3.5 HYDROLOGY

The survey area occurs within the Busselton Coast basin, specifically within the Boyanup catchment. The Buayanyup River (a minor tributary) runs north through the centre of the survey area, leading to the delta approximately 15 km north on the Busselton coast (**Figure 7**). No Ramsar wetlands are located within the survey or study areas, with the closest known Ramsar wetland, "Vasse and Wonnerup System" located approximately 17 km north-east of the survey area, also within the Busselton Coast basin, within the Vasse Wonnerup Estuary Catchment (DCCEW 2019).

3.5.1 Geomorphic Wetlands

The Geomorphic Wetlands of the Swan Coastal Plain dataset displays the location, boundary, geomorphic classification (wetland type) and management category of wetlands on the Swan Coastal Plain. Wetland management categories are based on their ecological, hydrological and geomorphological significance, and the degree of disturbance that has occurred. The three Wetland Management Categories on the Swan Coastal Plain can be summarised as follows:

- Conservation Category (CC) – wetlands that support a high level of ecological attributes and functions (generally having intact vegetation and natural hydrological processes), or that have a reasonable level of functionality and are representative of wetland types that are rare or poorly protected.
- Resource Enhancement (RE) – wetlands that have been modified (degraded) but still support substantial ecological attributes (wetland dependant vegetation covering more than 10%) and functions (hydrological properties that support wetland dependent vegetation and associated fauna) and have some potential to be restored to CC quality. Typically, such wetlands still support some elements of the original native vegetation, and hydrological function.
- Multiple Use (MU) – wetlands that are assessed as possessing few remaining ecological attributes and functions. While such wetlands can still play an important role in regional or landscape ecosystem management, including water management, they are considered to have low intrinsic ecological value. Typically, they have very little or no native vegetation remaining (less than 10%).

According to the Geomorphic Wetlands Swan Coastal Plain dataset, no geomorphic wetlands occur within the survey area; however, 49 occur within the study area. Of these 49 wetlands, 14 are considered conservation category with the closest located 1.6 km south of the survey area (**Figure 7**).
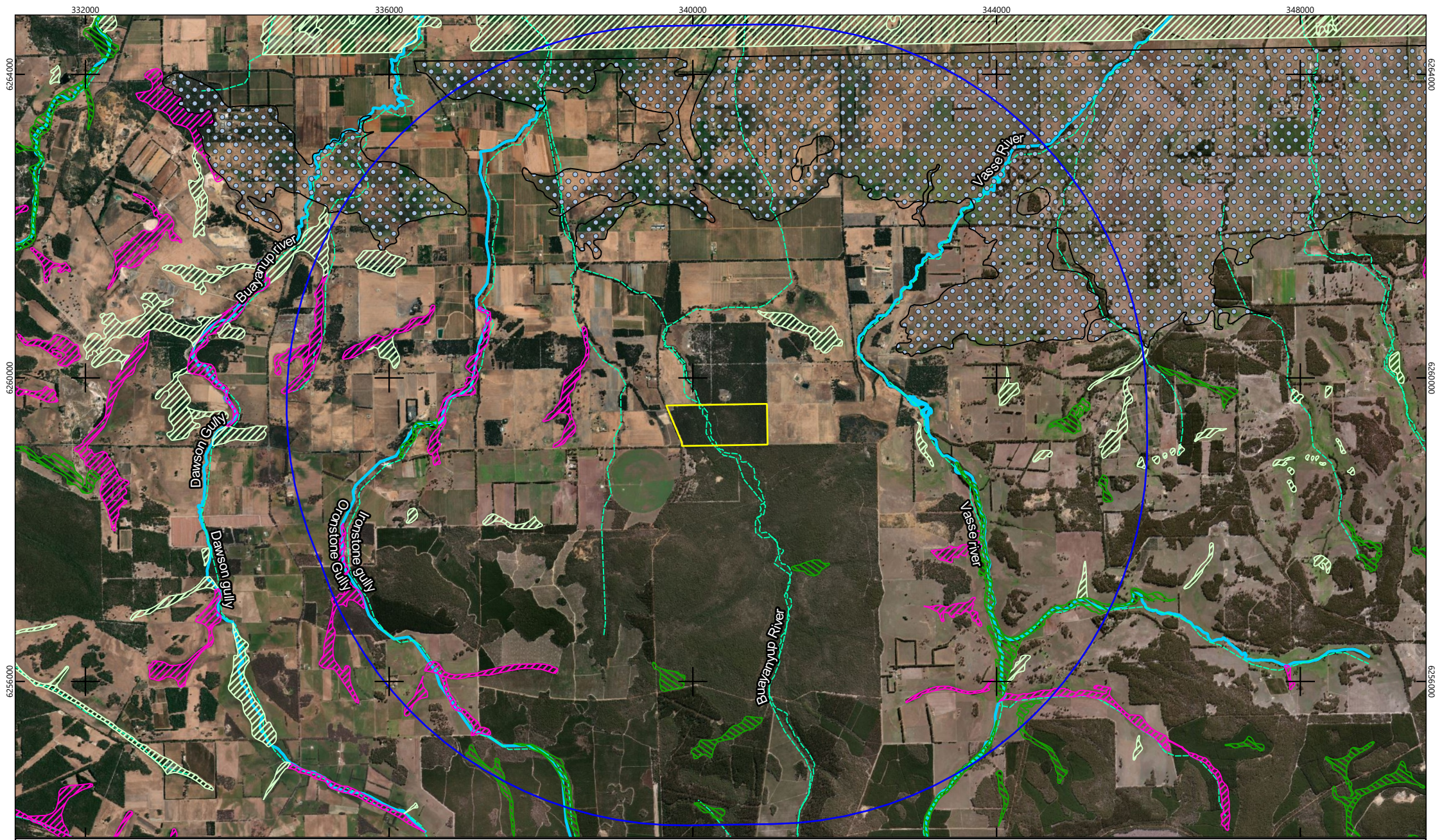
Figure 7 - Hydrology and Geomorphic Wetlands

GDA 2020 / MGA Zone 50

0   1   2   3   4 km

Legend

Survey Area

Study Area

Geomorphic Wetlands

Conservation

Resource Enhancement

Multiple Use

Not Assessed

Drainage

Major

Minor

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3.5.2 Groundwater Dependent Vegetation

Groundwater dependent ecosystems (GDEs) are those that require access to groundwater to meet some or all of their water requirements to maintain their biotic communities, ecological processes and ecosystem services they provide (Clifton *et al.* 2007; Tomlinson 2011).

The functioning and composition of GDEs are often highly responsive to changes in groundwater availability (Murray *et al.* 2003). Therefore, the groundwater regime is a key factor influencing the composition of flora and fauna, ecological processes, and ecosystem services (Hatton and Evans 1998; Evans *et al.* 2001).

Key elements of the groundwater regime that influence the health of GDEs (and the groundwater dependent vegetation (GDV) occurring within them) in relation to vegetation are:

- Groundwater level: groundwater-dependent plants require groundwater or the associated capillary fringe to be at least episodically or periodically within the root zone
- Groundwater flux: the rate of groundwater flow needs to be sufficient to maintain plant water status
- Groundwater quality: tolerance to changes in groundwater quality, such as pH and salinity, varies between plant species and is also dependent upon other environmental factors (Evans *et al.* 2001).

Phreatophytes, or groundwater-dependent plants, can be categorised as either:

- Obligate phreatophytes: plants that are completely or highly dependent on groundwater. This reliance can be continual, seasonal or episodic. Obligate phreatophytes are highly sensitive to changes in groundwater regime and will respond negatively to significant or rapid groundwater drawdown.
- Facultative phreatophytes: plants that utilise groundwater opportunistically, most notably during times of drought (Lamontagne *et al.* 2005).

The Groundwater Dependent Ecosystems Atlas (BoM 2022b) is sourced from National and Regional assessments to determine the presence or potential presence of groundwater/ecosystem interactions, classified as either a;

- Known GDE
- High potential GDE
- Moderate potential GDE
- Low potential GDE
- Unclassified GDE.

A total of 23 potential GDEs (from National Assessment) have been mapped within the study area, nine of which are considered "High potential" and 14 considered to be of "Moderate potential" as GDEs (**Figure 8**). Of these, two occur within the survey area; one "Moderate potential GDE" occurring along the Buayanyup River and one "High potential GDE" occurring to the east of the survey area, occupying 7.00 ha (10.69%) and 14.78 ha (22.56%) of the survey area, respectively (**Figure 8**).

