minnivale and east to Cue (TSSC 2015, How et al. 2003). Much the wheatbelt has been cleared since the 1960s and suitable microhabitat is now far less abundant (How et al. undated), although an increasing number of skinks are being located in altered habitat under piles of wood, scrap metal or under buildings on private property.

Most records of the Western Spiny-tailed Skink are found in York Gum (*Eucalyptus loxophleba)* woodland in clayey soils predominantly within the Avon Wheatbelt IBRA bioregion (DEC 2012). Populations have persisted in woodland patches as small as 1 ha, with some such patches completely isolated by cleared crop paddocks (Lee-Steere 2013). In the survey area, ELA (2021) identified 'Poor' quality habitat associated with the *Eucalyptus loxophleba* woodland fauna habitat. The 'Poor' quality rating was due to lack of shelter present in the survey area, namely fallen logs and tree stumps, and grazing present by cattle.

Through the likelihood of occurrence assessment, ELA (2021) identified the WSTS as having the Potential to occur based on the availability of suitable habitat, albeit 'Poor' quality, and close proximity of records. Based on the current targeted survey however, WSTS has been reassessed as being Unlikely to occur in the survey area due to the following:

- it is unlikely to occur due to the site lacking critical habitat, having at best marginally suitable habitat, and/or being severely degraded; and
- it is unlikely to occur due to few historic record/s and no other current collections in the local area.

The species has not been recorded in the survey area, despite adequate survey efforts, and no further surveys are required to be undertaken to meet the EPA Technical Guidance (2020).

5. References

Beard, J.S. 1975. The vegetation survey of Western Australia. Explanatory notes to Sheet 4, 1:1,000,000 Series Vegetation Survey of Western Australia. University of Western Australia Press, Nedlands, WA.

Beecham, B. 2001. Avon Wheatbelt 2 (AW2 – Re-juvenated Drainage subregion). In 'A Biodiversity Audit of Western Australia's 53 Biogeographical Subregions in 2002'. Department of Conservation and Land Management, Kensington, WA.

Cardno. 2014. Level 1 Flora and Fauna Survey. Prepared for CBH Miling.

Department of Agriculture, Water and the Environment 2021a. Australia's bioregions (IBRA). Available from: https://www.environment.gov.au/land/nrs/science/ibra

Department of Agriculture, Water and the Environment (DAWE). 2021b. EPBC Act Protected Matters Search Tool. Available from: http://www.environment.gov.au/epbc/pmst/index.html.

Department of Biodiversity, Conservation and Attractions (DBCA). 2020. Threatened and Priority Fauna database search. Reference number FAUNA#6500. Department of Biodiversity, Conservation and Attractions, Perth.

Department of Biodiversity, Conservation and Attractions (DBCA). 2007-2021. NatureMap. Department of Biodiversity, Conservation and Attractions. Available from: https://naturemap.dpaw.wa.gov.au/default.aspx.

Department of Environment and Conservation (DEC). 2012. Western Spiny-tailed Skink (*Egernia stokesii*) National Recovery Plan. Perth, Western Australia.

Department of Sustainability, Environment, Water, Populations and Communities (DSEWPaC). 2011. Survey Guidelines for Australia's threatened reptiles. Commonwealth of Australia.

Duffield, G.A. & C.M. Bull. 1998. *Seasonal and ontogenetic changes in the diet of the Australian skink Egernia stokesii*. Herpetologica. 54 (3):414-419.

Eco Logical Australia (ELA). 2021. Miling Grain Receival Site Expansion Flora and Fauna Survey. Prepared for CBH Group.

Environmental Consultants Association (ECA)/Department of Biodiversity, Conservation and Attractions (DBCA). 2016. Western Spiny-tailed Skink (*Egernia stokesii badia*) Best Practice Survey Guidelines – draft.

Environmental Protection Authority (EPA). 2020. Technical Guidance: Terrestrial vertebrate fauna surveys for environmental impact assessment. Perth, Western Australia.

How, R.A., J. Dell & D.J. Robinson. 2003. The Western Spiny-tailed Skink, *Egernia stokesii badia*: Declining distribution in a habitat specialist. The Western Australian Naturalist. 24(2):138-146.

How, R.A., Dell, J. and Aplin, K.P. 1999. Assessment of the central wheatbelt populations of the endangered skink, *Egernia stokesii badia*. Unpublished report to the Department of Conservation and Land Management, Perth.

How, R.A., J. Dell & K. Aplin (undated). Assessment of the central wheatbelt populations of the endangered skink Egernia stokesii badia. Western Australian Museum. Unpublished.

Lee-Steere, T. 2008-2013. Avon Wheatbelt Conservation Plan - Western Spiny-tailed Skink (*Egernia stokesii badia*) – draft.

Threatened Species Scientific Committee (TSSC). 2015. Commonwealth Listing Advice on *Egernia stokesii aethiops*. Available from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/26192-listing-advice-09092015.pdf.

Appendix A Likelihood of occurrence assessment criteria

Likelihood rating	Criteria
Recorded	The species has previously been recorded within survey area from DBCA database search results and/or from previous surveys of the survey area, and/or the species has been confirmed through a current vouchered specimen at the Western Australian Herbarium.
Likely	The species has not previously been recorded from within the survey area. However, (to qualify requires one or more criteria to be met): • the species has been recorded in close proximity to the survey area, and occurs in similar habitat to that which occurs within the survey area • core habitat and suitable landforms for the species occurs within the survey area either year-round or seasonally. In relation to fauna species, this could be that a host plant is seasonally present on site, or habitat features such as caves are present that may be used during particular times during its life cycle e.g. for breeding. In relation to both flora and fauna species, it may be there are seasonal wetlands present • there is a medium to high probability that a species uses the survey area
Potential	The species has not previously been recorded from within the survey area. However, (one or more criteria requires to be met): • targeted surveys may locate the species based on records occurring in proximity to the survey area and suitable habitat occurring in the survey area • the survey area has been assessed as having potentially suitable habitat through habitat modelling • the species is known to be cryptic and may not have been detected despite extensive surveys • the species is highly mobile and has an extensive foraging range so may not have been detected during previous surveys The species has been recorded in the survey area by a previous consultant survey or there is historic evidence of species occurrence within the survey area. However, (one or more criteria requires to be met) • doubt remains over taxonomic identification, or the majority of habitat does not appear suitable (although presence cannot be ruled out due to factors such as species ecology or distribution) • coordinates are doubtful
Unlikely	The species has been recorded locally through DBCA database searches. However, it has not been recorded within the survey area and • it is unlikely to occur due to the site lacking critical habitat, having at best marginally suitable habitat, and/or being severely degraded • it is unlikely to occur due to few historic record/s and no other current collections in the local area. The species has been recorded within the bioregion based on literature review but has not been recorded locally or within the survey area through DBCA database searches. The species has not been recorded in the survey area despite adequate survey efforts, such as a standardised methodology or targeted searching within potentially suitable habitat.
Does not occur	The species is not known to occur within the IBRA bioregion based on current literature and distribution. The conspicuous species has not been recorded in the survey area despite adequate survey efforts at an appropriate time of year to detect the species within potentially suitable habitat. The survey area lacks important habitat for a species that has highly selective habitat requirements. The species has been historically recorded within survey area or locally; however, it is considered locally extinct due to significant habitat changes such as land clearing and/or introduced predators.

