



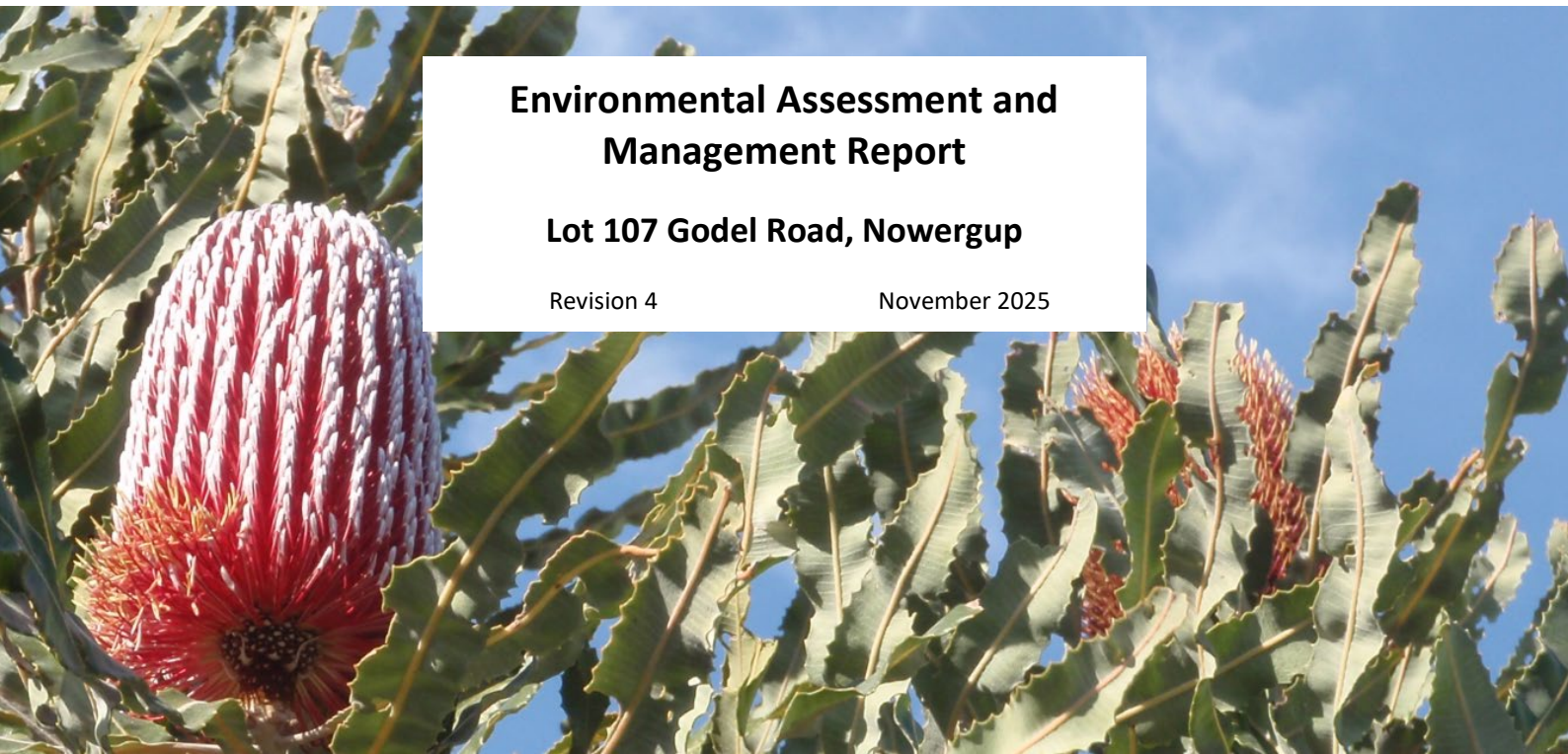
COTERRA
ENVIRONMENT

**Environmental Assessment and
Management Report**

Lot 107 Godel Road, Nowergup

Revision 4

November 2025



CALIBRE | COMMITMENT | COLLABORATION

This report was prepared by: Coterra Pty Ltd trading as COTERRA ENVIRONMENT

ABN: ABN: 92 143 411 456

Our Ref: URENOW01

Author(s): E. O'Brien & K Watts

Reviewer: K Watts & C. Norman

Report Version: Revision 4

Date: September 2025

This report was prepared for:

Urban Resources

33 Cocos Drive

Bibra Lake DC WA 6965

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1 Introduction

1.1 Background

Lot 107 Godel Road (No. 59) is located approximately 40 kilometres (km) north of the Perth Central Business District (CBD), in the City of Wanneroo (the site). The site is zoned 'Rural' under the Metropolitan Region Scheme (MRS), and 'Rural Resource' under the City of Wanneroo District Planning Scheme No. 2 (DPS2) (CoW, 2024a).