Figure 8 - Groundwater Dependent Ecosystems

GDA 2020 / MGA Zone 50

0 1 2 3 4 km
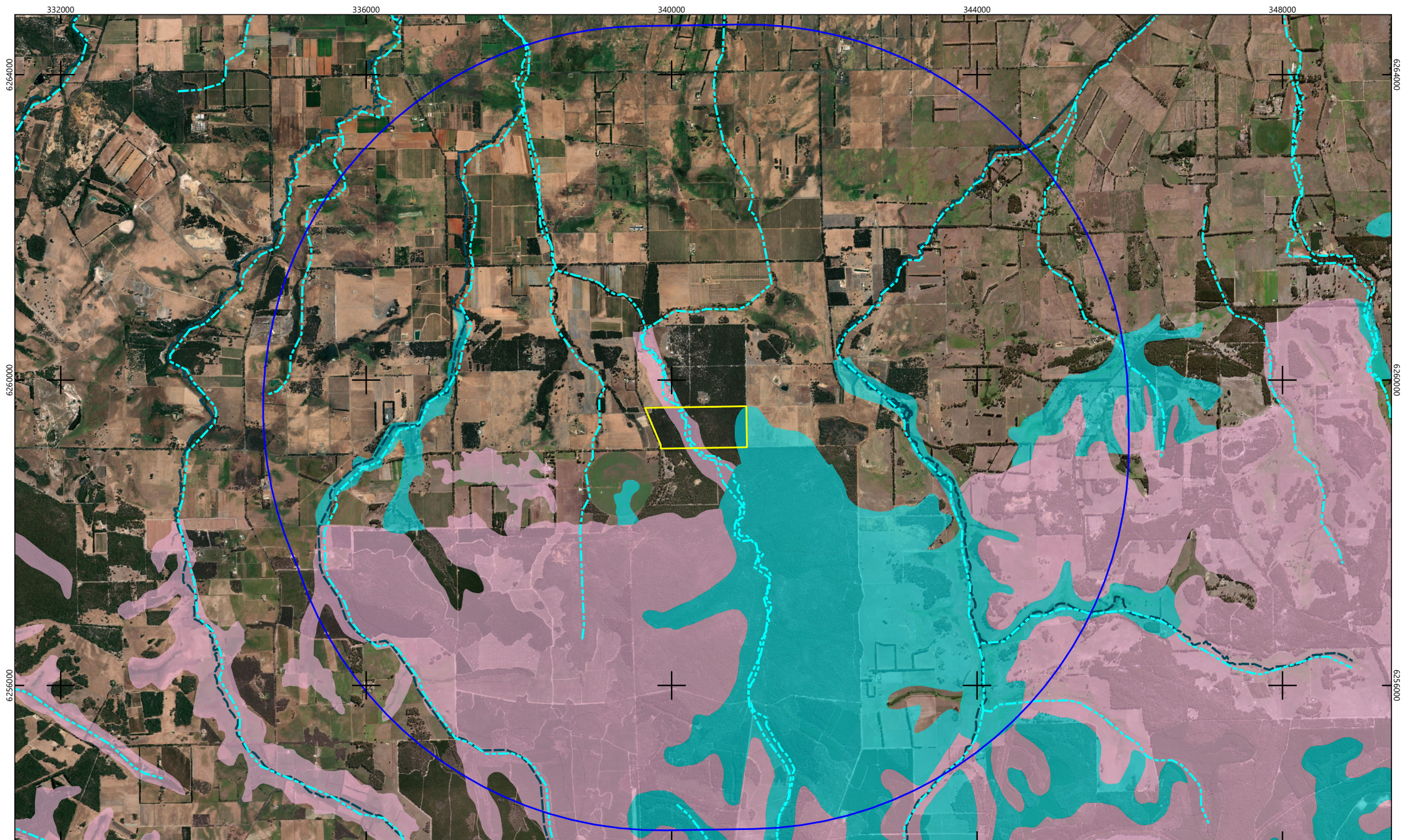
Legend

Survey Area

Study Area

Terrestrial GDE

High potential GDE - from national assessment

Moderate potential GDE - from national assessment

Drainage

Major

Minor

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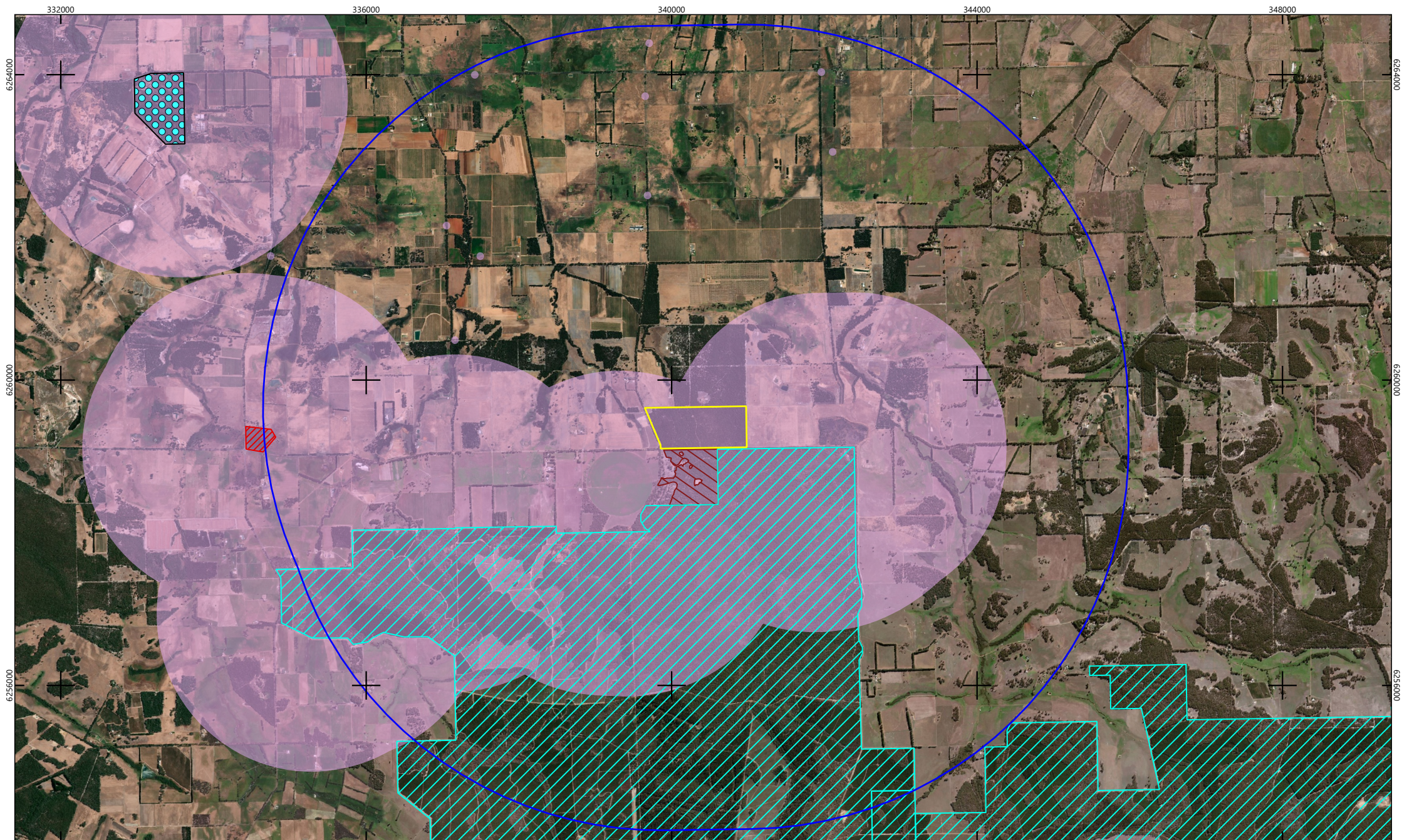
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3.6 RESERVES, CONSERVATION AREAS AND ENVIRONMENTALLY SENSITIVE AREAS

The World Database on Protected Areas (WDPA) lists both terrestrial and marine protected areas and is managed by the UN Environment World Conservation Monitoring Centre (UNEP-WCMC) and the International Union for Conservation of Nature (IUCN) (Belle *et al.* 2018). No DBCA or conservation reserves occur within the survey area; however, two Terrestrial and Inland Waters Protected Areas listed by the WDPA and the Blackwood State Forest occur within the study area (**Table 8**, **Figure 9**). The entire survey area is considered an ESA (**Figure 9**), this is likely due to the presence of TECs and Threatened flora identified within close proximity to the survey area (see **Section 5.1**).

Table 8 – Reserves, Conservation Areas and ESAs within the Study Area

Site Name	Type	Area within Study Area (ha)	Comment
NTWA Bushland covenant (0069)	Terrestrial and Inland Waters Protected Areas	42.55	Located adjacent to the southern boundary of the survey area.
Unamed WA45533	Terrestrial and Inland Waters Protected Areas	9.84	Located approximately 4.8 km west of the survey area, with little remnant vegetation and cleared agricultural properties between.
Blackwood State Forest	Crown Land	53,144.78	Located approximately 0.3km south of the survey area, connected via NTWA Bushland covenant (0069), extending 42 km south-east and adjacent to Millbrook State Forest, Wiltshire-Butler National Park, South Blackwood State Forrest, Milyeannup State Forest.

Legend

Survey Area

Study Area

ESAs

National Reserve System

NTWA Bushland covenant (0069)

Sussex Location 2561

Unnamed WA45533

DPaW Managed Lands and Waters

Blackwood State Forest

GDA 2020 / MGA Zone 50

Figure 9 - Reserves, Conservation Areas and ESAs

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4   METHODOLOGY

4.1   DESKTOP ASSESSMENT

4.1.1   Literature Review

Available information from previous biological surveys conducted in the region of the survey area were reviewed as part of the desktop assessment. These surveys are listed below, and the results have been summarised in **Section 5.1**:

- Stream Environment and Water (2021) Reconnaissance and Targeted Flora and Fauna Survey: Interim report
- Ecoedge (2020) Reconnaissance and Targeted Flora and Vegetation Survey Wonnerup South Road (1.40-8.88 SLK) Upgrade
- Stream Environment and Water (2018) Flora and vegetation assessment, Lot 75 Haag Road Yelverton
- Ecoedge (2017) Report of a Flora and Vegetation Survey of Lot 2626 Jamisons Road, Boallia
- Ecoedge (2014) Report of a Level 2 Flora and Vegetation survey at Yoongarillup
- Keighery *et al.* (2008) A Floristic Survey of the Whicher Scarp.

4.1.2   Database Searches

The desktop assessment for significant fauna, flora and ecological communities consisted of database searches based on a central point within the survey area (GDA2020, zone 50: 340368 mE 6259388 mN) with a 5 km buffer (study area) for all purposes, except for a 15 km buffer (Black-Cockatoo study area) for the assessment of Black-Cockatoo habitat.

The desktop assessment used database search results from NatureMap (DBCA 2023) (**Appendix A**), DBCA Threatened and Priority flora (DBCA ref: 11-0622FL), DBCA Threatened and Priority fauna (DBCA ref: Morrell7176_Boalia) and ecological communities databases (DBCA ref: 01-0622EC.) and the Commonwealth Protected Matters Search Tool (PMST) for MNES (DCCEEW 2023b) (**Appendix B**).

Prior to field assessments, the occurrence of potential suitable habitats for flora and fauna species was assessed in reference to regional vegetation data, aerial imagery and results from the Threatened and Priority Flora Database (TPFL) and the WA Herbarium database (WAH) provided by the Species and Communities Branch within DBCA.

The likelihood of occurrence (flora and vegetation) or expected nature of occurrence (fauna) of each potential significant species/community was evaluated prior to field assessments and was based on four criteria: the presence of suitable habitat within the survey area, age of previous records, proximity of previous records to the survey area, and current condition of the survey area (**Table 9**, **Table 10**).

Table 9 – Likelihood of Flora Occurrence Criteria

Criteria	Explanation
Suitable habitat	The likelihood of suitable habitat being present within the survey area was based on known habitat information gathered from DBCA database information, FloraBase (Western Australian Herbarium 1998-) and literature sourced from the Species Profile and Threats Database (SPRAT) (DCCEEW 2023a) (e.g., recovery plans, conservation advice).
Age of previous records	The age of previous records for significant species resulting from the desktop assessment was evaluated to determine how likely the species was to still occur in the survey area (i.e., habitat of species recorded decades ago may no longer occur or a species may be locally extinct).
Proximity of previous records	The proximity of previous significant flora and vegetation results in relation to the survey area contributed to the likelihood of occurrence conclusions, with those previously recorded close by considered more likely to occur within the survey area. It is noted that species identified from the PMST have not necessarily been recorded within proximity to the survey area and may have resulted due to habitat possibly occurring within the survey area.
Current condition of survey area	The survey area is largely unmodified although is degraded in some areas from pastoral activities, particularly in the riparian sections where degradation has likely been exacerbated by cattle grazing and trampling and long-term low rainfall and dry conditions. Highly modified and degraded environments usually represent a lower likelihood of the occurrence of significant flora, whilst intact remnants are known to harbour significant species and communities that may have otherwise been cleared or impacted throughout their range.

Table 10 – Fauna Expected Occurrence Criteria

Section	Occurrence Category	Description
Fauna	Resident	Species with a population permanently present in the survey area.
	Regular migrant or visitor	Species that occur within the survey area regularly in at least moderate numbers, such as part of an annual cycle.
	Irregular Visitor	Species that occur within the survey area irregularly such as nomadic and irruptive species. The length of time between visitations could be decades but when the species is present, it uses the survey area in at least moderate numbers and for some time.
	Vagrant	Species that occur within the survey area unpredictably, in small numbers and/or for very brief periods. Therefore, the survey area is unlikely to be of importance for the species.
	Locally extinct	Species that would have been present but have not been recently recorded in the local area and therefore are almost certainly no longer present in the survey area.

4.2 FIELD ASSESSMENT

4.2.1 Flora and Vegetation

A single phase, reconnaissance flora and vegetation assessment was carried out by Julie Fielder (Senior Botanist) and Sarah Beckwith (Undergraduate Ecologist) between 14-16 November 2022, over three days, including travel time. The survey was undertaken and reported in accordance with the EPA (2016a) *Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment*. The purpose of the field assessment was to assess the vegetation types and condition within the survey area.

Field data were collected using flora and vegetation relevés (a low intensity survey technique used to quickly capture vegetation structure data) in order to represent the diversity of vegetation throughout the survey area. A total of nine relevés were assessed with the locations presented in **Figure 10**. The following information was collected at each relevé:

- observer
- date
- GPS location (MGA94)
- representative photograph
- soil type and colour
- topography
- vegetation degradation/disturbances (e.g. grazing, weed invasion, fire)
- flora species observed, including average height and estimated projected foliage cover of dominant species within each stratum
- vegetation community, described in accordance with Level 5 of the National Vegetation Information System (NVIS) (The National Vegetation Information Technical Working Group 2017)
- vegetation condition, assessed against the currently accepted scale; an adaptation of the Keighery (1994) and Trudgen (1991) condition scales.

Observations and opportunistic data collection were also carried out continuously within and throughout the survey area, and track logs of all personnel were captured at all times, to demonstrate survey effort and site coverage (**Figure 10**).

Field data were collected using electronic tablet devices with customised data forms and mobile spatial mapping capability, within the software program, Mappt™ (Takor Group 2021).

Opportunistic targeted searching was also carried out during field survey while traversing between relevés. Habitat preferences for all target flora species were determined during the desktop assessment and study planning tasks, to enable targeted searching in the field. Any observed flora suspected to be Threatened or Priority was marked using GPS-enabled devices to enable inclusion in the report maps and spatial data layers. Where taxa suspected or known to be Priority flora whilst in the field were located, dedicated targeted searches were continued to quantify populations and to map their extents.

The vegetation units of the survey area have been defined by data collected within relevés and opportunistically between, and how they relate to other environmental features such as soil type and landform. A map of the vegetation units was then developed using GIS and is presented in this report.

Vegetation condition was assessed using the current bushland condition scale which is an adaptation of Keighery (1994) scale, as described in EPA (2016a). The spatial extent of the varying vegetation condition was mapped using GIS and is presented in this report.
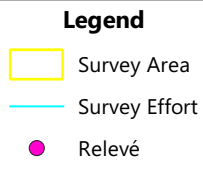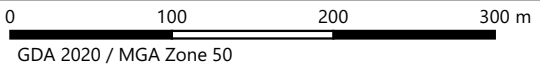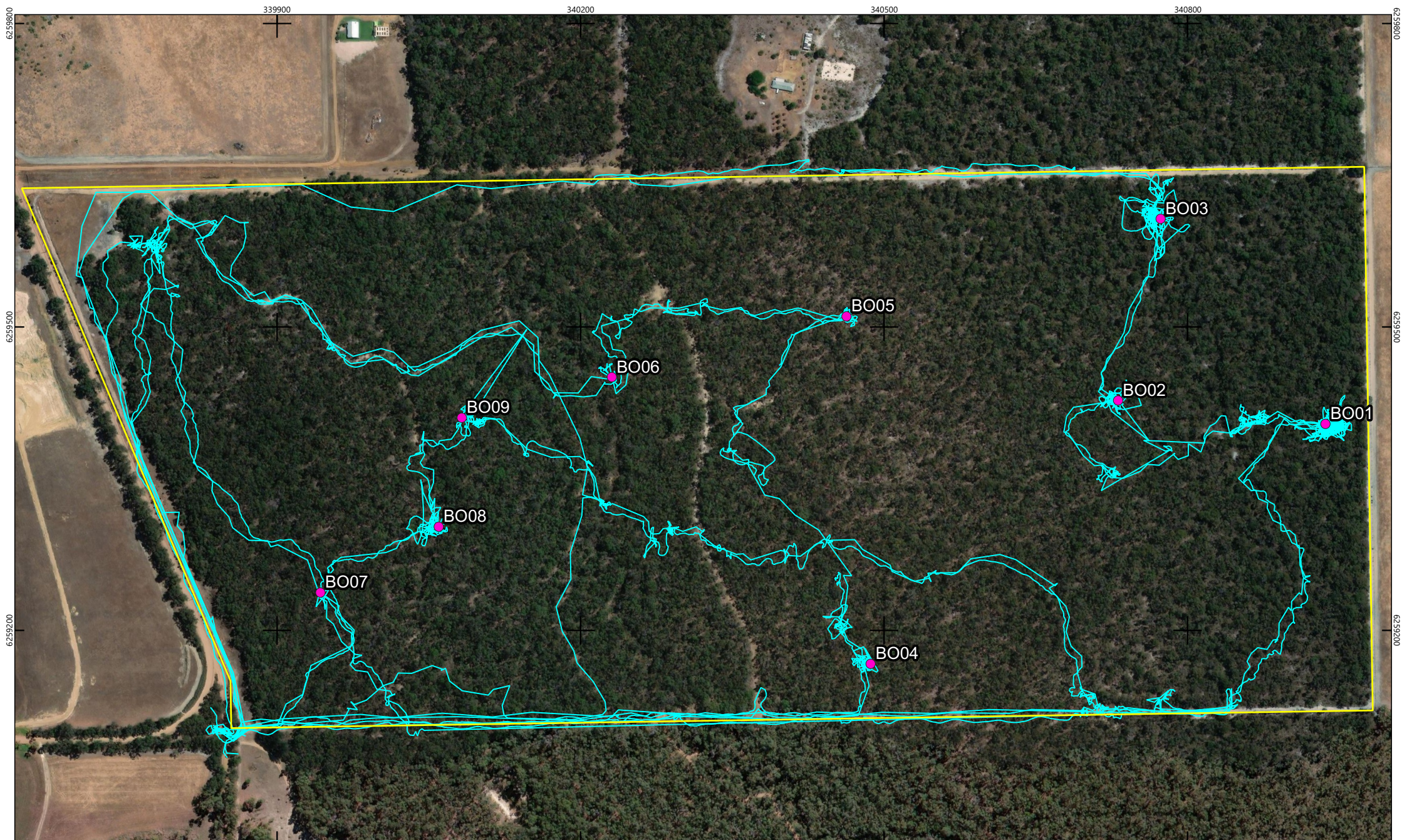
Figure 10 - Vegetation Relevé Survey Effort

GDA 2020 / MGA Zone 50

Legend
- Survey Area
- Survey Effort
- Relevé

BO01
BO02
BO03
BO04
BO05
BO06
BO07
BO08
BO09

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4.2.2   Dieback Assessment

A dieback assessment was conducted by Evan Brown (Dieback Interpreter registration, DPW-PDI-004) on 7, 8 and 21 November 2022. During the assessment process, evidence was collected to support the field diagnosis and recorded using a GPS-enabled device running the ESRI Collector application. Waypoints were recorded at locations where field observations were recorded. These points were used in developing the *Phytophthora* dieback status of the vegetation.