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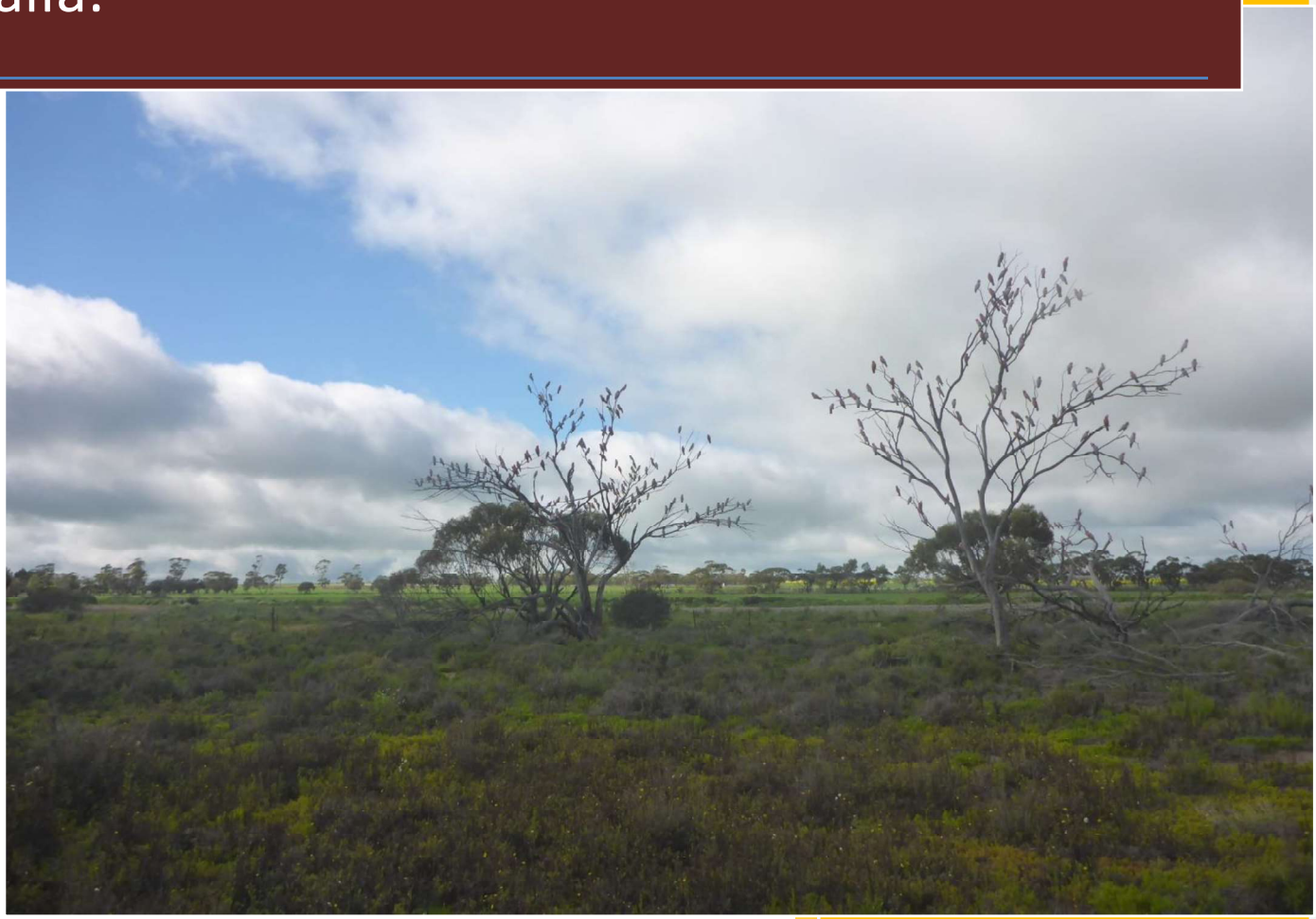
Appendix F Desktop assessment and targeted survey for SRE and Conservation Significant Invertebrate Fauna for the CBH Miling Expansion Project

Desktop assessment and targeted survey for SRE and Conservation Significant Invertebrate Fauna for the CBH Miling Expansion Project, Western Australia.



Report by Invertebrate Solutions Pty Ltd for Eco Logical Australia Pty Ltd on behalf of Co-operative Bulk Handling Group Ltd

October 2021

Dr Timothy Moulds
Director and Principal Ecologist
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Invertebrate Solutions. (2021). Desktop assessment and targeted survey for SRE fauna for the CBH Miling Expansion Project, Western Australia. Unpublished report to Eco Logical Australia Pty Ltd on behalf of Co-operative Bulk Handling Group Ltd, October 2021.

Report Number 2021ISJ08_F01_20211006

Prepared for: Eco Logical Australia Pty Ltd on behalf of Co-operative Bulk Handling Group Ltd

Frontispiece: Native vegetation within the survey area.

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Executive Summary

Co-operative Bulk Handling Group Ltd (CBH Group) has undertaken biological assessments to support State and Federal environmental approvals for the clearing of native vegetation to allow for the expansion of the Miling Grain Receival Site (the Project). CBH Group proposes to develop this land for the expansion of the Miling Grain Receival facility. The Project is located on the western edge of the Miling townsite in the Wheatbelt region of Western Australia.

Invertebrate Solutions has been requested by Eco Logical Australia Pty Ltd (ELA) on behalf of CBH Group to undertake a desktop assessment of short range endemic (SRE) and conservation significant invertebrates followed by a targeted survey for these species for the Project.

The Desktop Study Area contains one Confirmed SRE species from WAM records:

- A mygalomorph spider – *Idiosoma nigrum* - BC Act Endangered / EPBC Act Vulnerable

The Desktop Study Area contains a single Likely SRE species from WAM records:

- A millipede – *Antichiropus sp. 'hamatus'*

The remaining species identified from desktop resources were found to be widespread and neither of the species identified within the Desktop Study area were found to be present within the Project Area.

Whilst 21 conservation listed invertebrate species occur within the entire Wheatbelt region, within the Miling area only two of these species have any potential habitat or distributions in the local region, with the remaining species found several hundreds of kilometres away in the broader Wheatbelt region:

- A fairy shrimp - *Branchinella simplex* – DBCA Priority 1
- A fairy shrimp - *Branchinella denticulata*– DBCA Priority 3

Of these two conservation significant species none are known to be present within the Project Area.

The targeted SRE and conservation significant invertebrate survey undertaken on the entire Project Area on 22nd July 2021 recorded no SRE or conservation significant invertebrates. The Project Area was found to be disturbed from minor earthworks in most areas, and further disturbed by vehicle tracks that have degraded the potential habitat for SRE and conservation significant invertebrate species.

No SRE or conservation significant invertebrates were found to occur within the Project Area and no further surveys are required to be undertaken to meet Technical Guidance – Sampling of short range endemic invertebrate fauna (EPA 2016).

1. Introduction

Co-operative Bulk Handling Group Ltd (CBH Group) has undertaken biological assessments to support State and Federal environmental approvals for the clearing of native vegetation to allow for the expansion of the Miling Grain Receival Site (the Project). CBH Group proposes to develop this land for the expansion of the Miling Grain Receival facility. The Project is located on the western edge of the Miling townsite in the Wheatbelt region of Western Australia.

Invertebrate Solutions has been requested by Eco Logical Australia Pty Ltd (ELA) on behalf of CBH Group to undertake a desktop assessment of short range endemic (SRE) and conservation significant invertebrates followed by a targeted survey for these species for the Project.