The site is approximately 18.93 hectares (ha) in size and is currently undeveloped, containing native vegetation in 'Degraded' to 'Completely Degraded' condition (Figure 1).

1.2 Existing Land Use

Historic aerial imagery indicates that the site had been partially cleared, likely for agricultural purposes, prior to 1965. Vegetation has regrown since the clearing, and the site has not undergone any development or vegetation clearing since this time. The site contains multiple informal accessways, which can be seen on aerial imagery from 1965, and which have increased in both number and extent since this time (Landgate, 2024a; Figure 1).

Surrounding land uses are typical of rural localities, including a poultry farm and market garden immediately south of the site, quarries immediately to the north and to the east of the site, intensive horticultural operations to the northwest, rural properties to the south-west of the site and uncleared bushland to the west.

1.3 Proposed Development

Urban Resources proposes to undertake resource extraction within the site. This will involve the following:

- Clearing of up to 13.94 ha of native vegetation by mechanical removal
- Access road installation (within the clearing footprint)
- Excavation of approximately 1,123,000 cubic meters of sand and limestone materials over an anticipated 10 year project lifetime
- Implementation of environmental management commitments and conditions.

1.4 Purpose of this Report

This Environmental Assessment and Management Report (EAMR) was prepared to describe the environmental values of the site and surrounds, identify potential environmental impacts of the proposed development and to outline actions proposed to effectively mitigate and manage these matters.

1.5 Relevant Legislation, Guidance and Policies

1.5.1 Federal Legislation

1.5.1.1 Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) aims to protect and manage nine Matters of National Environmental Significance (MNES) throughout Australia including:

- World Heritage Properties
- National Heritage Places
- Wetlands of international importance (listed under the Ramsar Convention)
- Nationally threatened species and ecological communities
- Migratory species protected under international agreements
- Commonwealth Marine Areas
- The Great Barrier Reef Marine Park
- Nuclear actions (including uranium mines)
- Water resources, that relate to unconventional gas development and large coal mining development.

Referral to the commonwealth Department of Climate Change, Energy, the Environment and Water (DCCEEW) under this Act is required where an action may have a significant impact on a MNES.

1.5.2 State Legislation

1.5.2.1 Environmental Protection Act 1986

The *Environmental Protection Act 1986* (EP Act) is the pre-eminent environmental legislation in Western Australia. Development projects are regulated under Part IV of the Act. The Act also has a number of Environmental Protection Policies and Regulations which provide guidance on environmental management.

1.5.2.2 Environmental Protection (Clearing of Native Vegetation) Regulations 2004

The *Environmental Protection (Clearing of Native Vegetation) Regulations 2004* regulate the clearing of native vegetation in Western Australia. The regulations identify the requirements for obtaining a Native Vegetation Clearing Permit and identify potential exemptions.

1.5.2.3 Biodiversity Conservation Act 2016

The *Biodiversity Conservation Act 2016* (BC Act) and *Biodiversity Conservation Regulations 2018* provide protection for biodiversity, including threatened species and threatened ecological communities. They identify the requirements for approvals relating to impacts to flora, fauna and ecological communities, reporting and development of environmental plans and agreements.

1.5.3 State Policies and Guidance

The following State Planning Policies are potentially relevant to development proposed at the site:

- State Planning Policy (SPP) 2.0 – Environment and Natural Resources Policy (WAPC, 2003)
- SPP 2.4 – Planning for Basic Raw Materials (DPLH & WAPC, 2021a), and the associated Planning for Basic Raw Materials Guidelines (DPLH & WAPC, 2021b)
- Draft SPP 2.9 – Water Resources (DPLH & WAPC, 2021c)
- SPP 3.7 - Planning in bushfire prone areas (DoP & WAPC, 2015)



In addition, the following Environmental Protection Authority (EPA) technical guidance documents have been considered in the preparation of this report:

- Separation Distances Between Industrial and Sensitive Land Uses (EPA, 2005)
- Flora and Vegetation surveys for Environmental Impact Assessment (EPA, 2016)
- Terrestrial vertebrate surveys for environmental impact assessment (EPA, 2020).