Procedures and guidelines contained in DBCA's *Phytophthora* Dieback Interpreters Manual for lands managed by the department (DPaW 2015) were applied for the field assessment. Indicator species (plant species that are susceptible to dieback and reliably show early symptoms) and their deaths within the vegetation, the site topography, plant biomass, and vectoring agencies such as roads, creeks, and fauna were all used to assist in the detection and diagnosis of *Phytophthora cinnamomi,* the main fungus that causes dieback. *Phytophthora* zoospores infect plant roots and produces mycelium which draws nutrients and water from the plants and hinders the plants ability to take in any nutrients or water causing it die (DBCA 2022).

All of the procedures for *Phytophthora* dieback detection, diagnosis and mapping were based on the presence of indicator species in the vegetation, and the observance of deaths in these plants. An indicator species is a plant species reliably susceptible to *Phytophthora cinnamomi*. Indicator species deaths (ISDs) alone do not necessarily indicate disease presence, and it is necessary to consider all environmental and ecological factors that may be present. These other factors include:

- chronology of deaths - as the pathogen spreads through vegetation, some indicator species will display disease symptoms and die. These deaths can form an age range showing the progression of the disease. A strong chronological pattern with multiple indicator species would indicate a high likelihood of Phytophthora presence
- a pattern of deaths - a pattern in the arrangement of plant deaths provides evidence that an agent or force is involved in vectoring the pathogen through the landscape
- topographical position - the topographical position of ISDs can indicate the probability of the disease and the direction of spread. The infestation probability in a gully is higher than in upslope areas away from vectors such as roads, paths, and irrigation lines.
- vectoring – causal agencies – the pathogen will be introduced to the vegetation via a causal agent: such as roads, creeks, foot traffic and fauna
- plant biomass and biological diversity reduction may be observed in vegetation affected by *Phytophthora* dieback.

Other causes of plant deaths were considered when determining the possible presence of *Phytophthora* dieback, including:

- *Armillaria luteobubalina* (Australian honey fungus)
- various cankers and insects
- fire and lightning
- senescence and competition
- physical damage
- herbicides and chemical spills.

The assessment of the presence of *Phytophthora* Dieback against the Keighery (1994) condition scale is categorised in **Table 11**.

Table 11 - Keighery (1994) Vegetation Condition Scale and Disease Interpretability for *Phytophthora* Dieback

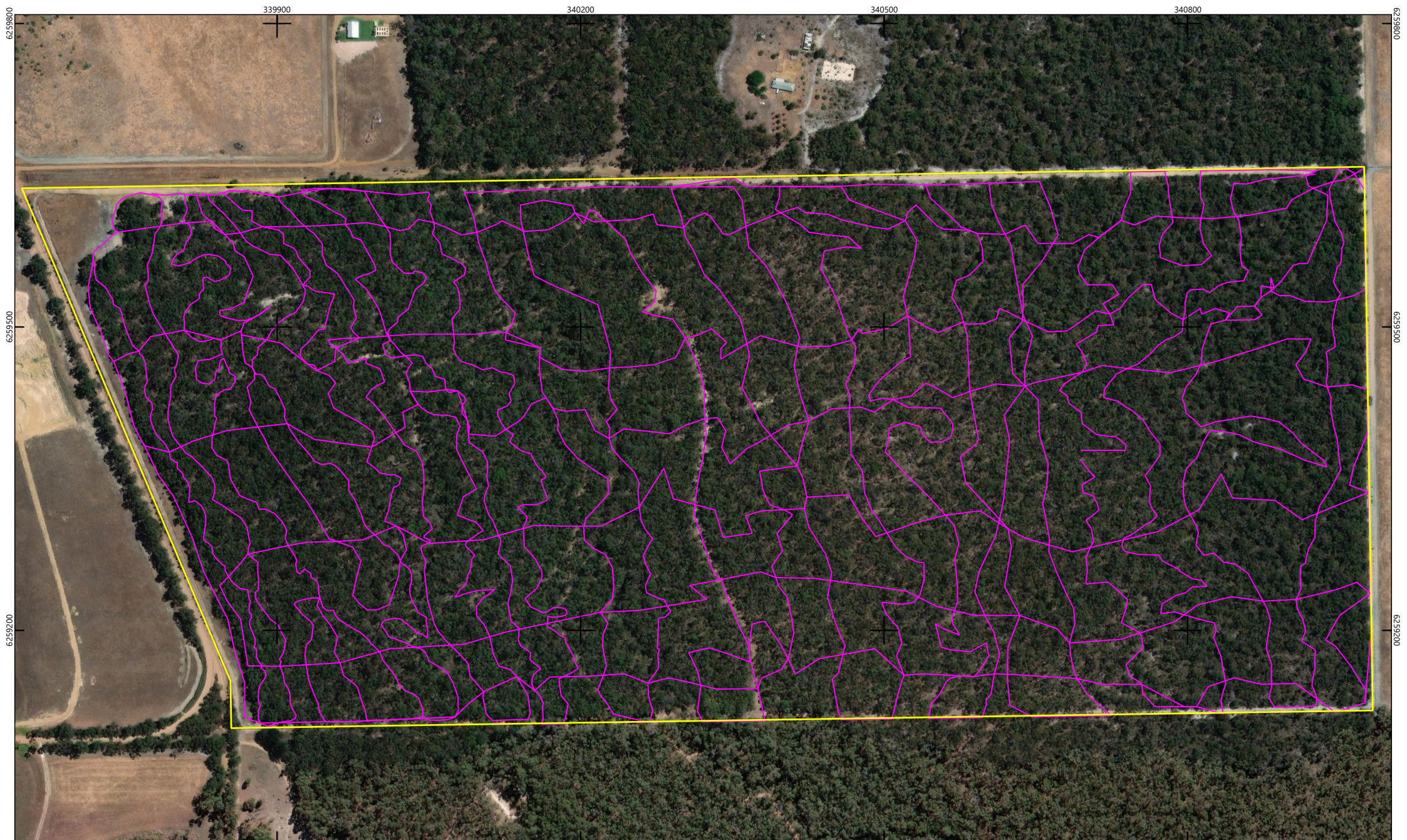| Scale		Vegetation Condition	Interpretability	Area (ha)
1	Pristine	Pristine or nearly so.	Can be assessed and categorised	Infested
2	Excellent	Vegetation structure intact.		Un-infested
3	Very good	Vegetation structure altered.		Uninterpretable
4	Good	Vegetation structure significantly altered by obvious signs of multiple disturbances.	Cannot be confidently assessed for disease symptoms	Not yet resolved.
5	Degraded	Basic vegetation structure severely impacted by disturbance.		Temporarily Uninterpretable
6	Completely Degraded	The structure of the vegetation is no longer intact, and the area is completely or almost completely without native species.		Excluded.

Areas are considered to be *Phytophthora* dieback protectable areas if they are :

- determined to be Uninfested, Uninterpretable or Temporarily Uninterpretable
- situated in areas receiving more than 600 mm rainfall per year or those that are water-gaining sites in the 400-600 mm per year rainfall range
- both positioned in the landscape and of sufficient size such that it is adjudged that the pathogen will not be autonomously engulfed in the short term (greater than four hectares with an axis greater than 100 m)
- areas of high conservation and/or socio-economic value (for example, areas with a known population of a susceptible species of threatened flora)
- areas where human vectors such as the movement of infected soil and plant material by vehicle and bike tyres, bottom of shoes, the feet of farmstock, and through irrigation are controllable (DPaW 2015).

4.2.3 Fauna Assessment

A basic and targeted fauna assessment was conducted by six zoologists, led by Kelly Lamp over seven days between 18 October and 29 November 2022. The field fauna assessment was conducted via foot and vehicle traverses to observe and record evidence of fauna, and representative sample areas of the various habitats present (**Figure 11**). The assessment focused on fauna habitat mapping and targeted surveys for fauna species of significance and their habitats, in particular for Black-Cockatoo (foraging, breeding and roosting habitat), Western Ringtail Possums and South-western Brush-tailed Phascogales. Fauna species and direct evidence (signs) of fauna activity, such as scats, tracks, diggings, skeletons or calls were continuously searched for and recorded whilst on site.

Characterisation (and subsequent mapping) of fauna habitats was completed for the survey area, using known information about vegetation types, soil, and substrate and confirmed with on-site observations during the field assessment. The fauna habitat mapping was used to search and target habitat likely to be used by significant species. Fauna and fauna habitat assessments were recorded and reported in accordance with the Technical Guidance (EPA 2020).

Figure 11 - Fauna Survey Effort

GDA 2020 / MGA Zone 50

0   100   200   300 m

Legend

Survey Area

Survey Effort

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4.2.4 Targeted Black-Cockatoo Habitat Assessment

The Commonwealth environmental regulatory, (formerly DAWE, now DCCEEW) provides guidelines for referral of actions that may result in impact to Black-Cockatoos (for assessment under the EPBC Act). The targeted Black-Cockatoo habitat assessment was conducted in accordance with the revised guidelines (DAWE 2022) as well as other guidelines (DSEWPC 2012; DEE 2017), where appropriate. In addition, survey methodology followed the recommendations listed on the DCCEEW's Species Profile and Threats Database (DCCEEW 2023a).

All three Threatened species of Black-Cockatoos are likely to occur within the study area (Carnaby's Black-Cockatoo (*Zanda latirostris,* syn. *Calyptorhynchus latirostris*), Forest Red-tailed Black-Cockatoo (*Calyptorhynchus banksii naso*) and Baudin's Black-Cockatoo (*Zanda baudinii,* syn. *Calyptorhynchus baudinii*)). Hereafter, these three species will be collectively referred to as Black-Cockatoos.

The aim of the targeted field assessment for these three species of Black-Cockatoos and their habitat was to record any observed individuals either in the survey area or as an overfly observation, any evidence of their activity (e.g. chewed nuts), as well as habitat suitable for nesting/breeding, roosting or foraging. These habitats are described in **Table 12**. Suitable habitat was mapped, with areas rated and quantified, as discussed in the sections below.

The survey area was traversed on foot and surveyed in detail, to observe and record all suitable foraging, roosting and breeding habitat for all three species of Black-Cockatoo as summarised in **Table 12**.

Table 12 – Black-Cockatoo Habitats Surveyed

Habitat	Examples
Foraging habitat	Food source plants for Black-Cockatoos include Jarrah (*Eucalyptus marginata*), Marri (*Corymbia calophylla*), Proteaceous species from genera such as *Banksia, Hakea* and *Grevillea; Allocasuarina,* and *Anigozanthos* and introduced species such as Pines (*Pinus* spp.) and Cape Lilac (*Melia azedarach*), but also *Erodium* spp. and various species grown for fruit, nuts and seeds which grow in native shrubland, heathland, woodland or forest and agricultural areas.
Night roosting habitat	These habitats include suitable trees (*Eucalyptus* spp. or *Corymbia* spp.) within or near riparian environments or natural or artificial water sources.
Breeding/nesting habitat	Any patch of woodland or forest that contains *Eucalyptus* spp. or *Corymbia* spp. trees with either a diameter at breast height of greater than 500 mm (or 300 mm for Salmon Gum (*Eucalyptus salmonophloia*) and Wandoo (*Eucalyptus wandoo*)) or with suitable nest hollows. More specifically, all individual trees observed to support suitable hollows within the survey area.

4.2.4.1 Black-Cockatoo Foraging Habitat

Foraging habitat for Black-Cockatoos was given a score out of ten to indicate the quality of that foraging habitat for each species. The foraging habitat of the survey area was scored in accordance with methodologies developed by Bamford Consulting Ecologists (BCE), in which habitats are awarded a score out of ten to indicate the quality of that foraging habitat. The scoring system is comprised of the following:

- a score out of six for vegetation composition, condition and structure, in accordance with **Table 13**
- a score out of three for site context, in accordance with **Table 14**
- a score out of one for stocking rate (Black-Cockatoo species density).

The resulting total score (out of ten) reflects the quality of Black-Cockatoo foraging habitat and allows future application of the Commonwealth biodiversity offsets calculator (DSEWPC 2012).