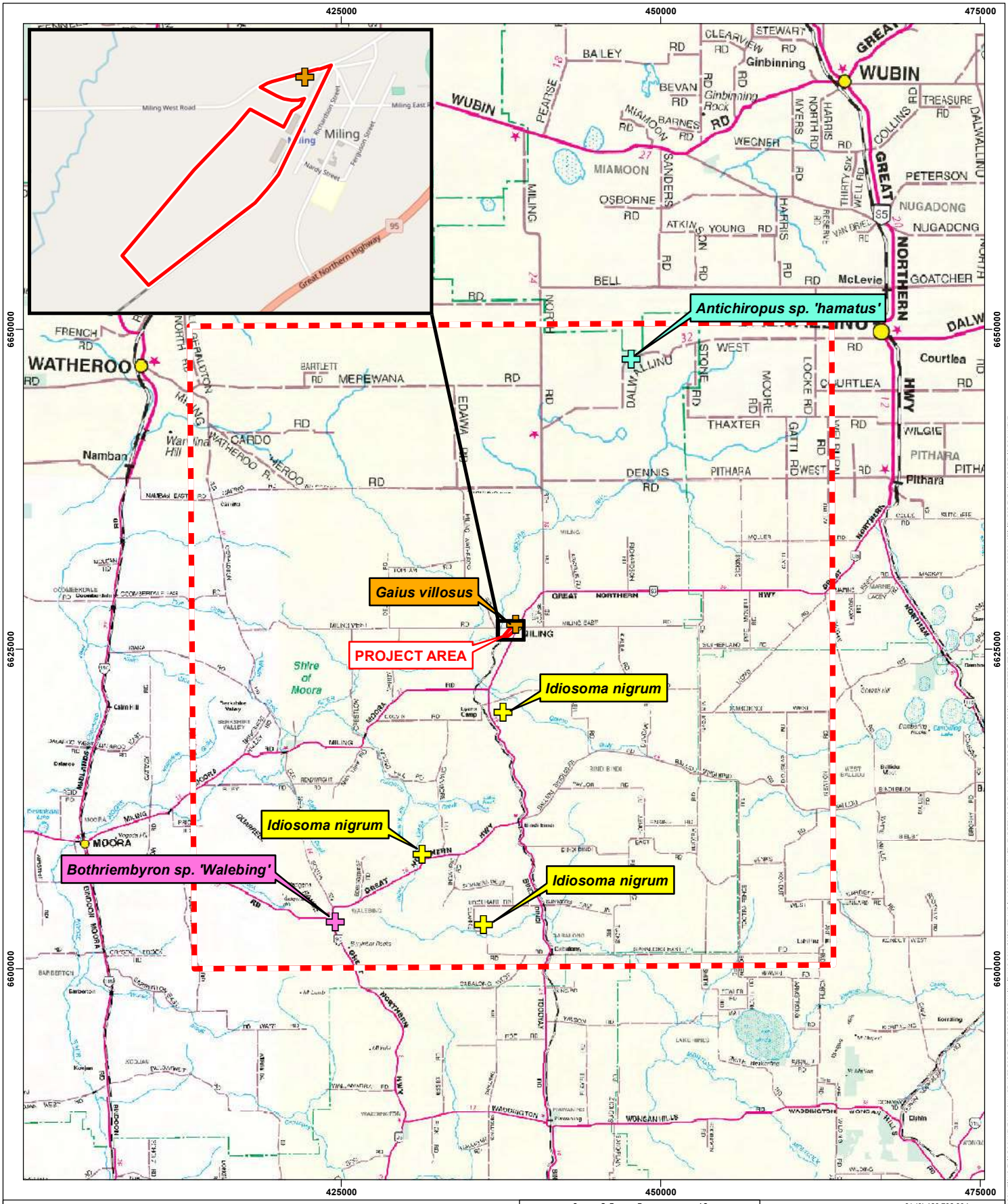
1.1 Purpose of this report

Eco Logical Australia has requested Invertebrate Solutions to undertake the following scope of works for the Project Area, Western Australia:

- Carry out a desktop review to inform the survey planning and report preparation, including identification of all SRE species likely to occur within the Project Area;
- Undertake a targeted SRE invertebrate survey to identify significant species in accordance with Environmental Protection Authority (EPA) Technical Guidance Sampling of short range endemic invertebrate fauna (EPA 2016);
- Identify to the lowest practical taxonomic unit all specimens recorded during the field survey;
- Provide recommendations and any suggested requirements for further work to comply with relevant legislation; and
- Provide a written report containing the above items.

1.2 Project Area

The Project is located to the west of Miling townsite, in the Wheatbelt region of Western Australia and is shown in Figure 1. The Desktop Study Area comprised a rectangle of approximately 250,000 Ha bounded by the north west corner (30.276112°S, 116.096764°E) and the south east corner (30.729840°S, 116.619365°E) centred on the Project.



Legend

- Desktop Study Area
- Project Area
- Idiopidae: *Idiosoma nigrum*
- Idiopidae: *Gaius villosus*
- Paradoxosomatidae: *Antichiropus sp. 'hamatus'*
- Bothriembyronitdae: *Bothriembyron sp. 'Walebing'*

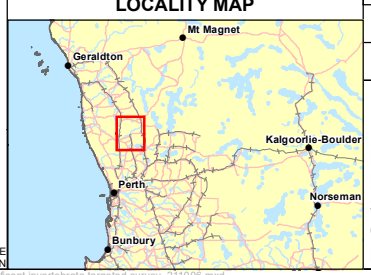
0 2.5 5 10 km

Scale: 1:400,000 @ A4

N

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS

LOCALITY MAP



- LOCALITY MAP SOURCED LANDGATE - TRAVELLERS ATLAS 9TH EDITION

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PROJECT ID	DATE
Miling Grain Receival Site Expansion	6/10/2021

HORIZONTAL DATUM AND PROJECTION: GDA 1994 MGA Zone 50

CREATED	CHECKED	APPROVED	REVISION
ENVIRONMAPS	TM	TM	0

Consolidated Bulk Handling Pty Ltd

Figure 1

Miling Grain Receival Site Expansion and Desktop Study Area for SRE and Conservation Significant Invertebrate Targeted Survey

ENVIRONMAPS t: 0406 560 006 Environmental Mapping Solutions www.environmaps.com.au

C:\GIS\Jobs\Invertebrate Solutions\Miling Grain Receival Site Expansion\Figures\MGRSE_F01 MGRSE and Desktop Study area for SRE and conservation significant invertebrate targeted survey_211006.mxd

1.3 Survey Effort and Timing

Invertebrate Solutions completed a targeted survey for SRE and conservation significant invertebrates on 22nd July 2021. This involved grid searching the entire Project Area by an experienced ecologist:

- Dr Timothy Moulds *BSc (Hons) Geol., PhD. Invert. Ecol.* (Invertebrate Solutions).

Survey work was undertaken under the collection licences issued by the Department of Biodiversity, Conservation and Attractions (DBCA):

- BA27000460; Licensee Timothy Moulds (Invertebrate Solutions); Valid 25/06/2021-30/06/2022.
- TFA 2021-0073; Licensee Timothy Moulds (Invertebrate Solutions); Valid 25/06/2021-30/06/2022.

1.4 Introduction to SRE fauna

Short range endemic (SRE) invertebrates are species with restricted distributions. The isolation of invertebrates in specific habitats or bioregions leads to endemism at various spatial scales. The vast majority of invertebrates are capable of dispersing substantial distances at some phase of their life cycle. Some groups, however, are susceptible to short range endemism - which describes endemic species with restricted ranges, arbitrarily defined in Western Australia as less than 10,000 km^2 (100 km x 100 km) (Harvey, 2002). Taxa that have been more commonly found to contain SRE representatives include:

- Onychophorans (velvet worms);
- Crustaceans (Isopoda);
- Arachnids (mygalomorph spiders, pseudoscorpions, opiliones, scorpions, schizomids);
- Myriapods (millipedes and centipedes);
- Molluscs (land snails); and
- Insects (hemipterans, grasshoppers, butterflies).

SRE invertebrate fauna taxa are generally found in sheltered, relatively mesic environments such as isolated habitats (e.g. boulder piles, isolated hills, dense patches of vegetation, gullies) and can include microhabitats within these environments such as deep leaf litter accumulation, large logs, under bark, cave areas and springs and permanent water bodies.

Many processes contribute to taxa being susceptible to short range endemism. Generally, these factors are related to the isolation of a species which can include the ability and opportunity to disperse, life history, physiology, habitat requirements, and habitat availability. Taxa that exhibit short range endemism generally exhibit poor dispersal, low growth rates, low fecundity and reliance on habitat types that are discontinuous (Harvey, 2002). Taxa that reside within easily isolated habitats surrounded by physical barriers such as islands, mountains, aquifers, lakes and caves are also more susceptible to becoming SRE species, often including additional taxa not otherwise generally forming SREs.

Taxa that exhibit short range endemism are particularly vulnerable to disturbance, either natural or anthropogenic, as they are reliant upon specialised and often restricted habitats (often moist)

(Framenau, et al., 2008). Short range endemic taxa are unable to disperse to *refugia* when their habitats are threatened or destroyed, thus making them a priority for conservation efforts.

The allocation of short range endemism status can be difficult due to the often incomplete taxonomic framework of many invertebrate groups and the often frequent need for substantial revision to enable accurate identification. Short Range Endemic status is assigned using the categories described in Table 1, based on the available information from the Western Australian Museum (WAM) database and discussion with appropriate taxonomic authorities for various invertebrate groups. Insufficient information exists for many invertebrate species due to specimens being juvenile, the wrong sex to allow identification, damaged, or inadequate taxonomic frameworks, precluding the assignment of SRE status.