1.5.4 City of Wanneroo Guidance

The City of Wanneroo has developed several local planning policies (LPP) and environmental guidance documents which are relevant to planning and the environmental matters related to the site including:

- Environmental Management Plan Guidelines (CoW, 2018a)
- Local Environment Strategy (CoW, 2019)
- *Local Biodiversity Plan 2018/19 – 2023/2* (CoW, 2019)
- LPP 3.3: *Fauna Management* (CoW, 2022a)
- LPP 4.8: *Tree Preservation* (CoW, 2024a)
- LPP 4.13: *Caves and Karstic Features* (CoW, 2022b).

2 Existing Environment

2.1 Climate

The climatic conditions experienced in this area include warm dry summers and cool wet winters. Temperatures range (as observed at the Gingin Aero weather station, approximately 22 km northeast of the site) from a mean maximum in summer of 33.3°C (January & February) to a mean minimum of 6.5°C (August) (BoM, 2024).

The mean annual rainfall experienced at this location is 632 millilitres (mm), with the majority of rain falling between May to September (Plate 2-1).

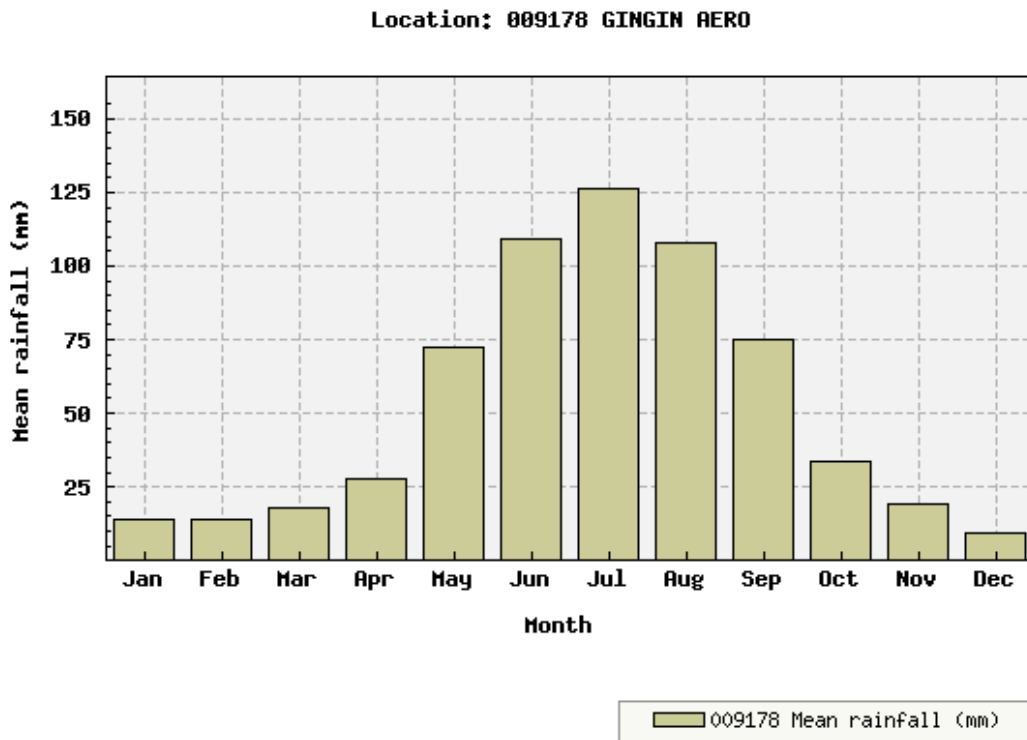


Plate 2-1: Mean Annual Rainfall

Source: BoM, 2024

Bureau of Meteorology climate data indicates that the strongest wind in this location occurs in January afternoons, and is recorded from a south westerly direction. Copies of the seasonal wind roses are provided in Plate 2-2 to Plate 2-5 (BoM, 2024).