The vegetation composition score is based on the presence, density/abundance, condition and proportions of food source plants for the relevant species of Black-Cockatoo. A selection of key examples applicable to each of the scores for the three Black-Cockatoo species is presented in **Table 13**.

Table 13 - Scoring System for the Assessment of Foraging Value of Vegetation for Black-Cockatoos

Site Score	Description of Vegetation		
	Carnaby's Black-Cockatoo	**Baudin's Black-Cockatoo**	**Forest Red-tailed Black-Cockatoo**
0	No foraging value. No Proteaceae, eucalypts or other potential sources of food. Examples would be salt lakes and bare ground.	No foraging value. No eucalypts or other potential sources of food.	No foraging value. No eucalypts (i.e. Marri, Jarrah, Wandoo, Blackbutt or Karri) or other potential sources of food.
1	Negligible to low foraging value. Scattered specimens of known food plants but projected foliage cover of these <2%. Could include urban areas with scattered foraging trees. Blue Gum plantations are considered to have a score of 1 as foraging by Black-Cockatoos has been reported but appears to be unusual.	Negligible to low foraging value. Scattered specimens of known food plants (e.g. Marri and Jarrah) but projected foliage cover of these <1%. Could include urban areas with scattered foraging trees.	Negligible to low foraging value. Scattered specimens of known food plants but projected foliage cover of these <1%. Could include urban areas with scattered foraging trees.
2	Low foraging value. Examples: • Shrubland in which species of foraging value, such as shrubby banksias, with <10% projected foliage cover. • Open eucalypt woodland/mallee of small-fruited species. • Paddocks with melons or other weeds (a short-term, seasonal food source).	Low foraging value. Example: • Woodland or forest with scattered specimens of known food plants (e.g. Marri and Jarrah) but projected foliage cover of these 1-<5%. Could include urban areas with scattered foraging trees.	Low foraging value. Examples: • Open eucalypt woodland (i.e. Marri, Jarrah, Wandoo, Blackbutt or Karri). Projected foliage cover of these 1-<5%. • Urban areas with scattered food plants such as Cape Lilac, *Eucalyptus caesia* and *Eucalyptus erythrocorys*.
3	Low to Moderate foraging value. Examples: • Shrubland in which species of foraging value, such as shrubby banksias, with 10-20% projected foliage cover. • Woodland with tree banksias 2-10% projected foliage cover. • Eucalypt woodland/mallee of small-fruited species; Marri, if present, <10% project foliage cover.	Low to Moderate foraging value. Examples: • Eucalypt woodland with known food plants (and in particular Marri) with a projected foliage cover of 5-<10%. • Parkland-cleared eucalypt woodland with projected foliage cover of known food plants of 10-<20% can be considered low-to-moderate because of poor long-term viability without management.	Low to Moderate foraging value. Examples: • Eucalypt woodland (i.e. Marri, Jarrah, Wandoo, and Blackbutt), if present, <10% project foliage cover.

Site Score	Description of Vegetation		
	Carnaby's Black-Cockatoo	**Baudin's Black-Cockatoo**	**Forest Red-tailed Black-Cockatoo**
4	Moderate foraging value. Examples: • Woodland with tree banksias 20-40% projected foliage cover. • Eucalypt woodland/forest with Marri 20-40% projected foliage cover.	Moderate foraging value. Examples: • Eucalypt woodland with known food plants (and in particular Marri) with a projected foliage cover of 10-<20%. • Parkland-cleared eucalypt woodland with projected foliage cover of known food plants of 20-<40% can be considered moderate because of poor long-term viability without management. • Areas of orchards and especially those with apples can be considered of moderate value.	Moderate foraging value. Example: • Eucalypt woodland/forest (i.e. Marri, Jarrah, Wandoo, and Blackbutt) with 20-40% projected foliage cover.
5	Moderate to High foraging value. Example: • Banksia woodlands with tree banksias >40%. Vegetation condition moderate due to weed invasion and some tree deaths.	Moderate to High foraging value. Example: • Eucalypt woodland with known food plants (and in particular Marri) with a projected foliage cover of 20-<40%. Parkland-cleared eucalypt woodland with projected foliage cover of known food plants of >40% can be considered moderate because of poor long-term viability without management.	Moderate to High foraging value. Example: • Eucalypt woodland/forest (i.e. Marri, Jarrah, Wandoo, and Blackbutt) with >40% projected foliage cover. Vegetation condition moderate due to weed invasion and some tree deaths.
6	High foraging value. Example: • Banksia woodlands of key species (e.g. *B. attenuata, B. menziesii*) with projected foliage cover >60%. Vegetation condition good with low weed invasion and low tree death to indicate it is robust and unlikely to decline in the medium term.	High foraging value. Example: • Eucalypt woodland/forest with a high proportion of Marri (>40% projected foliage cover). Vegetation condition good with low weed invasion and low tree death to indicate it is robust and unlikely to decline in the medium term.	High foraging value. Example: • Eucalypt woodland/forest (i.e. Marri, Jarrah, Wandoo, and Blackbutt) with >60% projected foliage cover. Vegetation condition good with low weed invasion and low tree death to indicate it is robust and unlikely to decline in the medium term.

Vegetation characteristic scores of ≤2 are not further analysed for context and species presence (stocking rate), as such habitat is considered to be of negligible foraging value.

The site context score is species-specific as it depends upon factors such as the vegetation type and extent, and the presence of breeding birds. Scores for site context are guided by **Table 14**, noting that 'local area' is defined as within a 15 km radius of the centre point of the survey area. To assign a score for site context, a maximum score of three is applied where foraging habitat is known or found to support breeding birds, or it can also be applied in fragmented landscapes where there is little foraging habitat remaining and thus what is left has a high contextual value.

Table 14 – Key to Black-Cockatoo Site Context Score for Foraging Habitat Quality

Site Context Score	Existing Native Vegetation within the 'Local Area' that the Survey Area Represents (%)	
	'Local' Breeding Known/Likely	'Local' Breeding Unlikely
3	> 5	> 10
2	1 - 5	5 - 10
1	0.1 - 1	0.1 - 5
0	< 0.1	< 0.1

The score for stocking rate/species density (0 or 1), is based upon the relevant Black-Cockatoo species being either abundant or low and is species-specific. A score of 1 is applied where the species is seen or known to occur/reported regularly and/or there is abundant foraging evidence. 'Regularly' is considered to be when the species is seen at intervals of every few days or weeks for at least several months of the year. A score of 0 is applied when the species is recorded or reported very infrequently and there is little or no foraging evidence.

4.2.4.2 Black-Cockatoo Potential Breeding Habitat

Potential breeding habitat was assessed by examining each tree within the survey area and determining whether each is suitable as a breeding tree, with or without hollows, with or without nesting evidence (for trees with hollows), or as potential future nesting trees (with a diameter at breast height of 500 mm or greater, or 300 mm or greater for Salmon Gum and Wandoo). Any tree of suitable diameter at breast height (DBH) was recorded and scored as per **Table 15**, which provides a ranking system to differentiate between trees of low, moderate and high potential as nest trees.

Table 15 - Ranking System for Black-Cockatoo Nesting and Potential Nesting Trees

Rank	Description of Tree and Hollows/Activity
0	Tree large (DBH +/= 500 mm), but not tall, may be with thinner or branching trunks, so does not contain and no potential for hollows.
1	Active nest observed; adult (or immature) bird seen entering or emerging from hollow.
2	Hollow of suitable size and angle (i.e. near-vertical) visible with chew marks around entrance.
3	Potentially suitable hollow visible but no chew marks present; or potentially suitable hollow present (as suggested by structure of tree, such as large, vertical trunk broken off at a height of >10 m).
4	Tree with large hollows or broken branches that might contain large hollows, but hollows or potential hollows are not vertical or near-vertical; thus, a tree with or likely to have hollows of sufficient size but not to have hollows of the angle preferred by Black-Cockatoos.
5	Tree lacking large hollows or broken branches that might have large hollows; a tree with more or less intact branches and a spreading crown.
x	Where a hollow that is (otherwise) potentially suitable for Black-Cockatoo nesting has been colonised by feral Honey Bees (*Apis mellifera*), and therefore rendered unusable, the nest-tree rank is preceded by 'x' (e.g. x2, x3, x4).

The revised referral guidelines (DAWE 2022) and the previous referral guidelines (DSEWPC 2012; DEE 2017) list certain tree species as typical and preferred breeding habitat for each of the three species of Black-Cockatoo, however, evidence suggests that Black-Cockatoos breed and nest in any trees that are sufficiently large and provide suitable hollows (Mike Bamford, pers. comm.). Therefore, all large Eucalypts within the survey area were inspected for breeding habitat suitability and the presence of hollows. However, only those of species as listed in the referral guidelines would trigger the need for referral to the DCCEEW.

4.2.4.3 Black-Cockatoo Roosting Habitat

Roosting habitat was assessed and mapped based on tree species and their proximity to water sources. A review of known datasets and literature regarding known roost sites was also used to assist in the determination of potential roost sites.. Tall trees within approximately 2 km of water sources are suitable roosting habitat. A review of DBCA data for known roost sites (DBCA 2022b) was undertaken to assist in identifying whether the survey area is known to support, or may support, roosting habitat.

4.2.5   Targeted Western Ringtail Possum and Phascogale Habitat Assessment

Nocturnal surveys were conducted while walking through the survey area over seven nights. Surveys occurred from last light with the canopy of tree searched for eye shine to detect fauna with a spotlight and head torch.

Daytime survey and habitat assessment recorded presence of flora known to be foraging species, with an assessment of area and quality of vegetation. Any dreys, used by Western Ringtail Possums, observed or evidence of presence, such as scats, was also recorded.

4.3   DATA PROCESSING/ANALYSIS AND REPORTING

Following completion of the desktop and field assessments, all information and collected field data were collated, ready for analysis and reporting.

Flora identifications were undertaken by Botanist, Margaret Collins, as listed in **Section 8**. Flora taxonomy and nomenclature followed current protocols of the WA Herbarium (WAH) (1998b-).

As per the recommendations of the EPA (2008), the nomenclature and taxonomic order presented in this report for fauna are based on the Western Australian Museum's (WAM) current (November 2022) version of *Checklist of the vertebrates of Western Australia* (WAM 2022).

Flora data collected from relevés were analysed by comparing similarities to determine vegetation types based on some or all of the following characteristics; key dominant flora species, vegetation structure, habitat, geographical location, soils/landforms, vegetation complexes and site hydrological status. Other analysis in reference to relevant conservation advice and available information for significant ecological communities was also carried out in order to determine whether TECs or PECs are supported by the survey area.

Vegetation mapping was used as the basis for fauna habitat mapping, which was then able to consider the presence of habitat for significant fauna species.

All relevant data and results from the desktop and field assessments were collated or digitised in GIS, to enable the preparation of the suite of figures presented in this report.

All spatial data has been prepared as ESRI shapefiles that meet the protocols of the Index of Biodiversity Surveys for Assessment (IBSA) initiative.

This report has been prepared by suitably qualified and experienced professionals, including those who led the field studies, in accordance with relevant guidelines.

4.4   SURVEY LIMITATIONS

The surveys were assessed against limitations imposed by many variables as outlined in the Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016a) and *Technical Guidance – Terrestrial Fauna Surveys for Environmental Impact Assessment* (EPA 2020) (**Table 16**).

Table 16 – Potential Survey Limitations and Constraints

Aspect	Constraint?	Commentary
Availability of regional data, previously available information	Minor	Literature and other previous biological surveys conducted within the region is available for site for flora and vegetation and the Western Ringtail Possum. There is limited data available on breeding and roosting sites for the three Black-Cockatoo species and the presence of South-western Brush-tailed Phascogales.
Scope (detail)	No	A single phase, reconnaissance flora and vegetation assessment was carried out in accordance with EPA (2016). A total of nine relevés were sampled across the survey area. This level of survey detail was adequate for the assessment of floristic values required for the study. Appropriately, the fauna assessment scope focused on identifying fauna habitat and targeted survey for Black-Cockatoo, Western Ringtail Possum and South-western Brush-tailed Phascogale since they are key species of relevant to the region and of greatest importance to the study.

Aspect	Constraint?	Commentary
Competency/ Experience of personnel	No	All of the personnel leading the botanical field assessment, and undertaking flora identifications, data analysis, vegetation mapping and reporting are experienced botanists, with specialist skills in their respective fields. All botanists have a minimum of three (and up to 40) years' experience. Senior Botanist, Julie Fielder, who undertook the field flora and vegetation survey has more than 20 years' experience in undertaking botanical surveys. The basic fauna survey and targeted Black-Cockatoo habitat assessment was led by Zoologist, Kelly Lamp, who meets the Commonwealth requirements for such surveys.
Survey effort/detail/ intensity	No	As per the 'scope (detail)' aspect above, the reconnaissance flora and vegetation assessment was more than adequate for the assessment of floristic values in the survey area. With the entirety of the survey area in very good to excellent condition, nine relevés were sampled throughout to ensure representation from each vegetation unit present. The basic fauna assessment and targeted survey for Black-Cockatoo habitats, Western Ringtail Possum and South-western Brush-tailed Phascogale was at an appropriate level of detail.
Seasonal timing and climatic conditions	No	The reconnaissance flora assessment was conducted during November (spring), which is the optimal season for biological surveys on the Swan Coastal Plain. The basic fauna assessment was conducted during spring, which is considered to optimal survey time for foraging and breeding for all three Black-Cockatoo Species and Western Ringtail Possums.
Access	No	The majority of the survey area was easily accessible, with several established access tracks running throughout the survey area. Where private property exists, permission was granted and was therefore was accessible.
Mapping reliability	No	The mapping has been prepared at a scale based on ground-truthed areas, with limited extrapolation given the good accessibility for most of the survey area. Therefore, mapping reliability based on scale is considered high.
Disturbances	No	Only a small proportion of the survey area has previous disturbances where active tracks are present. These areas are minimal and do not impede the quality of remnant vegetation throughout the survey area, with only boundary vegetation in the east showing signs of historical disturbance.
Survey completeness	Minor	The entire survey area was accessible by foot and surveyed for flora and fauna values, including suitable habitat and Black-Cockatoo breeding trees. Roosting surveys were confined to three dawn and six dusk surveys to ensure an adequate area was assessed for Black-Cockatoos. Nocturnal surveys were confined to seven surveys to observed Western Ringtail Possums and South-western Brush-tailed Phascogales. Survey results are constrained to those species utilising the survey area at the time of the assessment only as the area surveyed did not include the entire home range for each species. There are constraints in surveying Western Ringtail Possums and South-western Brush-tailed Phascogales due to the time they may arise from their rest site. Their home range may overlap the survey area, with a rest site being used outside the survey area during the survey times. While all significant trees (DBH >50cm) were examined for the presence of hollows prerequisites that determine the suitability of a hollow for use by cockatoos are difficult to assess, particularly from ground level and without potential disturbance to Black Cockatoo's.
Proportion of fauna identified, recorded and/or collected	No	The fauna assessment targeted Black-Cockatoo's, Western Ringtail Possums and South-western Brush-tailed Phascogales specifically. All Black-Cockatoos, Western Ringtail Possum's and South-western Brush-tailed Phascogale observed during the field assessment, or evidence of use within of the survey area, were confirmed/identified and recorded.