Table 1 Short Range Endemic Status of Species

SRE Status	Definition
Confirmed	A confirmed SRE species. A known distribution of < 10,000 km^2 (after Harvey 2002). Taxonomy of the group is well known. The group is well represented in collections, or via comprehensive sampling.
Likely	Likely to be a SRE species based upon knowledge of the family/genus, where other closely related species show evidence of short range endemism. Where habitats containing the specimens show discontinuity within the landscape.
Possible	Based upon existing knowledge of the genus / family there is a possibility that the species may have a restricted range. Where habitats containing the specimens may show discontinuity within the landscape. Possible SRE species may be assigned one of the sub categories below: A. Data deficient i.e. new species, lack of distribution, taxonomic or collecting knowledge, juvenile specimens, wrong sex for identification B. Habitat indicators C. Morphology indicators D. Molecular evidence E. Research and expertise of WAM staff/taxonomic specialists
Widespread	Not a SRE, a wide ranging distribution of > 10,000 km^2

1.5 Conservation Legislation and Guidance Statements

Terrestrial SRE species are protected under State legislation via the newly enacted *Biodiversity Conservation* (BC) *Act* (2016) which came into force on 1st January 2019, replacing the outdated *Wildlife Conservation* (WC) *Act* (1950). The BC Act is aligned with the federal *Environment Protection and Biodiversity Conservation* (EPBC) *Act* (1999). The assessment of SRE fauna for Environmental Impact Assessment (EIA) is undertaken in Western Australia with regard to Technical Guidance – Sampling of short range endemic invertebrate fauna (EPA 2016).

At the State level, the BC Act provides a list of species that have special protection as species listed under Part 2 of the BC Act. This notice is updated periodically by the DBCA (formerly the Department of Parks and Wildlife (DPaW)) and the current list (January 2019) includes numerous SRE species from the Goldfields, Wheatbelt, South Coast, Murchison and Pilbara regions. Included in the list are crustaceans, arachnids and myriapods that are considered to be "Rare or Likely to become extinct,

as Critically Endangered fauna, or are declared to be fauna that is in need of special protection" (Appendix 1). In addition to the specially protected fauna, DBCA also maintains a list of Priority fauna that are considered to be of conservation significance, but do not meet the criteria for formal listing under the BC Act. The Priority fauna list is irregularly updated by DBCA and is now part of the BC Act.

The BC Act provides the ability for the state government of Western Australia to formally list Threatened Ecological Communities (TECs), along with threatening processes.

The EPBC Act protects both species and ecological communities. The most relevant listing for SRE fauna in Western Australia is the mygalomorph spider *Idiosoma nigrum* that occurs in the Wheatbelt region and is listed under the EPBC Act as Vulnerable.

1.6 Report Limitations and Exclusions

This study was limited to the written scope provided to the client by Invertebrate Solutions (28th April 2021) and in Section 1.1. This study was limited to the extent of information made available to Invertebrate Solutions at the time of undertaking the work. Information not made available to this study, or which subsequently becomes available may alter the conclusions made herein.

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

The opinions, conclusions and any recommendations in this report are based on assumptions made by Invertebrate Solutions described in this report (this section and throughout this report). Invertebrate Solutions disclaims liability arising from any of the assumptions being incorrect.

Invertebrate Solutions has prepared this report on the basis of information provided by CBH Group, Eco Logical Australia Pty Ltd and others (including Government authorities), which Invertebrate Solutions has not independently verified or checked beyond the agreed scope of work. Invertebrate Solutions does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

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

Species were identified to the lowest practical taxonomic level, taking into consideration that the taxonomic framework of many invertebrate groups is incomplete and often in need of substantial revision to enable accurate identification. Short Range Endemic status was assigned using the available information from the WAM database and discussion with appropriate taxonomic authorities for various invertebrate groups. Insufficient information exists for many invertebrate species due to specimens being juvenile, the wrong sex to allow identification, damaged, or inadequate taxonomic frameworks, precluding the assignment of SRE status.

Field surveys for SRE invertebrates require multiple seasonal surveys to fully record all species that may be present in an area, and in varying weather conditions. The current survey was undertaken in

a single season and additional surveys at different times of the year may record additional species. However, the combination of collection techniques and the intensity of the survey provides a high degree of certainty that majority of potential SRE invertebrates present within the Survey Area were recorded.

1.6.1 Survey Specific Limitations

The following specific comments are made with regard to project specific limitations for the Project:

- **Sampling effort** – The single-phase targeted survey included a detailed grid search of the entire Project Area by an experienced ecologist for burrows of mygalomorph spiders and searching under vegetation and organic debris for land snails. The very detailed nature of the survey provides a high degree of certainty that the majority of potential SRE invertebrates present at the time of survey were recorded from the Survey Area.
- **Timing** – The survey was undertaken in July, which is suitable for targeted surveys for mygalomorph spiders and land snails that can be observed throughout the year.
- **Methods** – A wide variety of collecting techniques were used including active searching (raking and leaf litter searching) providing a high degree of certainty that the majority of targeted potential SRE invertebrates present at the time of the survey were recorded from the Survey Area.
- **Habitats sampled** – All significant potential SRE habitats within the Survey Area were sampled using a combination of techniques.
- **Access to areas** – The entire area was able to be accessed, with no restrictions. All vegetated parts of the Project Area were able to be comprehensively surveyed.

2. Desktop Methods

Invertebrate Solutions undertook the following tasks for the desktop SRE and Conservation Significant Invertebrate assessment of the Project:

- SRE desktop assessment based upon the WAM Records;
- An assessment of the likelihood that SRE invertebrate species are present in the habitats located within the Project Area; and
- An assessment of potential conservation significant invertebrates that may occur in the region based upon DBCA and EPBC conservation listings.

The desktop assessment was undertaken with regard to the Technical Guidance – Sampling of short range endemic invertebrate fauna (EPA 2016).

2.1 SRE Desktop Methodology

A search of the WAM databases for Arachnids, Crustacea and Molluscs was undertaken for potential SRE taxa occurring in the Miling region (Desktop Study Area). In addition other published reports were examined where available. The desktop analysis was used to identify any potential SRE species that may occur in the Miling region and target those taxa during the subsequent targeted field survey of the Project Area.

2.1.1 Likelihood of SRE invertebrate occurrence

The likelihood of SRE invertebrate species occurring in the Project Area was assessed using a combination of regional and local botanical and landform information, and database searches including:

- Analysis of published and unpublished reports concerning SRE invertebrate from the region;
- Botanical and vegetation mapping and other information available for the Project Area;
- Results of a Protected Matters Search from the Federal Government's Department of the Environment and Energy (DAWE) website; and
- Records of fauna held by the WAM.

Based on the analysis of all available information within the Project Area and from the broader Desktop Study Area, each SRE and Conservation Significant invertebrate species was assigned a level of likelihood to occur within the Project Area of either 'Very Low', 'Low', 'Moderate', 'High', or 'Definite'.

Table 2 SRE species likelihood of occurrence definitions

SRE Species Likelihood of occurrence	Definition
Definite	The species is confirmed to occur within the Project Area
High	Habitat for the species is known to occur within the Project Area and known current records of the species are within 20 km
Moderate	Habitat for the species is known to occur within the Project Area and known current records of the species are within 50 km
Low	The species has been recorded from within 50 km, however, no habitat is present for the species within the Project Area or the records are historical.
Very low	No habitat exists for the species within the Project Area and no records of the species are within 50 km or the distribution of the species is known well enough to exclude its presence within the Project Area.

2.2 SRE Survey Methodology

The SRE survey was undertaken using a combination of sampling techniques and employed both systematic (timed active searching) and opportunistic (litter collection and/or transect) sampling. Where applicable, Project Area search sites were chosen to maximise the likelihood of identifying SREs and habitat (which typically includes south-facing slopes, gullies, rocky outcrops, dense patches of trees and permanent water bodies).