9 am Jan
802 Total Observations

Calm *

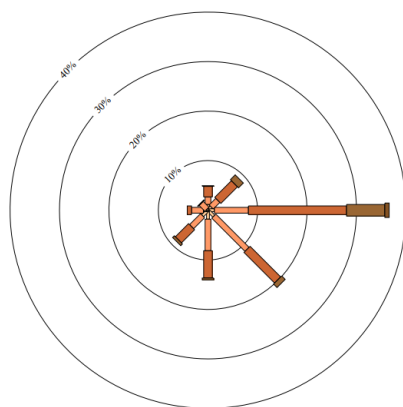
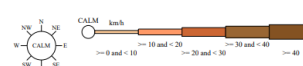


Plate 2-2: Wind Rose – January 9am



3 pm Jan
801 Total Observations

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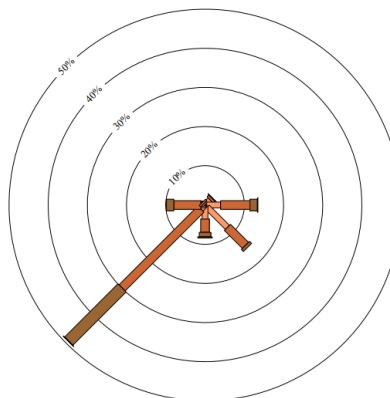


Plate 2-3: Wind Rose – January 3pm



9 am Jul
852 Total Observations

Calm 5%

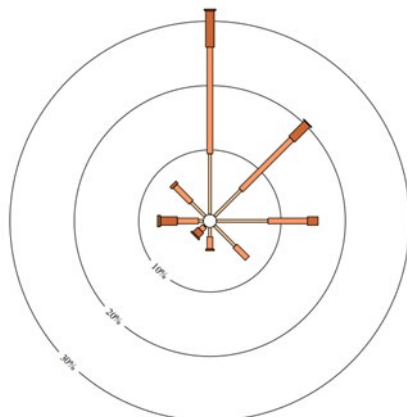
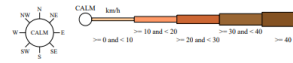


Plate 2-4: Wind Rose – July 9am



3 pm Jul
851 Total Observations

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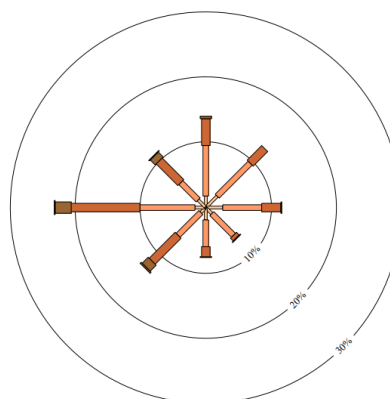


Plate 2-5: Wind Rose – July 3pm

2.2 Topography and Landforms

Topography within the site ranges between 22 metres Australian Height Datum (mAHD) in the southwestern corner to 48 mAHD to the northeastern corner of the lot (Landgate 2024b, Figure 2).

The site forms part of the Cottesloe Soil and Landform unit which is described as a low hilly landscape with shallow brown sands over limestone, with exposed limestone also present (Churchward & McArthur, 1980).

2.3 Geology and Soils

2.3.1 Description

Soils within the project area are mapped as comprising Sand derived from Tamala Limestone (Unit S7), described as 'Sand - pale and olive yellow, medium to coarse-grained, sub-angular quartz with a trace of

feldspar, moderately sorted, of residual origin’. This unit is considered compatible with excavation/mining (Gozzard, 1982).

The Department of Primary Industries and Regional Development (DPIRD) maps soils within the site as comprising the Spearwood Sand Phase and Karrakatta Sand Yellow Phase (DPIRD, 2024). These systems are described in Table 2-1. Table 2-2 lists the land degradation risk categories for each of the above soils.