5 RESULTS

5.1 DESKTOP ASSESSMENT

5.1.1 Literature Review

A literature review was undertaken as part of the desktop assessment to identify previous biological surveys undertaken within or in the vicinity of the survey area. The biological surveys were reviewed to provide a broader locality context and to identify key findings including significant flora, presence of TECs and PECs and significant fauna. The biological surveys reviewed to provide local and regional context of the survey area are summarised in **Table 17**.

Table 17 – Previous Surveys Within and Surrounding the Survey Area

Report Title	Survey Methodology	Key Survey Results
Ecoedge (2014) Report of a Level 2 Flora and Vegetation survey at Yoongarillup	Flora and Vegetation Survey	- 233 taxa from 44 families - Two Threatened species: *Daviesia elongata* subsp. *elongata* and *Verticordia densiflora* var. *pedunculata* - Two Priority species: *Acacia semitrullata* (P4) and *Conospermum paniculatum* (P3) - Open forest or woodland of *Eucalyptus marginata* and *Corymbia calophylla*, and *Eucalyptus marginata*, *Corymbia haematoxylon* and *Allocasuarina fraseriana* open forest
Ecoedge (2017) Report of a Flora and Vegetation Survey of Lot 2626 Jamisons Road, Boallia	Flora and Vegetation Survey	- 92 species of vascular flora, including five naturalised species - No Threatened, Priority flora or other flora of conservation significance species - No Threatened or Priority ecological community - One vegetation unit - an open forest of Jarrah (*Eucalyptus marginata*) and Marri (*Corymbia calophylla*) - No Declared Pest plants
Ecoedge (2020) Reconnaissance and Targeted Flora and Vegetation Survey Wonnerup South Road (1.40-8.88 SLK) Upgrade	Reconnaissance and Targeted Flora and Vegetation Survey	- 97 vascular flora taxa including 39 naturalised, non-native or planted species - Five vegetation units - One Priority 4 species - *Calothamnus quadrifidus* subsp. *teretifolius* - Two declared pest plants: *Zantedeschia aethiopica* and *Asparagus asparagoides*
Stream Environment and Water (2018) Flora and vegetation assessment, Lot 75 Haag Road Yelverton	Flora and Vegetation Survey	- 108 taxa of vascular plants from 37 families, including 13 introduced species - Seven vegetation units - Swan Coastal Plain TEC - Banksia Woodland - No Threatened or Priority flora species - Two declared pest plants: *Asparagus asparagoides* and *Zantedeschia aethiopica*

Report Title	Survey Methodology	Key Survey Results
Stream Environment and Water (2021) Reconnaissance and Targeted Flora and Fauna Survey Boallia Road: Interim report	Reconnaissance and Targeted Flora and Fauna Survey	- 90 taxa of vascular plants from 29 families including 15 introduced taxa - Two potential TECs: Vulnerable SCP1b *Corymbia calophylla* woodlands on heavy soils of the southern Swan Coastal Plain and SCP02 Southern wet shrublands, Swan Coastal Plain - One Threatened species - *Grevillea brachystylis* subsp. *Grandis* - Four priority flora species: *Stylidium lowrieanum* (P3), *Loxocarya magna* (P3), *Calothamnus quadrifidus* subsp. *teretifolius*(P4), *Acacia semitrullata* (P4) - One declared pest - *Zantedeschia aethiopica* - Environmental weeds and Weed of National Significance including *Watsonia meriana* var. *bulbillifera* and Rubus fruticosus - 23 species of fauna were observed, including all three Black-Cockatoos and Western Ringtail Possum which are species of conservation significance - 123 suitable (DBH) habitat trees for Black-Cockatoos, but no evidence of use
Keighery *et al.* (2008) Floristic Survey of the Whicher Scarp	Flora and Vegetation Survey	- Analysis of a set of 124 quadrats of the Whicher Scarp - Six unique vegetation complexes, of which two are highly restricted and three have in effect less than 30% of their area remaining. - A diverse suite of woodland floristic assemblages - Restricted and rare wetland communities - More than 900 native species reflecting flora of the Jarrah Forest, south coast sands and wetlands and Swan Coastal Plain sands as well as a large number of Whicher Scarp centered species - More than 40 species having been recently described in the Whicher Scarp and about a further 25 species are expected to be able to be differentiated genetically and/or morphologically - More than 60 rare species - Ninety species at the end of their range - More than 100 species with disjunct populations - A diversity of unusual and possibly relictual habitats - High degree of intactness of native vegetation - Based on species richness, endemism, geographically distinct species, the Whicher Scarp deserves recognition as a local biodiversity hotspot in the species rich south-west

5.1.2 Threatened and Priority Flora

The DBCA database search (incorporating Western Australian Herbarium (WAH) records), NatureMap Species Report and the DCCEEW PMST conducted for the study area determined that 43 species of Threatened and Priority flora that have the potential to occur within the survey area (**Table 18**). An assessment of suitable habitat, proximity of previous records and current condition of survey area indicated that 25 of these species have the potential to be supported by the survey area (considered likely to occur or may occur) (**Figure 12**). Of these 25 flora species, seven are listed as Threatened flora, four species are P1, one is P2, nine are P3 and three are P4 taxa. Of these, 16 species are considered likely to occur, including four Threatened flora: *Banksia nivea* subsp. *uliginosa* (Endangered), *Banksia squarrosa* subsp. *argillacea* (Vulnerable), *Daviesia elongate* (Vulnerable) and *Gastrolobium modestum* (Vulnerable). Known locations of them in the vicinity of the study area are presented in **Figure 12**.

Table 18 – Threatened and Priority Flora Potentially Occurring within the Survey Area

Species	EPBC Cons. Status	WA Cons. Status	Description*	Preferred Habitat*	Likelihood of Occurrence (Pre-Survey)	Source
Brachyscias verecundus	CR	CR	Annual (or ephemeral) herb growing to 0.02 m high, entirely glabrous. Produces white/cream flowers.	In a moss sward, on granite outcrops.	**Unlikely to occur** – the closest occurrence of this species is approximately 30 km north-east of the survey area. Granite outcropping unlikely to occur within the survey area.	PMST
Caladenia busselliana	CR	CR	Tuberous perennial herb growing to 0.2 to 0.3 m high. Produces green, cream and red flowers in September to October.	Winter-wet swamps. On sandy loam.	**Unlikely to occur** - the nearest record found 18.34 km north-west of survey area on different soil and geology that is present within the survey area.	PMST
Caladenia huegelii	CR	CR	Tuberous perennial herb growing to 0.25 to 0.6 m high. Produces green, cream and red flowers in September to October.	Coastal plain. On grey or brown sand, clay loam.	**Unlikely to occur** - the nearest record found 26.7 km north-east of survey area on different soil and geology that is present within the survey area.	PMST
Eucalyptus x *phylacis*	CR	CR	Mallee or tree growing to 5 m high, with rough and flaky bark. Produces cream flowers in May.	Coastal areas. On laterite, loam over granite.	**Unlikely to occur** - the nearest record found 28.58 km north-west of survey area on different soil and geology that is present within the survey area.	PMST
Gastrolobium papilio	CR	CR	Tangled, clumped shrub growing to 1.5 m high. Produces cream-red flowers in October to December.	Flat plains. On sandy clay over ironstone and laterite.	**Unlikely to occur** - the nearest record found 8.2 km south-east of survey area on different soil though on similar geology that is present within the survey area.	NatureMap, PMST
Grevillea brachystylis subsp. *grandis*	CR	CR	Erect, spreading shrub growing to 1.8 m high. Produces red flowers in September to January.	Plains and flats, road verges. On brown sandy loam, laterite clay soils.	**May occur** - one occurrence 2.6 km west of survey area on similar soil and geology that is present within the survey area.	DBCA, NatureMap, PMST
Lambertia echinata subsp. *occidentalis*	CR	CR	Prickly, much-branched non-lignotuberous shrub growing to 3 m high. Produces yellow flowers in February or April or December.	Flats to foothills, winter-wet sites. On white sandy soils over laterite, orange, brown-red clay over ironstone.	**Unlikely to occur** - the nearest record found 16.33 km north of survey area on different soil and geology that is present within the survey area.	PMST

Species	EPBC Cons. Status	WA Cons. Status	Description*	Preferred Habitat*	Likelihood of Occurrence (Pre-Survey)	Source
Petrophile latericola	CR	CR	Multi-stemmed shrub growing from 0.4 to 1.5 m high. Produces yellow flowers in November.	Winter-wet flats. On red lateritic clay.	**Unlikely to occur** - the nearest record found 25.6 km north-west of survey area on different soil and geology that is present within the survey area.	PMST
Synaphea sp. Fairbridge Farm (D. Papenfus 696)	CR	CR	Dense clumped shrub growing to 0.3 m high and to 0.4 m wide. Produces yellow flowers in October.	Near winter-wet flats, in low woodland with weedy grasses. On sandy with lateritic pebbles.	**Unlikely to occur** - the nearest record found 64.7 km north-east of survey area on different soil though on similar geology that is present within the survey area.	PMST
Verticordia plumosa var. *ananeotes*	CR	CR	Erect sparsely branched shrub growing from 0.3 to 0.5 m high. Produces pink-purple or white flowers in November to December.	Seasonally inundated plains. On sandy loam.	**May occur** - two occurrences, one of them found 2.7 km west on similar soil and geology that is present within the survey area.	DBCA, NatureMap, PMST
Banksia nivea subsp. *uliginosa*	EN	EN	Dense, erect, non-lignotuberous shrub growing from 0.2 to 1.5 m high. Produces yellow-brown flowers in August to September.	Flat plain seasonally inundated. On sand or sandy clay, gravel.	**Likely to occur** - six occurrences on similar soil and geology that is present within the survey area. Two of which 1.2 km east of the survey area.	DBCA, NatureMap, PMST
Caladenia hoffmanii	EN	EN	Tuberous perennial herb growing to 0.13 to 0.3 m high. Produces green, yellow and red flowers in August to October.	Clay, loam, laterite, granite. On rocky outcrops and hillsides, ridges, swamps and gullies.	**Unlikely to occur** - the nearest record found 563 km north of survey area on different soil and geology that is present within the survey area.	PMST
Drakaea micrantha	EN	EN	Tuberous perennial herb growing from 0.15 to 0.3 m high. Produces red and yellow flowers in September to October.	Slope to creek line. On white-grey sand.	**Unlikely to occur** - the nearest record found 10.1 km south of survey area on different soil though on similar geology that is present within the survey area.	NatureMap, PMST
Verticordia densiflora var. *pedunculata*	EN	EN	Erect to spreading shrub growing from 0.3 to 0.6 m high. Produces pink or pink-white flowers in December or January.	Winter-wet low-lying areas. On grey or yellow sand, sandy loam.	**Unlikely to occur** - the nearest record found 6.2 km north of survey area on different soil and geology that is present within the survey area.	NatureMap, PMST

Species	EPBC Cons. Status	WA Cons. Status	Description*	Preferred Habitat*	Likelihood of Occurrence (Pre-Survey)	Source
Verticordia plumosa var. *vassensis*	EN	EN	Shrub growing from 0.3 to 1 m high. Produces pink flowers in September to December or January to February.	Winter-wet flats. On white or grey sand.	**Unlikely to occur** - the nearest record found 6.2 km north of survey area on different soil and geology that is present within the survey area.	NatureMap, PMST
Banksia mimica	VU	VU	Prostrate, lignotuberous shrub growing to 0.4 m high. Produces yellow-brown flowers from December to February.	Slopes and flats. On white or grey sand, sandy loam soils over laterite.	**May occur** - one occurrence 5 km south of survey area on different soil though similar geology that is present within the survey area.	NatureMap, PMST
Banksia squarrosa subsp. *argillacea*	VU	VU	Erect, open shrub growing to 4 m high. Produces yellow flowers from June to November.	Seasonally inundated depressions and plains and clay flats. On white-grey sand, gravelly clay or loam soils.	**Likely to occur** - four occurrences on similar soil and geology that is present within the survey area. One of which 880 m east of the survey area.	DBCA, NatureMap, PMST
Chamelaucium roycei (Syn. *Chamelaucium* sp. S coastal plain (R.D. Royce 4872))	VU	VU	Bushy shrub growing from 0.3 to 1.5 m high. Produces white to pink flowers in August to December.	Winter-wet flats, swamps, stream banks. On sandy clay, clay, lateritic soils.	**Unlikely to occur** - the nearest record found 5.6 km north-west of survey area on different soil and geology that is present within the survey area.	DBCA, NatureMap
Daviesia elongata	VU	VU	Spreading or sprawling shrub growing from 0.4 to 1 m high. Produces yellow, orange and red flowers in September or December or January to February.	Gentle slopes, undulating plain. On sand, sandy loam or laterite.	**Likely to occur** - 11 occurrences on similar soil and/or geology that is present within the survey area. Five of which found from 760 m to 1 km south and south-east of the survey area.	DBCA, NatureMap, PMST
Diuris micrantha	VU	VU	Tuberous perennial herb growing from 0.3 to 0.6 m high. Produces yellow and brown flowers in September to October.	Winter-wet swamps, in shallow water. On brown loamy clay.	**Unlikely to occur** - the nearest record found 120 km north-east of survey area on different soil and geology that is present within the survey area.	PMST
Drakaea elastica	VU	CR	Tuberous perennial herb growing from 0.12 to 0.3 m high. Produces red, green and yellow flowers in October to November.	White or grey sand. On low-lying situations adjoining winter-wet swamps.	**Unlikely to occur** - the nearest record found 14.63 km north-east of survey area on different soil and geology that is present within the survey area.	PMST