2.2.1 Active searching

Active searching was undertaken across the entire Project Area, and consisted of searching soil and/or leaf litter from suitable habitat areas within each site (millipedes and snails); the raking of leaf litter (land snails, mygalomorph burrows); examination of vegetative material below logs and bark (land snails), and an examination of areas of rock outcrops and associated rock piles.

2.3 Sorting and curation

Sorting for all SRE samples occurred in the Invertebrate Solutions laboratory using a Leica M125 100x dissecting microscope and was undertaken by Dr Timothy Moulds. Each taxon was identified to the lowest practical taxonomic rank using published keys and descriptions, and the number of each taxon recorded. Each identified taxon was kept in a separate labelled vial and assigned a specimen tracking code. Specimen and site collection data were recorded in an Excel spreadsheet. At the conclusion of the study, all specimens will be lodged at the Western Australian Museum.

2.4 Taxonomy and Nomenclature

Identification of collected invertebrate material was undertaken by Dr Timothy Moulds. Invertebrate groups collected that have no SRE representatives such as ants and flying insects were not identified or reported. The presence of winged adults in most insect groups suggests that they are more capable dispersers and are therefore less likely to have a restricted range.

The level of specimen identification achievable is dependent on the level of taxonomic knowledge and expertise available. The majority of the taxonomic expertise relating to SRE taxa resides with the staff of the WAM, while some groups are also worked on by researchers within other government departments and academic institutions. Taxonomic treatments are available for some invertebrate groups, but not for all. The EPA expects that invertebrates collected for identification will be identified to the lowest taxonomic level possible. Ideally, this is to the species level, however there will be limits due to the nature of specimens and the availability of taxonomic keys.

2.5 Short Range Endemic Status

Taxonomic groups known to contain SRE representatives were examined in more detail to determine if the records in this study are potentially restricted forms. SRE status was assigned after comparison with other close relatives in the group and current knowledge on their distribution and ecology, where known.

3. Results

3.1 SRE Invertebrates of the Wheatbelt region

Whilst there are few systematic surveys for SRE species within the Wheatbelt region of Western Australia, the area has been the subject of numerous invertebrate collections by researchers from the WAM and Universities over the past 80 years or more. This has resulted in a reasonable understanding of the region's fauna within a highly fragmented agricultural landscape. The highly conservation significant *Idiosoma nigrum* (Vulnerable EPBC Act) is now known to be restricted to the central northern Wheatbelt (Rix et al. 2018), along with several other conservation significant mygalomorph spiders from various portions of the Wheatbelt. *Idiosoma* species are also commonly known as Shield-Backed Trapdoor Spiders and have distinctive hardened sigillate abdomens (Plate 1A) and make a 'moustache' arrangement of leaves or twigs around the entrance of their burrows (Plate 1B) to aid in the detection of passing prey.

Plate 1 A. Adult female *Idiosoma* showing sigillate abdomen. B. Distinctive 'moustache' arrangement of leaves at burrow entrance

There are no previous SRE surveys in the local vicinity of Miling or the Project Area. The previous studies in the region are almost exclusively related to ad hoc surveys of remnant vegetation, usually nature reserves, with little in the way of broad scale systematic data available. Although, the recent work on the mygalomorph spider fauna of Western Australia has greatly increased our knowledge of some specific families and genera, compared with the general SRE fauna. Many species remain to be properly documented and the taxonomy of many groups remains unresolved.

3.2 Conservation Significant and SRE Fauna in the Desktop Study Area

A list of conservation significant fauna for the Desktop Study Area was compiled from the DBCA Specially Protected Fauna Notice 2019 (DBCA 2019) and the DAWE's Protected Matters Search Tool (PMST) with a 50 km radius around the Project area. SRE species that are listed under the BC Act and/or the EPBC Act and are likely to occur or have known habitat within the Desktop Study Area are shown in Table 3 along with their conservation code. The PMST results listed a single invertebrate, the mygalomorph spider *Idiosoma nigrum* as having the potential for habitat based upon bioclimatic modelling to occur within the Project Area. The species was once considered wide ranging

throughout much of the Western Australian Wheatbelt and into the arid zone prior to a revision by Rix et al. (2018) that split *I. nigrum* into 15 species and restricts true *I. nigrum* to a small portion of the northern Wheatbelt including Wongan Hills from where it was first described (Main 1952). The species is now known to occur roughly within a polygon bounded by Bolgart, New Norcia, Walebing, and Bindi Bindi along its western margin, east to Koorda along its northern margin, south to Durokoppin and Kellerberrin along its eastern margin, and from Kellerberrin to Bolgart along its southern margin (Rix et al. 2018, Plate 6).

A full description of the DBCA and EPBC conservation codes are shown in Appendix 1 and Appendix 2 respectively. The full list of species obtained from the PMST search is shown in Appendix 2.

A search of the WAM databases for potential SRE taxa occurring in the broader Desktop Study Area centred on the Project was undertaken (WAM 2021a, b, c). The results of these were filtered for SRE species as shown in Table 3. Definitions for SRE status are found in Table 1. The records held by the WAM are not exhaustive and represent only specimens within the WAM collections that have been databased. The Entomology, Mollusc and Crustacean collections remain largely un-databased. Specimens identified to genus level only have been excluded from the analysis as it is impossible to determine if they represent a SRE taxa.

The Desktop Study Area contains a single Confirmed SRE species from WAM records (Table 3) and this species is summarised below:

- A mygalomorph spider – *Idiosoma nigrum* - BC Act Endangered / EPBC Act Vulnerable

The Desktop Study Area contains a single Likely SRE species from WAM records (Table 3) and this species is summarised below:

- A millipede – *Antichiropus sp. 'hamatus'*

The remaining species identified from desktop resources were found to be widespread.

Whilst 21 conservation listed invertebrate species occur within the entire Wheatbelt region, within the Miling area only two of these species have any potential habitat or distributions in the local region (Table 3), with the remaining species found several hundreds of kilometres away in the broader Wheatbelt region:

- A fairy shrimp - *Branchinella simplex* – DBCA Priority 1
- A fairy shrimp - *Branchinella denticulata*– DBCA Priority 3

Of these two conservation significant species none are known to be present within the Desktop Project Area.

Table 3 SRE Invertebrates in WAM databases and Conservation Significant invertebrates recorded from or with potential habitat within the Project area.

Higher Classification	Genus and Species	SRE status	DBCA / BC Act Conservation Status	EPBC Conservation Status	Likely habitat present in Project area	Desktop likelihood of species within the Project Area
Gastropoda:						
Bothriembryontidae	*Bothriembryon sp. 'Walebing'*	Possible A	-	-	Not Present	Low
Crustacea:						
Thamnocephalidae	*Branchinella denticulata*	Widespread	Priority 3	-	Not present	Very Low
	Branchinella simplex	Widespread	Priority 1	-	Not Present	Very Low
Arachnida:						
Araneae: Mygalomorphae						
Idiopidae	*Idiosoma nigrum*	Confirmed	Endangered	Vulnerable	Present	Moderate
Diplopoda						
Polydesmida						
Paradoxosomatidae	*Antichiropus sp. 'hamatus'*	Likely	-	-	Not Present	Low

3.3 SRE Habitat in Project Area

The vegetation units and condition mapping identified in the flora and vegetation assessment (Eco Logical Australia 2021) were used to assess the Project Area for potential SRE habitat. The vegetation condition is fragmented and classified as being in Very Good to Completely Degraded, with several old unsealed vehicle access tracks present through the vegetated areas. The vegetation mapping undertaken by Eco Logical Australia (2021) show that the Project Area is comprised of six vegetation types, with samphire on the north western edge of the Project area and a mix of *Acacia* and *Hakea* shrubland and *Eucalyptus loxophleba* open woodland (Eco Logical Australia 2021). The samphire habitat that is seasonally inundated provides Nil habitat for SRE mygalomorph spiders, whilst the remaining habitat is considered to provide extremely limited potential SRE habitat due to the historical ground disturbance observed throughout during the field assessment (refer Section 3.4).

3.4 SRE Field Survey Results

The targeted field survey recorded no SRE or conservation significant invertebrates from the Project Area.

One abandoned burrow of the widespread, non conservation significant mygalomorph spider *Gaius villosus* were recorded (Figure 1, Plate 5) from within the Project area. This species is widespread in inland Western Australia from the southern Pilbara to near the south coast.