Table 2-1: Land Systems

Mapping Units	Land System	Description
211Sp__Sp	Spearwood Sand phase	Irregular banks of karst depressions. Some limestone outcrop. Shallow brown sands. Banksia spp. woodland with emergent <i>E. gomphocephala</i> and <i>E. marginata</i> ; dense shrub layer
211Sp__Ky	Karrakatta Sand Yellow phase	Low hilly to gently undulating terrain. Yellow sand over limestone at 1-2 m. Banksia spp. woodland with scattered emergent <i>E. gomphocephala</i> and <i>E. marginata</i> and a dense shrub layer

Source: DPIRD, 2024

Table 2-2: Land degradation Risk categories

Land Degradation Risk Category	211Sp__Sp	211Sp__Ky
Water Erosion	5% of map unit has a very high to extreme hazard	0% of map unit has a very high to extreme hazard
Wind Erosion	98% of map unit has a high to extreme hazard	98% of map unit has a high to extreme hazard
Flood Hazard	0% of the map unit has a moderate to high hazard	0% of the map unit has a moderate to high hazard
Salinity Risk	0% of map unit has a moderate hazard	0% of map unit has a moderate hazard
Waterlogging and Inundation	0% of map unit has a moderate to very high risk	0% of map unit has a moderate to very high risk

Source: DPIRD, 2024

2.3.2 Basic Raw Materials

State Planning Policy 2.4 – Planning for Basic Raw Materials (DPLH & WAPC, 2021a) identifies Significant Geological Supplies (SGS) which are the highest priority extractions areas for Basic Raw Materials (BRM). BRM mapping available through GeoView.WA identifies the site as containing a regionally significant ‘limestone, high grade’ resource (DMIRS, 2024).

2.3.3 Caves and Karst

The City of Wanneroo Caves and Karstic Features LPP (CoW, 2022b) and associated risk mapping identifies that the site has areas of Medium and Low cave risk (Plate 2-6).