Species	EPBC Cons. Status	WA Cons. Status	Description*	Preferred Habitat*	Likelihood of Occurrence (Pre-Survey)	Source
Gastrolobium modestum	VU	VU	Prostrate to clumped shrub growing to 0.5 m high. Produces cream-green-pink flowers in September to November.	Gullies and edges of flats. On shallow red clay-loam or grey sand, ironstone.	**Likely to occur** - group of 11 occurrences found from 930 m to 1.7 km south of the survey area on similar soil and geology.	DBCA, NatureMap, PMST
Morelotia australiensis (Syn. *Tetraria australiensis*)	VU	VU	Rhizomatous tufted perennial sedge growing to 1 m high. Produces brown flowers in November to December.	Flats with grey or brown sandy clay loam.	**Unlikely to occur** - the nearest record found 26.78 km north-west of survey area on different soil and geology that is present within the survey area.	PMST
Andersonia ferricola		P1	Shrub growing from 0.2 m to 0.5 m high. Produces purple flowers in October.	Seasonally wet flats. On white sand or red-brown loam over ironstone. Seasonally wet flats.	**Likely to occur** - one occurrence 1.4 km east of survey area on similar soil and geology that is present within the survey area.	DBCA, NatureMap
Loxocarya striata subsp. *implexa*		P1	Rhizomatous tangled sedge growing from 20 to 30 cm, though can rich up to 1.2 m.	Winter wet flats, red clay. On ironstone or silty soil over massive laterite pavement.	**Likely to occur** - one occurrence 842 m east of survey area on similar soil and geology that is present within the survey area.	DBCA, NatureMap
Stylidium ferricola		P1	Caespitose perennial herb from 0.09 to 0.15 m high. Produces pale orange flowers in November.	Seasonally wet poorly drained slopes. On shallow red-brown clay loam over ironstone.	**Likely to occur** - one occurrence 1.1 km east of survey area on similar soil and geology that is present within the survey area.	DBCA, NatureMap
Thysanotus formosus		P1	Caespitose perennial herb growing to 0.3 m high. Produces purple flowers in November to December or January.	In situations often inundated in winter. On clayey sand, sandy loam.	**Likely to occur** - one occurrence 930 m south of survey area on similar soil and geology that is present within the survey area.	DBCA
Leucopogon sp. Busselton (D. Cooper 243)		P2	Slender, erect shrub growing to 0.7 m. Produces white flowers in in March, April or September.	Seasonal wet flats. On sand or sandy clay over clay.	**Unlikely to occur** - one occurrence 4.5 km north of survey area on different soil and geology that is present within the survey area.	DBCA, NatureMap
Melaleuca incana subsp. Gingilup (N. Gibson & M. Lyons 593)		P2	Shrub growing from 1.2 to 1.8 m high. Produces cream-yellow flowers in May to Jun.	Seasonally wet flats. On red-grey sand, sandy clay over ironstone.	**Likely to occur** - one occurrence 1.9 km west of survey area on similar soil and geology that is present within the survey area.	DBCA

Species	EPBC Cons. Status	WA Cons. Status	Description*	Preferred Habitat*	Likelihood of Occurrence (Pre-Survey)	Source
Boronia tetragona		P3	Perennial herb growing from 0.3 to 0.7 m high, leaves sessile, entire, with papillate margins, branches quadrangular, sepals ciliate. Produces pink & red flowers in October to December.	Winter-wet flats, swamps, open woodland. On black or white sand, laterite, or brown sandy loam.	**May occur** - one occurrence 4.4 km south-east of survey area on different soil though similar geology that is present within the survey area.	DBCA, NatureMap
Calothamnus lateralis var. *crassus*		P3	Shrub growing to 1.5 m high. Produces red flowers in August to September.	Wet depressions. On sand.	**May occur** - one occurrence 2.9 km west of survey area on different soil though similar geology that is present within the survey area.	DBCA, NatureMap
Grevillea brachystylis subsp. *brachystylis*		P3	Much-branched, prostrate or decumbent, non-lignotuberous shrub growing from 0.2 to 0.5 m high and to 3 m wide. Produces red flowers in August to November.	Swampy situations. On black sand, sandy clay.	**Likely to occur** - two occurrences, with one of them found 1.6 km west of survey area on similar soil and geology that is present within the survey area.	DBCA, NatureMap
Hakea oldfieldii		P3	Open, straggling shrub growing to 2.5 m high. Produces white-cream or yellow flowers in August to October.	Seasonally wet flats. On red clay or sand over laterite.	**Likely to occur** - five occurrences, with one of them found 1.6 km west of survey area on similar soil and geology that is present within the survey area.	DBCA, NatureMap
Isopogon formosus subsp. *dasylepis*		P3	Low upright, non-lignotuberous shrub growing from 0.2 to 2 m high. Produces pink-purple or red flowers in June to December.	Often swampy areas. On sand, sandy clay, gravelly sandy soils over laterite.	**Likely to occur** - five occurrences on similar soil and geology that is present within the survey area; one of which found 250 m east of the survey area.	DBCA, NatureMap
Lasiopetalum laxiflorum		P3	Erect, compact perennial shrub growing up to 1.5 m high. Produces purple/pink sticky flowers in October to December.	Hill, sandy clay over ironstone/laterite.	**Likely to occur**- three occurrences approximately 6 km south-west/south-eat of the survey area. Similar geology likely present within the survey area.	DBCA
Loxocarya magna		P3	Rhizomatous, perennial sedge-like herb growing from 0.5 to 1.5 m high. Produces flowers in September or November.	Seasonally inundated or damp habitats. On sand, loam, clay, ironstone.	**Likely to occur** - one occurrence 1.05 km east of survey area on similar soil and geology that is present within the survey area.	DBCA, NatureMap

Species	EPBC Cons. Status	WA Cons. Status	Description*	Preferred Habitat*	Likelihood of Occurrence (Pre-Survey)	Source
Pultenaea pinifolia		P3	Erect, slender multi-stemmed shrub growing from 1 to 3 m high. Produces flowers with yellow and orange parts from September to November.	Floodplains and swampy areas. On loam or clay soils.	**May occur** - population of six records found from 3.5 to 4.2 km north-west of survey area on different soil and geology that is present within the survey area.	DBCA, NatureMap
Schoenus benthamii		P3	Tufted perennial sedge growing from 0.15 to 0.45 m high. Produces brown flowers from October to November.	Winter-wet flats and swamps. On white, grey sand, sandy clay soils.	**Unlikely to occur** - one occurrence 3.5 km north of survey area on different soil and geology that is present within the survey area.	DBCA, NatureMap
Synaphea hians		P3	Prostrate or decumbent shrub growing from 0.15 to 0.6 m high and to 1 m wide. Produces yellow flowers in July or September to November.	Rises. On sandy soils.	**May occur** - one occurrence 2.9 km west of survey area on different soil though similar geology that is present within the survey area.	DBCA, NatureMap
Synaphea petiolaris subsp. *simplex*		P3	Tufted shrub growing from 0.1 to 0.6 m high. Produces yellow flowers in September to October.	Flats, winter-wet areas. On sandy soils.	**Likely to occur** - one occurrence 1.6 km east of survey area on similar soil and geology that is present within the survey area.	DBCA, NatureMap
Calothamnus quadrifidus subsp. *teretifolius*		P4	Erect or sprawling shrub growing to 2 to 3 m high, leaves are linear. Produces red flowers in November.	Flats, winter wet flats or slopes. On grey sand or red-brown clay loam.	**Likely to occur** - four occurrences on similar soil and geology that is present within the survey area. One of which is found 88 m east of the survey area.	DBCA, NatureMap
Chamelaucium erythrochlorum		P4	Erect shrub growing to 1.5 (-2) m high. Produces pink-red flowers in November to December or January.	Flats or slopes. On gravelly lateritic soils, clayey sand or clay.	**May occur** - one occurrence 2.6 km west of survey area on similar soil and geology that is present within the survey area.	DBCA
Lambertia rariflora subsp. *rariflora*		P4	Small tree or shrub growing to 7 m high. Produces green, yellow-green flowers in February to Mar or May.	Near intermittent streams. On red-brown clay soils, black organic loam or laterite.	**May occur** - four occurrences from 2.1 km to 3.1 km south of survey area on different soil though similar geology that is present within the survey area.	DBCA, NatureMap

Figure 12 - Threatened and Priority Flora

Legend

Survey Area
Study Area

Threatened
- ⬟ Banksia nivea subsp. uliginosa
- ⬟ Banksia squarrosa subsp. argillacea
- ⬟ Daviesia elongata
- ⬟ Gastrolobium modestum
- ⬟ Grevillea brachystylis subsp. grandis
- ⬟ Verticordia plumosa var. ananeotes

Priority 1
- ▲ Andersonia ferricola
- ▲ Loxocarya striata subsp. implexa
- ▲ Stylidium ferricola
- ▲ Thysanotus formosus

Priority 2
- ◆ Leucopogon sp. Busselton
- ◆ Melaleuca incana subsp. Gingilup

Priority 3
- ■ Boronia tetragona
- ■ Calothamnus lateralis var. crassus
- ■ Grevillea brachystylis subsp. brachystylis
- ■ Hakea oldfieldii
- ■ Isopogon formosus subsp. dasylepis
- ■ Lasiopetalum laxiflorum
- ■ Loxocarya magna
- ■ Pultenaea pinifolia
- ■ Schoenus benthamii
- ■ Synaphea hians
- ■ Synaphea petiolaris subsp. simplex

Priority 4
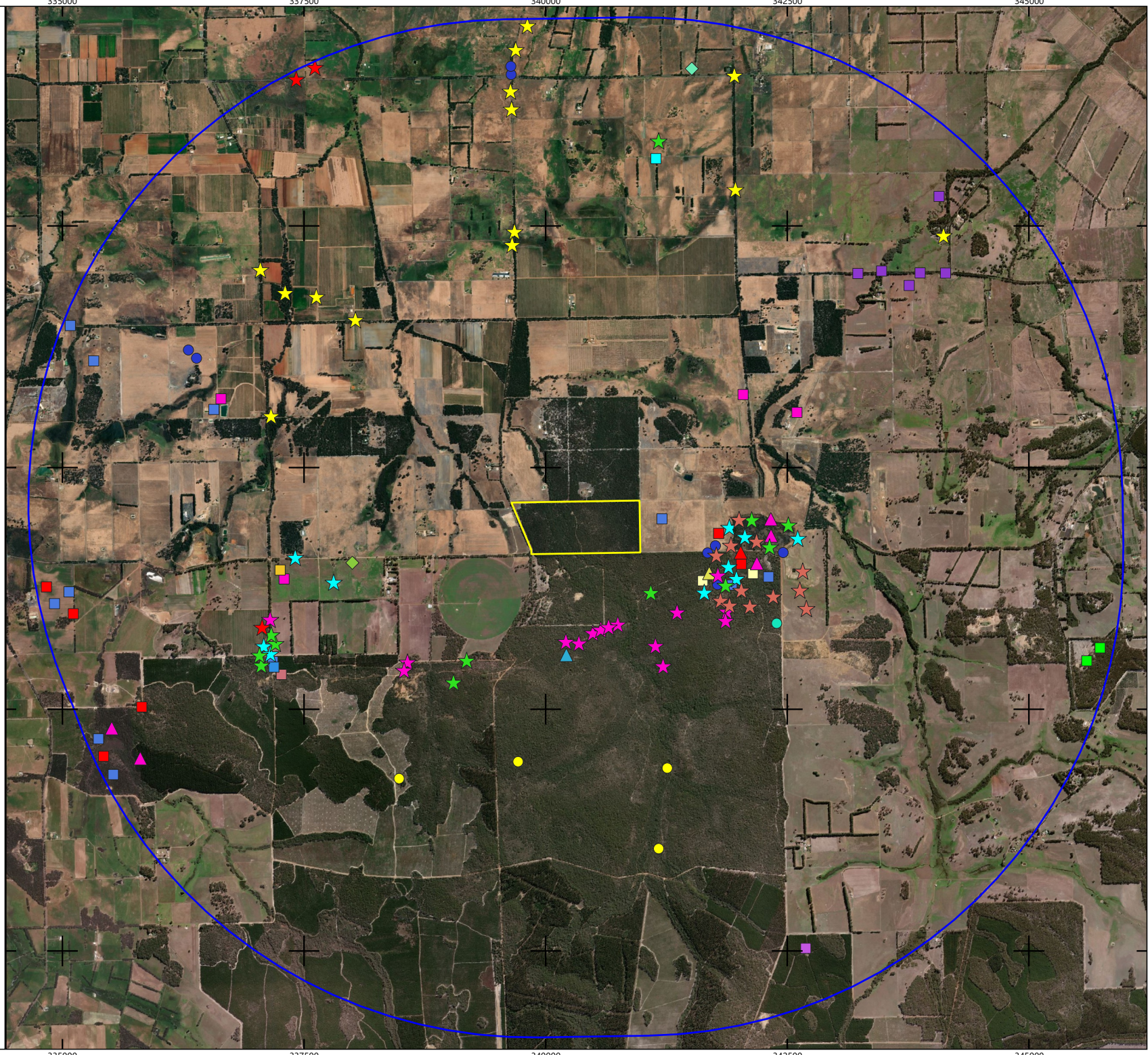- ● Calothamnus quadrifidus subsp. teretifolius
- ● Chamelaucium erythrochlorum
- ● Lambertia rariflora subsp. rariflora