The Project Area was found to be disturbed from minor earthworks, dumping of building waste and vehicle tracks in most areas (Plate 2, Plate 3, and Plate 4) that have degraded the potential habitat for SRE and conservation significant invertebrate species. Large areas in the southern portion of the Project area are subject to salinisation and seasonal inundation that provides no habitat for mygalomorph spiders.

Plate 2 Previous ground disturbance within the Project area

Plate 3 Previous ground disturbance within the Project area

Plate 4 Typical open woodland subject to disturbance within the Project Area

Plate 5 Burrow of the widespread mygalomorph spider *Gaius villosus* abandoned within the Project Area

4. Discussion

4.1 SRE Invertebrate Assessment

The broader Desktop Study Area contains a single Confirmed SRE species with potential habitat present within the Project area:

- A mygalomorph spider – *Idiosoma nigrum* - BC Act Endangered / EPBC Act Vulnerable.

The remainder of the species were found to be widespread or no potential habitat was present within the Project area.

The Confirmed SRE species *Idiosoma nigrum* is conservation significant, although no other non SRE but conservation significant species occur, or have habitat within the Desktop Study Area.

This species is discussed in detail in section 4.1.1.

4.1.1 Arachnida: Mygalomorphae

Idiosoma nigrum – Endangered (DBCA) / Vulnerable (EPBC Act)

Idiosoma nigrum, commonly known as the 'Shield-backed trapdoor spider', is the only spider in Australia currently provided protection at a Federal level under the EPBC Act which considers the species as Vulnerable. The species was once considered wide ranging throughout much of the Western Australian Wheatbelt and into the arid zone prior to a revision by Rix et al. (2018) that split *I. nigrum* into 15 species and restricts true *I. nigrum* to a small portion of the northern Wheatbelt including Wongan Hills from where it was first described (Main 1952). The species is now known to occur roughly within a polygon bounded by Bolgart, New Norcia, Walebing, and Bindi Bindi along its western margin, east to Koorda along its northern margin, south to Durokoppin and Kellerberrin along its eastern margin, and from Kellerberrin to Bolgart along its southern margin (Rix et al. 2018, Plate 4).

The species is known to occur in the vicinity of Miling and the Project Area, although it is likely it occurs within undisturbed portions of remnant vegetation away from the Miling townsite (Rix et al. 2018).

This species was considered using desktop information a Moderate Likelihood of occurrence within the Project area, however, the species was not recorded from the Project Area during the targeted field survey in July 2021 and is not considered to occur there.

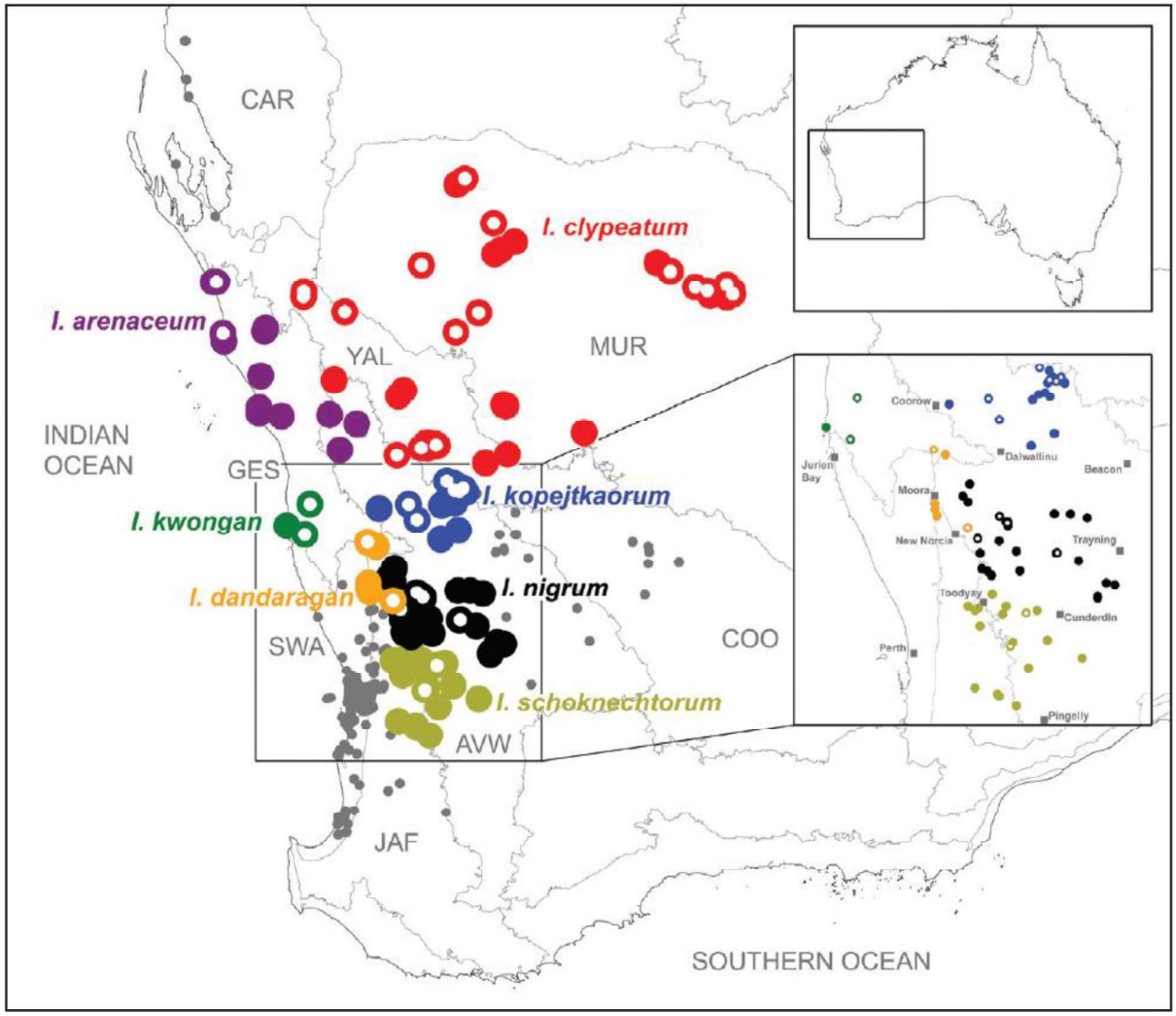


Plate 6 Distribution of *Idiosoma* spp. in the Wheatbelt and pastoral regions of Western Australia (After Rix et al. 2018, Figure 374)

5. Conclusions

The broader Desktop Study Area contains a single Confirmed SRE species located outside of the Project Area:

- A mygalomorph spider – *Idiosoma nigrum* - BC Act Endangered / EPBC Act Vulnerable.

The Confirmed SRE species *Idiosoma nigrum* is conservation significant, although no other non SRE but conservation significant species occur, or have habitat within the Desktop Study Area.

The targeted SRE and conservation significant invertebrate survey undertaken on the entire Project Area on 22nd July 2021 recorded no SRE or conservation significant invertebrates. The Project Area was found to be disturbed from minor earthworks in most areas, and further disturbed by vehicle tracks that have degraded the potential habitat for SRE and conservation significant invertebrate species. The samphire habitat within the Project area is subject to seasonal inundation and salinisation and provides no habitat for mygalomorph spiders including *Idiosoma nigrum*.

No SRE or conservation significant invertebrates are anticipated to occur within the Project Area and no further surveys are required to be undertaken to meet Technical Guidance – Sampling of short range endemic invertebrate fauna (EPA 2016).

6. References

Eco Logical Australia. (2021). Miling Grain Receival Site Expansion: Flora and fauna survey. Unpublished report to Co-operative Bulk Handling Pty, 90p.

EPA (2016). Technical guidance. Sampling of short range endemic invertebrate fauna. Environmental Protection Authority: Perth. 35 pp.

Framenau, V.W., Moir, M.L. & Harvey, M.S. (2008) Terrestrial Invertebrates of the south coast NRM region of Western Australia: short-range endemics in Gondwanan relictual habitats. Unpublished Report to the Southcoast Natural Resource Management Inc.