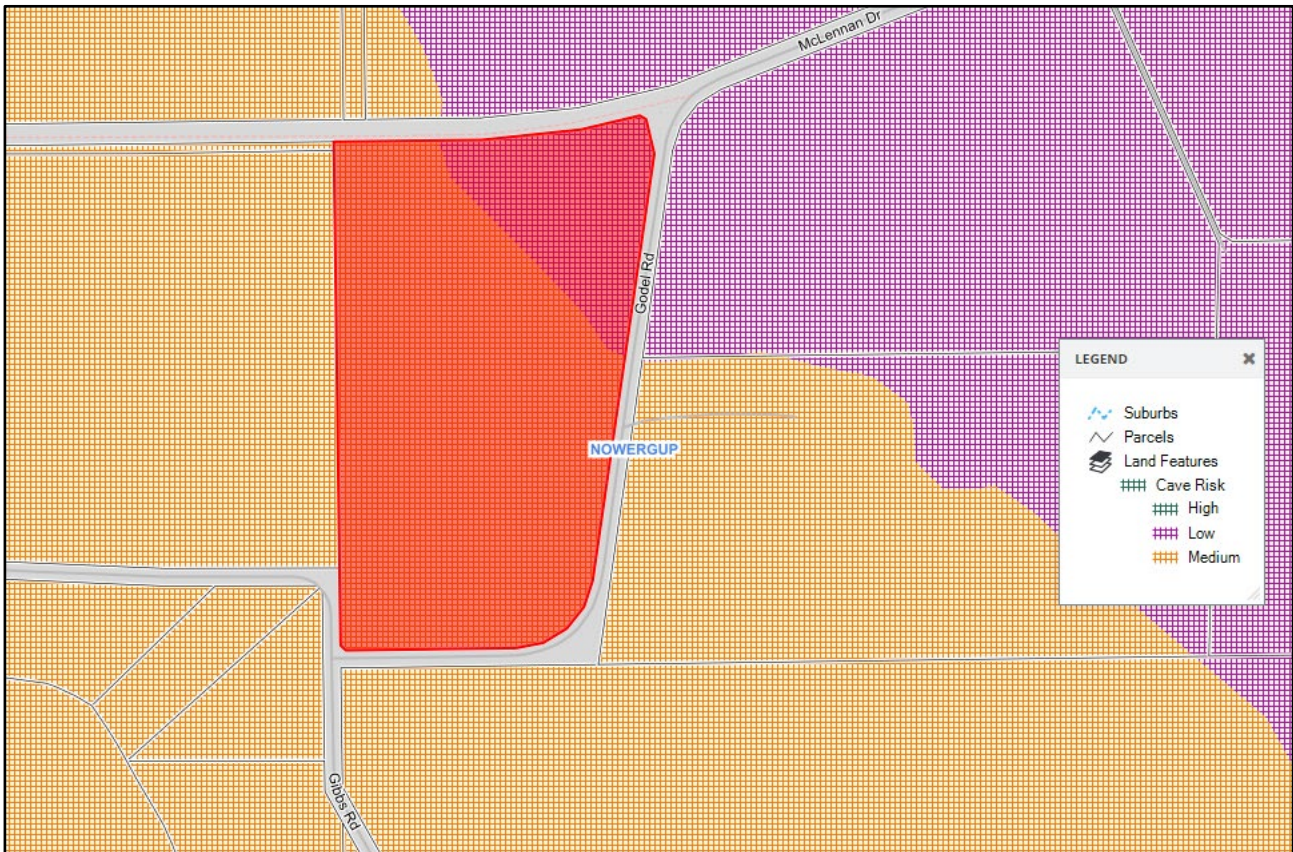


Plate 2-6: Cave Risk

Source: CoW IntraMaps, 2024b

2.3.4 Acid Sulfate Soils

Soils within the site are not mapped as posing an Acid Sulfate Soils risk (Landgate, 2024b).

2.4 Hydrology

2.4.1 Groundwater

The site is underlain by the Superficial Swan aquifer, the confined Leederville aquifer and the confined Yarragadee North aquifer. This location is within the proclaimed Wanneroo groundwater area (DWER, 2024a).

Regional mapping by the Department of Water and Environmental Regulation (DWER) indicates that the maximum groundwater level in this location ranges from approximately 16 to 17 mAHD (Figure 3), with superficial aquifer groundwater flow direction being westerly towards the coast (DWER, 2024b). Based on topographic elevations this indicates that depth to groundwater varies from approximately 9 m below ground level (BGL) in the southern section of the site to 31 mBGL in the northern section of the site (DWER, 2024b).

There are no Public Drinking Water Source Areas (PDWSA) located within the site, with the Priority 3 Perth Coastal and Gwelup Underground Water Pollution Control Area located approximately 1.5 km west of the site (DWER, 2024b).

2.4.2 Surface Water and Drainage

There are no surface water features or drainage lines within the site.

2.4.3 Wetlands

There are no wetlands mapped onsite (Landgate, 2024b).

Nowergup Lake, a Conservation Category Wetland (CCW), is located approximately 275 m southwest of the site (Figure 3) (Landgate, 2024b). CCWs are defined by the EPA as wetlands which support a high level of attributes and functions. The management objective is to preserve and protect the existing conservation values (EPA, 2008).

The EPA identifies buffer requirements for conservation significant wetlands. In general, wetlands that are to be protected require a minimum 50 m buffer distance (EPA, 2008). As the site is outside of the mapped extent of this CCW and associated buffer zone, impacts to this wetland are not anticipated.

2.5 Flora and Vegetation

2.5.1 Vegetation Association

Broad scale mapping of pre-European vegetation within the Perth region was undertaken by Beard (1976) which recorded major categories of plants. Shepherd et al. (2002) reassessed and digitised Beard’s mapping and based on this mapping there are a total of 819 vegetation associations mapped across the state.

The site is mapped containing the following broad vegetation association (Landgate, 2024):

- Spearwood_998: Jarrah, marri and wandoo *Eucalyptus marginata*, *Corymbia calophylla*, *E. wandoo*.

The status of this vegetation association at the state, regional and local level is presented in Table 2-3. The remnant native vegetation of the Spearwood 998 association within the Swan Coastal Plain (SCP) bioregion is approximately 36.4%, with approximately 60.1% remaining within the City of Wanneroo. The proposed clearing to be undertaken onsite will not alter this number significantly.