0 1 2 3 km
GDA 2020 / MGA Zone 50

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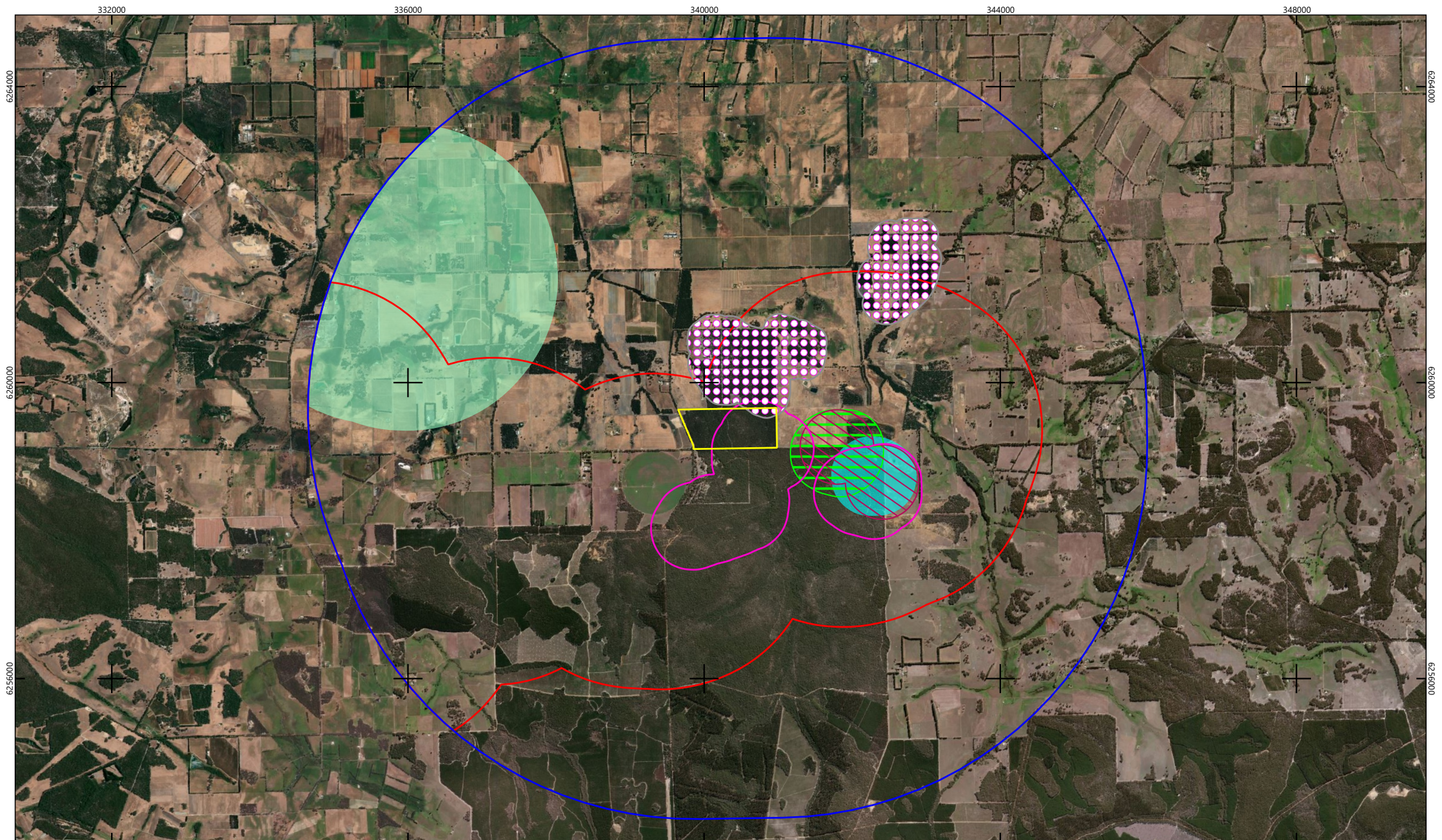
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5.1.3 Threatened and Priority Ecological Communities

A review of DBCA's TEC and PEC database, the PMST report (DCCEEW 2023b) and the Gibson *et al.* (1994) and Keighery *et al.* (2008) datasets identified seven significant ecological communities found or predicted to occur within 5 km of survey area (**Table 19**). The likelihood of occurrence of each TEC and PEC is determined through assessment of various factors such as the FCTs present nearby, soil land systems, geology and known extent of the relevant TECs and PECs. Three of these seven Threatened and Priority Ecological Communities, or their associated buffer, also occur within the survey area: SCP10b, Banksia WL SCP and Whicher Scarp C1 (**Figure 13**). The known extent of these State-listed TECs and PECs returned from the database search is presented in **Figure 13**.

Table 19 – Threatened and Priority Ecological Communities Potentially Occurring within the Survey Area

Abbreviated Identifier	Community Name	EBPC Cons. Status	WA Cons. Status
SCP10b	Shrublands on southern Swan Coastal Plain Ironstones (Busselton area) (floristic community type 10b as originally described in Gibson *et al.* (1994))	EN	CR
Banksia WL SCP	Banksia Woodlands of the Swan Coastal Plain	EN	P3
Whicher Scarp C1	Central Whicher Scarp Jarrah woodland		P1
Whicher Scarp C2	Whicher Scarp Jarrah woodland of deep coloured sands		P1
Whicher Scarp G2	Shrublands of near permanent wetlands in creek lines of the Whicher Scarp (Whicher Scarp community G2)		P1
Whicher Scarp Paluslope Wetlands	Swan Coastal Plain Paluslope Wetlands		P1
SCP1a*	*Eucalyptus haematoxylon - E. marginata* woodlands on Whicher foothills		P3

*Reallocated to the Whicher Scarp (WHS) types (PECs) and recommended by DBCA in 2021 to be delisted (DBCA pers. com.), therefore, no longer considered a PEC and not addressed further in this report

Figure 13 - Threatened and Priority Ecological Communities

Legend

Survey Area
Study Area
Banksia WL SCP
SCP10b
SCP1a
Whicher Scarp C1
Whicher Scarp C2
Whicher Scarp G2
Whicher Scarp Paluslope Wetlands

GDA 2020 / MGA Zone 50

0 1 2 3 4 km

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5.1.4 Significant Fauna

The NatureMap Species Report (**Appendix A**), PMST Report (DCCEEW 2023b) (**Appendix B**) and DBCA Threatened and Priority Fauna database search identified 19 significant fauna species that were considered to potentially occur within the survey area, of these were; eight birds, 10 mammals and one reptile (**Table 20**, **Figure 14**). The potential habitat within the survey area was assessed against habitat preference for each species, as well as the distance and age of previous records, to determine the likelihood of their occurrence. Of the potential 19 species identified, nine were considered not to occur, nine were considered regular visitors, and one species was considered to be a resident within the survey area, *Pseudocheirus occidentalis* (Western Ringtail Possum) (**Table 20**). Of the ten species considered to be either residents or regular visitors within the survey area, five are CS1, two are CS2, two are S6 and one S7, including;

- *Pseudocheirus occidentalis* (Western Ringtail Possum) – Resident, CS1
- *Zanda baudinii* (Baudin's Black-Cockatoo) – Regular Visitor, CS1
- *Zanda latirostris* (Carnaby's Black-Cockatoo) – Regular Visitor, CS1
- *Calyptorhynchus banksii naso* (Forest Red-tailed Black Cockatoo) – Regular Visitor, CS1
- *Dasyurus geoffroii* (Chuditch) – Regular Visitor, CS1
- *Falsistrellus mackenziei* (Western Falsistrelle) – Regular Visitor, CS2
- *Isoodon fusciventer* (Quenda) – Regular Visitor, CS2
- *Cacatua pastinator pastinator* (Muir's Corella) – Regular Visitor, S6
- *Phascogale tapoatafa wambenger* (South-western Brush-tailed Phascogale) – Regular Visitor, S6
- *Falco peregrinus* (Peregrine Falcon) – Regular Visitor, S7.

All three of the Black-Cockatoo species are considered to be regular visitors of the survey area.

**Table 20 – Significant Fauna Potentially Occurring within the Survey Area**

Species	EPBC Cons. Code	WA Cons. Code	Significance	Preferred Habitat	Pre-Survey Expected Occurrence	Source
BIRDS						
Zanda baudinii (Baudin's Black-Cockatoo)	EN	EN	CS1 (EN, S2[en])	Dense Jarrah, Karri, and Marri forests. Species nest in large hollows in these species.	**Regular Visitor** – Suitable habitat present. Database searches indicate species and/or species habitat known to occur within area. DBCA database closest record approximately 6.2 km south-east of the survey area, recorded in 2003.	DBCA, NatureMap, PMST
Zanda latirostris (Carnaby's Black-Cockatoo)	EN	EN	CS1 (EN, S2[en])	Dense Jarrah, Karri, and Marri forests. Species nest in large hollows in these species.	**Regular Visitor** – Suitable habitat present. Database searches indicate species and/or species habitat known to occur within area. DBCA database closest record to the survey area is approximately 4.1 km north-east, recorded in 2009.	DBCA, NatureMap, PMST
Calyptorhynchus banksii naso (Forest Red-tailed Black-Cockatoo)	VU	VU	CS1 (VU, S3[vu])	Dense Jarrah, Karri, and Marri forests. Species nest in large hollows in these species.	**Regular Visitor** – Suitable habitat present. Database searches indicate species and/or species habitat known to occur within area. DBCA database search closest record is 3.3 km south-east of the survey area, recorded in 2017.	DBCA, NatureMap, PMST
Falco hypoleucos (Grey Falcon)	VU	VU	CS1 (VU, S3[vu])	Areas where annual rainfall is less than 500 mm. Known to frequent timbered lowland plains and Acacia shrublands crossed by tree lined water courses. Hunts in open areas, grassland, and open woodland.	**Would not occur** – No suitable habitat provided. PMST database indicates species and/or species habitat may occur within area; however, no DBCA database records.	PMST
Leipoa ocellata (Malleefowl)	VU	VU	CS1 (VU, S3[vu])	Semi-arid to arid shrublands and low woodlands dominated by mallee and/or Acacia.	**Would not occur** – No suitable habitat provided. DBCA database closest record is approximately 8.3 km south-east of the survey area, recorded in 2011.	DBCA, NatureMap
Oxyura australis (Blue-billed Duck)		P4	CS2 (P4)	Deep freshwater areas with dense vegetation.	**Would not occur** - No suitable habitat provided. DBCA database closest record is approximately 13.5 km north of the survey area, recorded in 2001.	DBCA, NatureMap

Species	EPBC Cons. Code	WA Cons. Code	Significance	Preferred Habitat	Pre-Survey Expected Occurrence	Source
Cacatua pastinator pastinator (Muir's Corella)		CD	S6	Large live or dead eucalypts, particularly *Corymbia calophylla* and *Eucalyptus marginata*, *E. rudis*, *E. cornuta* and *Melaleuca preissiana* in forested areas or as lone trees in paddocks and along roadsides.	**Regular visitor** – Suitable habitat potentially present. DBCA database closest record is approximately 11.1 km north-east of the survey area (no date recorded).	DBCA, NatureMap
Falco peregrinus (Peregrine Falcon)		OS	S7	Generalist, wide variety. Prefers coastal and inland cliffs or open woodlands near water.	**Regular visitor** – Potentially suitable habitat may be present. DBCA database closest record approximately 8.7 km west of the survey area, recorded in 2018. The survey area could represent part of its home range as they maintain a home range 20-30 km^2 throughout the year (The Australian Museum 2019).	DBCA, NatureMap
MAMMALS						
Pseudocheirus occidentalis (Western Ringtail Possum)	CR	CR	CS1 (CR, S1[cr])	Coastal Areas of Peppermint woodland and Peppermint / Tuart woodland associations.	**Resident** – Potential breeding habitat present. PMST indicated that breeding is known to occur within region. DBCA database closest record is approximately 5.7 km east of the survey area, recorded in 2015.	DBCA, NatureMap, PMST
Bettongia penicillata ogilbyi (Woylie)	EN	CR	CS1 (EN, S1[cr])	Open forest and woodland with low understorey of woody scrub. Woodlands and adjacent heaths with a dense understorey of shrubs. Tall Eucalypt forest and woodland, dense myrtaceous shrubland, kwongan or mallee heath.	**Would not occur** – Outside known range. DBCA database closest record in approximately 10.2 km north-west of the survey area, records in 2011.	DBCA, NatureMap
Dasyurus geoffroii (Chuditch)	VU	VU	CS1 (VU, S3[vu])	Variety, most dense in riparian Jarrah forests. Require large, unfragmented habitats.	**Regular Visitor** – Suitable habitat potentially present. PMST indicated species and/or species habitat likely to occur within area. Closest DBCA database record is approximately 0.5 km south of the survey area, recorded in 2017.	DBCA, NatureMap, PMST
Macrotis lagotis (Bilby)	VU	VU	CS1 (VU, S3[vu])	Open tussock grassland on uplands and hills, *Acacia aneura* (mulga) woodland/shrubland growing on ridges and rises, and hummock grassland in plains and alluvial areas.	**Would not occur** - No suitable habitat provided. Outside known range. Closest DBCA database record is approximately 13.9 km south-west of the survey area, recorded in 1932 (historical).	DBCA, NatureMap