Harvey, M.S. (2002). Short-range endemism in the Australian fauna: some examples from non-marine environments. Invertebrate Systematics. 16: 555–570.

Main, B. Y. (1986). Trapdoors of Australian mygalomorph spiders: protection or predation? Actas X Congreso International de Arachnologia, Jaca, España 1, 95–102.

Rix, M.G., Raven R.J., Main, B.Y., Harrison, S.E., Austin A.D., Cooper S.J.B. and Harvey M.S. (2017). The Australasian spiny trapdoor spiders of the family Idiopidae (Mygalomorphae : Arbanitinae): a relimitation and revision at the generic level. Invertebrate Systematics, 2017, 31, 566–634 http://dx.doi.org/10.1071/IS16065

Rix, M.G., Huey J.A., Cooper S.J.B., Austin A.D., Harvey M.S. (2018). Conservation systematics of the shield-backed trapdoor spiders of the nigrum-group (Mygalomorphae, Idiopidae, *Idiosoma*): integrative taxonomy reveals a diverse and threatened fauna from south-western Australia. ZooKeys 756: 1–121. https://doi.org/10.3897/zookeys.756.24397

Western Australian Museum (WAM). (2021a). Arachnida and Myriapoda database search July 2021.

Western Australian Museum (WAM). (2021b). Crustacea database search July 2021.

Western Australian Museum (WAM). (2021c). Mollusc database search July 2021.

Appendix 1

DBCA Conservation Categories

Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

CONSERVATION CODES

For Western Australian Flora and Fauna

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

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

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

T **Threatened species**

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

Threatened fauna is that subset of 'Specially Protected Fauna' listed under schedules 1 to 3 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* for Threatened Fauna.

Threatened flora is that subset of 'Rare Flora' listed under schedules 1 to 3 of the *Wildlife Conservation (Rare Flora) Notice 2018* for Threatened Flora.

The assessment of the conservation status of these species is based on their national extent and ranked according to their level of threat using IUCN Red List categories and criteria as detailed below.

CR **Critically endangered species**

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

Listed as critically endangered under section 19(1)(a) of the BC Act in accordance with the criteria set out in section 20 and the ministerial guidelines. Published under schedule 1 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* for critically endangered fauna or the *Wildlife Conservation (Rare Flora) Notice 2018* for critically endangered flora.

EN **Endangered species**

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

Listed as endangered under section 19(1)(b) of the BC Act in accordance with the criteria set out in section 21 and the ministerial guidelines. Published under schedule 2 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* for endangered fauna or the *Wildlife Conservation (Rare Flora) Notice 2018* for endangered flora.

VU **Vulnerable species**

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

Listed as vulnerable under section 19(1)(c) of the BC Act in accordance with the criteria set out in section 22 and the ministerial guidelines. Published under schedule 3 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* for vulnerable fauna or the *Wildlife Conservation (Rare Flora) Notice 2018* for vulnerable flora.

Extinct species

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

EX Extinct species

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

Published as presumed extinct under schedule 4 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* for extinct fauna or the *Wildlife Conservation (Rare Flora) Notice 2018* for extinct flora.

EW Extinct in the wild species

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

Currently there are no threatened fauna or threatened flora species listed as extinct in the wild. If listing of a species as extinct in the wild occurs, then a schedule will be added to the applicable notice.

Specially protected species

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

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

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).

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

Published as migratory birds protected under an international agreement under schedule 5 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018*.

CD Species of special conservation interest (conservation dependent fauna)

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

Published as conservation dependent fauna under schedule 6 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018*.

OS Other specially protected species

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

Published as other specially protected fauna under schedule 7 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018*.

P Priority species

Possibly threatened species that do not meet survey criteria, or are otherwise data deficient, are added to the Priority Fauna or Priority Flora Lists under Priorities 1, 2 or 3. These three categories are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as threatened fauna or flora.

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

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

1 Priority 1: Poorly-known species

Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.

2 Priority 2: Poorly-known species

Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.

3 Priority 3: Poorly-known species

Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.

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

(a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection but could be if present circumstances change. These species are usually represented on conservation lands.
(b) Near Threatened. Species that are considered to have been adequately surveyed and that are close to qualifying for vulnerable but are not listed as Conservation Dependent.
(c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

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

Appendix 2

Protected Matters Search Tool Results

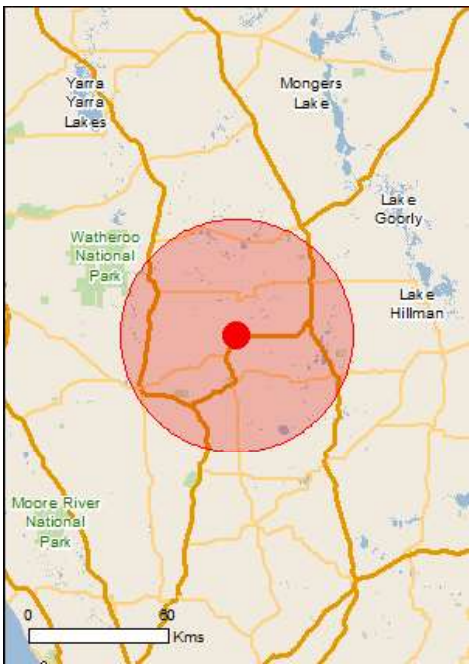
EPBC Act Protected Matters Report

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

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

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

Report created: 28/07/21 12:44:53



Coordinates
Buffer: 50.0Km

Summary

Matters of National Environmental Significance

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

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	2
Listed Threatened Species:	71
Listed Migratory Species:	8

Other Matters Protected by the EPBC Act

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

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

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

Commonwealth Land:	1
Commonwealth Heritage Places:	None
Listed Marine Species:	14
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

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

State and Territory Reserves:	30
Regional Forest Agreements:	None
Invasive Species:	19
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Listed Threatened Ecological Communities [Resource Information]

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

Name	Status	Type of Presence
Banksia Woodlands of the Swan Coastal Plain ecological community	Endangered	Community likely to occur within area
Eucalypt Woodlands of the Western Australian Wheatbelt	Critically Endangered	Community likely to occur within area

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calyptorhynchus latirostris Carnaby's Cockatoo, Short-billed Black-Cockatoo [59523]	Endangered	Breeding known to occur within area
Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat may occur within area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat known to occur within area
Pezoporus occidentalis Night Parrot [59350]	Endangered	Species or species habitat may occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area
Fish		
Nannatherina balstoni Balston's Pygmy Perch [66698]	Vulnerable	Species or species habitat likely to occur within area
Mammals		
Dasyurus geoffroii Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat likely to occur within area
Phascogale calura Red-tailed Phascogale, Red-tailed Wambenger, Kenngoor [316]	Vulnerable	Species or species habitat likely to occur within area
Other		
Idiosoma nigrum Shield-backed Trapdoor Spider, Black Rugose	Vulnerable	Species or species

Name	Status	Type of Presence
Trapdoor Spider [66798]		habitat known to occur within area
Plants		
Acacia aprica Blunt Wattle [64821]	Endangered	Species or species habitat likely to occur within area
Acacia aristulata Watheroo Wattle [64822]	Endangered	Species or species habitat known to occur within area
Acacia ataxiphylla subsp. magna Large-fruited Tammin Wattle [64823]	Endangered	Species or species habitat may occur within area
Acacia cochlocarpa subsp. cochlocarpa Spiral-fruited Wattle [23877]	Endangered	Species or species habitat known to occur within area
Acacia cochlocarpa subsp. velutinosa Velvety Spiral Pod Wattle [65112]	Critically Endangered	Species or species habitat likely to occur within area
Acacia denticulosa Sandpaper Wattle [20600]	Vulnerable	Species or species habitat known to occur within area
Acacia pharangites Wongan Gully Wattle [20281]	Endangered	Species or species habitat known to occur within area
Acacia pygmaea Dwarf Rock Wattle [56768]	Endangered	Species or species habitat known to occur within area
Acacia recurvata Recurved Wattle [64825]	Endangered	Species or species habitat likely to occur within area
Acacia vassalii Vassal's Wattle [6144]	Endangered	Species or species habitat known to occur within area
Andersonia gracilis Slender Andersonia [14470]	Endangered	Species or species habitat may occur within area
Banksia fuscobractea Dark-bract Banksia [83059]	Critically Endangered	Species or species habitat may occur within area
Banksia serratuloides subsp. serratuloides Southern Serrate Dryandra [82768]	Vulnerable	Species or species habitat may occur within area
Caladenia drakeoides Hinged Dragon Orchid [68687]	Endangered	Species or species habitat known to occur within area
Chamelaucium sp. Gingin (N.G.Marchant 6) Gingin Wax [88881]	Endangered	Species or species habitat may occur within area
Chorizema humile Prostrate Flame Pea [32573]	Endangered	Species or species habitat known to occur within area
Conospermum densiflorum subsp. unicephalatum One-headed Smokebush [64871]	Endangered	Species or species habitat known to occur within area
Conostylis wonganensis Wongan Conostylis [10906]	Endangered	Species or species