Table 2-3: Spearwood 998 - Vegetation Statistics

Area	Pre-European extent	Current Extent (% of pre-European extent)	Current Extent in DBCA managed lands (% of pre-European extent)
Western Australia	51,015 ha	18,493 ha (36.5%)	9,003 ha (17.7%)
SCP	50,868 ha	18,492 ha (36.4%)	9,003 ha (17.7%)
SCP sub-region - Perth	50,868 ha	18,492 ha (36.4%)	9,003 ha (17.7%)
City of Wanneroo	4,635 ha	2,787 ha (60.1%)	1,470 ha (31.7%)

Source: GoWA, 2019a

2.5.2 Vegetation Complex

Vegetation at the site is identified to be part of the Cottesloe Complex-Central and South which is described as a ‘Mosaic of woodland of *Eucalyptus gomphocephala* (Tuart) and open forest of *Eucalyptus gomphocephala* (Tuart) - *Eucalyptus marginata* (Jarrah) - *Corymbia calophylla* (Marri); closed heath on the Limestone outcrops’ (Hedde et al., 1980).

Approximately 32.2% of the original extent of the Cottesloe Complex-Central and South remains within the SCP bioregion with approximately 41.7% remaining within the City of Wanneroo (Table 2-4). The flora and vegetation survey for the site determined that vegetation broadly aligned with this complex (Ecoedge, 2024).

Table 2-4 Cottesloe Complex – Central and South

Area	Pre-European Extent (ha)	Current Extent (ha) (% of pre-European extent)	Current Extent Protected for Conservation (% of pre-European Extent)
Swan Coastal Plain	45,300 ha	14,568 ha (32.2%)	4,308 ha (9.5%)
Perth Metropolitan Region	34,702 ha	9,609 ha (27.7%)	2,122 ha (6.12%)
City of Wanneroo	13,314 ha	5,545 ha (41.7%)	-

Source: GoWA, 2019b

2.5.3 Flora and Vegetation Survey (2014)

2.5.3.1 Vegetation Type

In 2014, PGV Environmental undertook a flora and vegetation survey of the site in accordance with *Guidance Statement 51: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia* (EPA, 2004) (Ecoedge, 2024).

Three separate vegetation types were identified and described for the survey area based on the structure and composition of the dominant layers (Table 2-5). No Threatened flora species were observed onsite. The DBCA Priority 4 species *Jacksonia sericea* was identified as occurring onsite.

This survey was superseded by an updated flora and vegetation survey undertaken by PGV in 2023 (Section 2.5.4).

Table 2-5 Vegetation units identified and described in 2014 survey

Unit	Description
EgEm	<i>Eucalyptus gomphocephala</i>/E. marginata Woodland over <i>Xanthorrhoea preissii</i>/Hibbertia hypericoides Open Low Heath This vegetation type occurs in the south-east part of the lot on orange-brown sand. Tuart (<i>Eucalyptus gomphocephala</i>) is the main tree species up to 12 m high while Jarrah (<i>E. marginata</i>) is smaller at a maximum of around 8 m. The understory contains a mix of native species including <i>Xanthorrhoea preissii</i> , <i>Hibbertia hypericoides</i> , <i>Desmocladius flexuosus</i> and introduced species including Veldtgrass (<i>*Ehrharta calycina</i>), <i>*Hypochaeris glabra</i> , <i>*Ursinia anthemoides</i> and <i>*Briza maxima</i> . Quadrat MC5 is representative of this vegetation type.
Em	<i>Eucalyptus marginata</i> Low Woodland over <i>Xanthorrhoea preissii</i> Shrubland Tuart trees drop out in the lower southern half of the site and Jarrah occurs by itself over an [area] similar to the Tuart/Jarrah understory containing <i>Xanthorrhoea preissii</i> , <i>Acacia pulchella</i> , <i>Hardenbergia comptoniana</i> as well as <i>Macrozamia fraseri</i> and <i>Hakea lissocarpha</i> . The soil type is dark brown sand. Quadrat MC4 is representative of this vegetation type.
CcEm	<i>Eucalyptus marginata</i>/ <i>Corymbia calophylla</i> Low Woodland over <i>Xanthorrhoea preissii</i> Shrubland Marri (<i>Corymbia calophylla</i>) become more common with the Jarrah in the lower part of the site. The understory mostly consists of dense Veldtgrass and a few native shrubs such as <i>Xanthorrhoea preissii</i> and <i>Acacia pulchella</i> . The soils were dark brown sand. Quadrat MC3 is representative of this vegetation type.