Species	EPBC Cons. Code	WA Cons. Code	Significance	Preferred Habitat	Pre-Survey Expected Occurrence	Source
Setonix brachyurus (Quokka)	VU	VU	CS1 (VU, S3[vu])	Mainly dense riparian vegetation, other areas with dense vegetated understorey in proximity to freshwater.	**Would not occur** – Outside known range, although suitable habitat potentially present. PMST indicated species and/or species habitat may occur within area. DBCA database closest record is approximately 17 km south-west of the survey area, record in 1965.	DBCA, NatureMap
Falsistrellus mackenziei (Western Falsistrelle)		P4	CS2 (P4)	Wet sclerophyll forests of Karri, Jarrah, and Tuart eucalypts. Roost in hollows in old trees, branches, and stumps	**Regular visitor** - Suitable habitat potentially present. Closest DBCA database record is approximately 7.3 km south-east of the survey area, recorded in 2018.	DBCA, NatureMap
Hydromys chrysogaster (Rakali)		P4	CS2 (P4)	Found near permanent fresh or brackish waters.	**Would not occur** - No suitable habitat provided. Two DBCA records occur approximately 5.7 km east of the survey area, recorded in 2015.	DBCA, NatureMap
Isoodon fusciventer (Quenda)		P4	CS2 (P4)	Forest, woodland, shrub, and heath, usually in sandy soils with dense healthy vegetation in lower stratum.	**Regular visitor** – Some suitable habitat potentially present. Closest DBCA database record to the survey area approximately 5.8 km north-east (no record date).	DBCA, NatureMap
Notamacropus irma (Western Brush Wallaby)		P4	CS2 (P4)	Some areas of mallee and heathland. Uncommon in wet sclerophyll forests.	**Would not occur** - No suitable habitat provided. Closest DBCA database record approximately 0.5 km south of the survey area, recorded in 2014.	DBCA, NatureMap
Phascogale tapoatafa wambenger (South-western Brush-tailed Phascogale)		CD	S6	Highly arboreal, prefers open forest with sparse groundcover.	**Regular visitor** – Some suitable habitat potentially present. Closest DBCA database record approximately 0.5 km south of the survey area, recorded in 2014 and 2017.	DBCA, NatureMap
REPTILES						
Ctenotus ora (Coastal Plains Skink)		P3	CS2 (P3)	Coastal Plains, Sand dunes between Dunsborough and Mandurah.	**Would not occur** - No suitable habitat provided. Closest DBCA database record approximately 12.6 km north-east of the survey area, recorded in 2011. All other records are clustered together near this closest record.	DBCA, NatureMap

Legend

Survey Area

Study Area

Threatened - Endangered

★ Carnaby's cockatoo

☆ White-tailed black cockatoo

Threatened - Vulnerable

★ Carter's freshwater mussel

★ Chuditch, western quoll

★ Forest red-tailed black cockatoo

Specially Protected - Conservation Dependent

✚ South-western brush-tailed phascogale, wambenger

Specially Protected - Migratory

✚ Sharp-tailed sandpiper

Priority 4

● Quenda, southwestern brown bandicoot

● Western brush wallaby

Figure 14 - Significant Fauna

0   1   2   3 km

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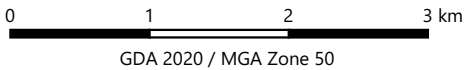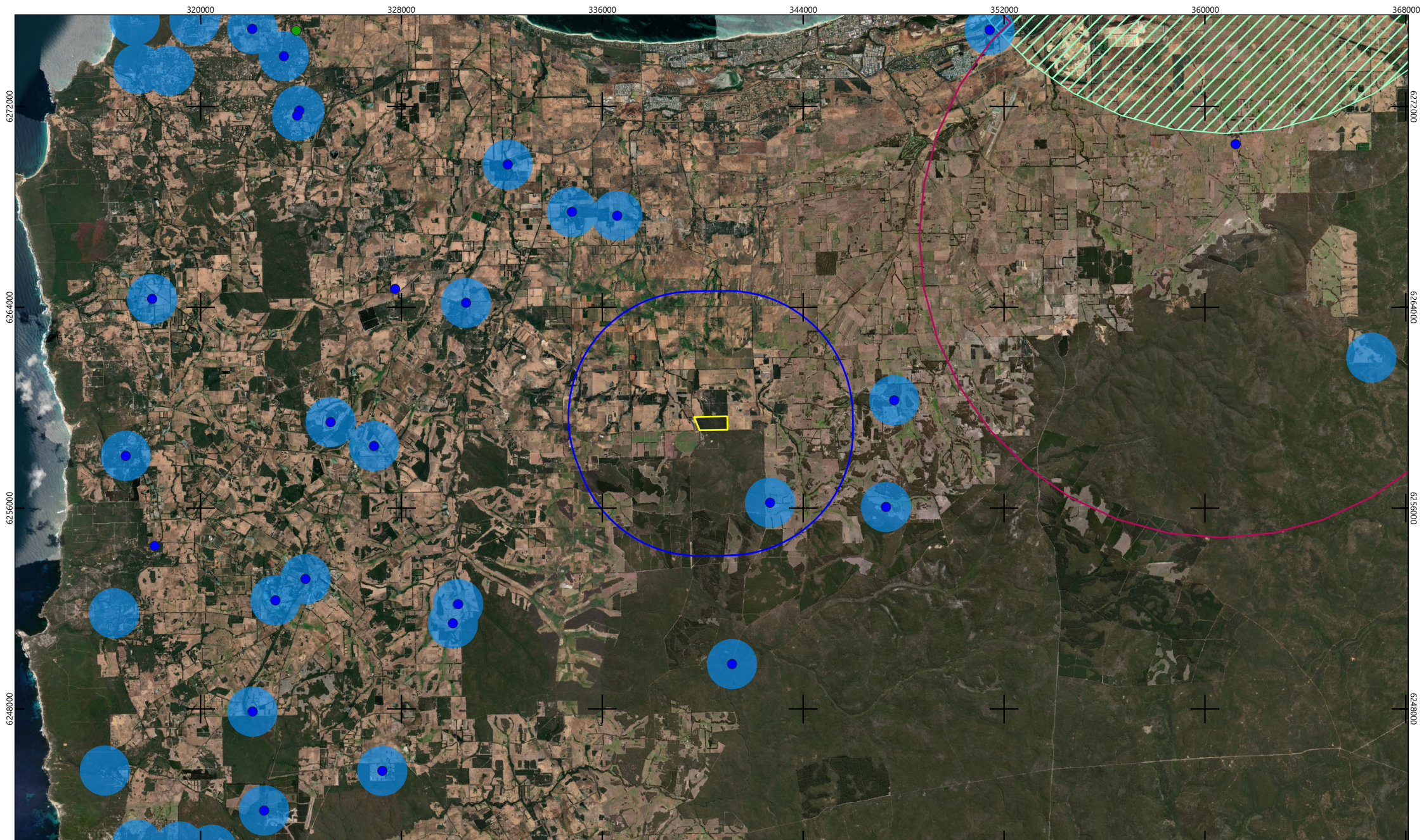
5.1.5   Black-Cockatoo Habitat

The desktop assessment identified no confirmed or unconfirmed Black-Cockatoo breeding sites that occur within the survey area. Two confirmed breeding sites are in the vicinity of the survey area, one for Forest Red-tailed Black-Cockatoo and one for Carnaby's Black-Cockatoo, approximately 22 km north-west and 19 km north-east of the survey area, respectively (**Figure 15**).

Both Carnaby's and Forest Red-tailed Black-Cockatoos are known to roost communally, and often use the same sites over long time periods (Peck *et al.* 2017). The desktop assessment revealed that there are no confirmed or unconfirmed Carnaby's Black-Cockatoo roosting sites within the study area, and the closest confirmed roost site is approximately 52 km north-east of the survey area. There is one Black-Cockatoo (species not specified) roost site within the study area, approximately 2.4 km south-east of the survey area (**Figure 15**). However, there are five other known roost sites within 10 km of the survey area, suggesting that the survey area is within their active range and could potentially support breeding, foraging and roosting habitat.

5.1.6   Western Ringtail Possum and South-western Brush-tailed Phascogale Habitat

The desktop assessment revealed that the survey area supports three levels of Western Ringtail Possum habitat suitability (high, medium and low) (DBCA 2018). Close to half of the survey area is comprised of habitat of medium suitability (32.62 ha, 53.63%) located in the west and central portions (**Figure 16**). Habitat of high suitability is associated with the two water courses that intersect the survey area in the central portion, totalling 12.04 ha (19.79%).

The South-western Brush-tailed Phascogale is known to utilise dry sclerophyll open woodlands of the south-west Western Australia (DEC 2012a; DBCA [no date]) with hollows containing Jarrah and Marri upper storey for nesting and foraging bark associated invertebrates (Rhind 1996). There is no publicly available habitat mapping for the South-western Brush-tailed Phascogale, however the desktop assessment revealed there have been two observations of the species within the study area, approximately 0.4 km south of the survey area and four additional observations within 5 km from the survey area (**Figure 14**). The proximity of these observations to the survey area suggests that suitable habitat is likely present.
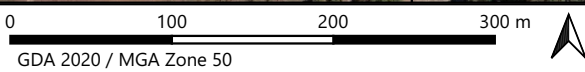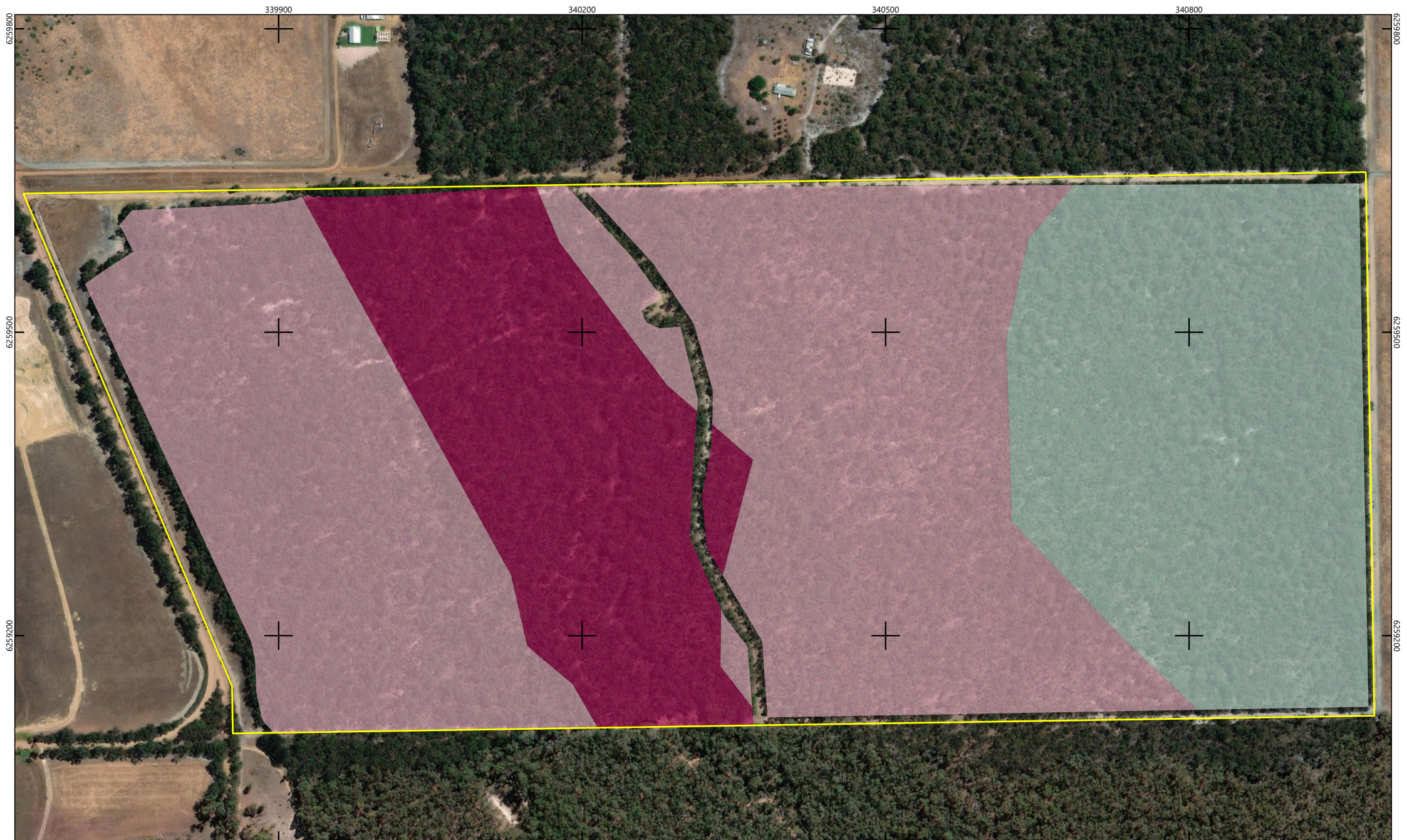
Figure 15 - Black-Cockatoo Habitat

Legend

Survey Area (yellow outline)	Carnabys Cockatoo Confirmed Breeding Sites (green hatched)
Study Area (blue outline)	Black Cockatoo Confirmed Roost Sites (blue fill)
Black Cockato Confirmed Roost Sites (blue dot)	Carnabys Cockatoo Unconfirmed Breeding Sites (pink line)
Forest Red Tailed Black Cockatoo Confirmed Breeding Sites (green dot)	

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0   5   10 km

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Figure 16 - Western Ringtail Possum Habitat

GDA 2020 / MGA Zone 50

0   100   200   300 m

Legend

Survey Area

High

Medium

Low

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