Name	Status	Type of Presence
		habitat likely to occur within area
Darwinia acerosa Fine-leaved Darwinia [9004]	Endangered	Species or species habitat known to occur within area
Dasymalla axillaris Native Foxglove [38829]	Critically Endangered	Species or species habitat likely to occur within area
Daviesia dielsii Diels' Daviesia [19617]	Endangered	Species or species habitat known to occur within area
Daviesia euphorbioides Wongan Cactus [3477]	Endangered	Species or species habitat known to occur within area
Eleocharis keigheryi Keighery's Eleocharis [64893]	Vulnerable	Species or species habitat may occur within area
Eremophila koobabbiensis Koobabbie Eremophila, Koobabbie Poverty Bush [86684]	Critically Endangered	Species or species habitat may occur within area
Eremophila nivea Silky Eremophila [14431]	Endangered	Species or species habitat may occur within area
Eremophila pinnatifida Pinnate-leaf Eremophila [64894]	Endangered	Species or species habitat known to occur within area
Eremophila resinosa Resinous Eremophila [11735]	Endangered	Species or species habitat likely to occur within area
Eremophila scaberula Rough Emu Bush [16729]	Endangered	Species or species habitat known to occur within area
Eremophila ternifolia Wongan Eremophila [2293]	Endangered	Species or species habitat known to occur within area
Eremophila vernicosa Resinous Poverty Bush [64596]	Vulnerable	Species or species habitat likely to occur within area
Eremophila viscida Varnish Bush [2394]	Endangered	Species or species habitat known to occur within area
Eucalyptus absita Badgingarra Box [24260]	Endangered	Species or species habitat may occur within area
Eucalyptus beardiana Beard's Mallee [18933]	Vulnerable	Species or species habitat may occur within area
Eucalyptus crispata Yandanooka Mallee [24268]	Vulnerable	Species or species habitat may occur within area
Eucalyptus impensa Eneabba Mallee [56711]	Endangered	Species or species habitat may occur within area
Eucalyptus leprophloia Scaly Butt Mallee, Scaly-butt Mallee [56712]	Endangered	Species or species habitat may occur within

Name	Status	Type of Presence
		area
Eucalyptus pruiniramis Midlands Gum, Jingymia Gum [56403]	Endangered	Species or species habitat known to occur within area
Eucalyptus recta Silver Mallet [56430]	Endangered	Species or species habitat known to occur within area
Eucalyptus rhodantha Rose Mallee [9362]	Vulnerable	Species or species habitat known to occur within area
Frankenia conferta Silky Frankenia [6074]	Endangered	Species or species habitat known to occur within area
Gastrolobium appressum Scale-leaf Poison [7358]	Vulnerable	Species or species habitat known to occur within area
Gastrolobium hamulosum Hook-point Poison [9212]	Endangered	Species or species habitat known to occur within area
Goodenia arthrotricha [12448]	Endangered	Species or species habitat known to occur within area
Grevillea christineae Christine's Grevillea [64520]	Endangered	Species or species habitat known to occur within area
Grevillea dryandroides subsp. dryandroides Phalanx Grevillea [64646]	Endangered	Species or species habitat known to occur within area
Grevillea dryandroides subsp. hirsuta Hairy Phalanx Grevillea [64577]	Endangered	Species or species habitat likely to occur within area
Grevillea pythara Pythara Grevillea [64525]	Endangered	Species or species habitat known to occur within area
Gyrostemon reticulatus Net-veined Gyrostemon [8491]	Critically Endangered	Species or species habitat likely to occur within area
Haloragis platycarpa Broad-fruited Haloragis [15371]	Critically Endangered	Species or species habitat known to occur within area
Hemiandra gardneri Red Snakebush [7945]	Endangered	Species or species habitat known to occur within area
Jacksonia pungens Pungent Jacksonia [64920]	Endangered	Species or species habitat known to occur within area
Lysiosepalum abollatum Woolly Lysiosepalum [83216]	Critically Endangered	Species or species habitat known to occur within area
Melaleuca sciotostyla Wongan Melaleuca [24324]	Endangered	Species or species habitat known to occur within area
Microcorys eremophiloides Wongan Microcorys [3498]	Vulnerable	Species or species habitat known to occur within area

Name	Status	Type of Presence
Philotheca wonganensis Wongan Eriostemon [64945]	Endangered	Species or species habitat known to occur within area
Rhagodia acicularis Wongan Rhagodia [11145]	Vulnerable	Species or species habitat known to occur within area
Roycea pycnophylloides Saltmat [21161]	Endangered	Species or species habitat likely to occur within area
Stylidium coroniforme subsp. coroniforme Wongan Hills Triggerplant, Wongan Triggerplant [85016]	Endangered	Species or species habitat likely to occur within area
Synaphea quartzitica Quartz-loving Synaphea [64978]	Endangered	Species or species habitat known to occur within area
Verticordia staminosa subsp. staminosa Wongan Featherflower [55825]	Endangered	Species or species habitat likely to occur within area
Reptiles		
Egernia stokesii badia Western Spiny-tailed Skink, Baudin Island Spiny-tailed Skink [64483]	Endangered	Species or species habitat known to occur within area

Listed Migratory Species [Resource Information]

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

Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat may occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land -

Listed Marine Species [Resource Information]

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

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Chrysococcyx osculans Black-eared Cuckoo [705]		Species or species habitat known to occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat may occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat likely to occur within area
Thinornis rubricollis Hooded Plover [59510]		Species or species habitat known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat may occur within area

Extra Information

State and Territory Reserves [Resource Information]

Name	State
Damboring	WA
Gunyidi	WA
Jocks Well	WA
Lake Hinds	WA
Long Pool	WA
Manaling	WA
Martinjinni	WA
Merewana	WA
NTWA Bushland covenant (0058)	WA
NTWA Bushland covenant (0059)	WA
NTWA Bushland covenant (0066)	WA
NTWA Bushland covenant (0115)	WA
Namban	WA
Nugadong	WA
Unnamed WA15312	WA
Unnamed WA21175	WA
Unnamed WA23179	WA
Unnamed WA23313	WA
Unnamed WA26575	WA
Unnamed WA28710	WA
Unnamed WA28863	WA
Unnamed WA38401	WA
Unnamed WA39322	WA
Unnamed WA41042	WA
Unnamed WA43811	WA
Unnamed WA45337	WA
Unnamed WA47694	WA
Unnamed WA52583	WA
Watheroo	WA
Wongan Hills	WA

Invasive Species [Resource Information]

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

Name	Status	Type of Presence
Birds		
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur

Name	Status	Type of Presence within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Streptopelia senegalensis Laughing Turtle-dove, Laughing Dove [781]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Mammals		
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Capra hircus Goat [2]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Carrichtera annua Ward's Weed [9511]		Species or species habitat may occur within area
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species habitat may occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat may occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Tamarix aphylla Athel Pine, Athel Tree, Tamarisk, Athel Tamarisk, Athel Tamarix, Desert Tamarisk, Flowering Cypress, Salt Cedar [16018]		Species or species habitat likely to occur within area

Caveat

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

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

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

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

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

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

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

- migratory and
- marine

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

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

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

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

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

Coordinates

-30.4646 116.3789

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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