Source: Ecoedge, 2024

2.5.3.2 Vegetation Condition

The 2014 survey found the vegetation condition on the survey area ranged from Completely Degraded to Degraded. The Completely Degraded areas occurred in the southwest and northeast portions of the survey area due to the presence of few native shrubs and abundance of introduced species, particularly grasses such as Veldtgrass. Where the understorey contained a higher density of native species this was rated as Degraded (Ecoedge,2024).

2.5.4 Flora and Vegetation Survey (2023)

2.5.4.1 Vegetation Type

In 2023, PGV consulting undertook a Detailed flora and vegetation assessment over a larger area which included the site in accordance with the EPA’s *Technical Guidance - Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA, 2016). The information relevant to Lot 107 has been summarised in the attached Detailed Flora and Vegetation Survey report (Appendix 1; Ecoedge,2024).

Vegetation units are used to refine the vegetation description for small scale sites, based on the structure of the vegetation and soils present. Three vegetation units were recorded within the site (Table 2-6), with the extent of these units shown on Figure 4.

Table 2-6: Vegetation Types

Type	Description	Extent within survey area	Maximum extent proposed to be cleared
EgEm	<p><i>Eucalyptus gomphocephala</i> Woodland over <i>Xanthorrhoea preissii</i> Shrubland over <i>Mesomelaena pseudostygia/Phyllanthus calycinus</i> Open Low Heath</p> <p>Occurs on the lower slopes of limestone hills, mostly in the central part of the survey area. <i>Eucalyptus gomphocephala</i> (Tuart) is up to 25 m high and moderately dense (15-25% cover). Typical understorey species include <i>Xanthorrhoea preissii</i>, <i>Mesomelaena pseudostygia</i>, <i>Phyllanthus calycinus</i>, <i>Hakea lissocarpha</i> and <i>Desmocladius flexuosus</i>.</p> <p>The soils are orange-brown sand with some surface limestone.</p> <p>Quadrat C22 is a representative of this vegetation type.</p>	9.77 ha	7.40 ha
CcEm	<p><i>Corymbia calophylla/Eucalyptus marginata</i> Low Woodland over <i>Xanthorrhoea preissii</i> Shrubland</p> <p>Only one area containing Marri (<i>Corymbia calophylla</i>) mixed with Jarrah was recorded on the site, at the southern end of Lot 107 Godel Road. The vegetation is in Degraded to Completely Degraded condition with Perennial Veldtgrass dominating the understorey. <i>Xanthorrhoea preissii</i> is the only common native species.</p> <p>The soils are dark brown sand.</p> <p>Quadrat C18 is representative of this vegetation type.</p>	4.77 ha	3.70 ha
Em	<p><i>Eucalyptus marginata</i> Low Woodland over <i>Xanthorrhoea preissii</i> Tall Shrubland</p> <p>Occurs on lower areas in the central part of the survey area. All of the areas mapped have a very weedy understorey. The <i>Eucalyptus</i></p>	3.83 ha	2.85 ha



Type	Description	Extent within survey area	Maximum extent proposed to be cleared
	<p><i>marginata</i> (Jarrah) trees have mostly been coppiced with few to no old, mature single stem trees.</p> <p><i>Xanthorrhoea preissii</i> is the most common native understorey species while the most common weed species is Perennial Veldtgrass.</p> <p>The soils are dark brown sand.</p>		
	Total	18.37 ha	13.94 ha

Source: Ecoedge, 2024

2.5.4.2 Vegetation Condition

According to the Keighery scale of vegetation condition, remnant vegetation within Lot 107 varied from 'Degraded' to 'Completely Degraded' (Ecoedge, 2024; Figure 5). Areas where the soils consisted of deeper sand over limestone contained more weeds.

The condition category extents within the proposed clearing footprint are as follows (Ecoedge, 2024):

- Degraded - 13.05 ha (93.62% of clearing footprint)
- Completely Degraded - 0.89 ha (6.38% of clearing footprint).

2.5.4.3 Floristic Community Types

No Floristic Community Type (FCT) analysis was undertaken for Lot 107 as vegetation condition was determined to be too degraded to assign an FCT (Ecoedge, 2024).

Based on PATN analysis outcomes for Eucalyptus dominated vegetation units in Very Good and Excellent condition in the surrounding survey area, it appears likely that the vegetation onsite would have originally represented FCT 24 and/or FCT 28 (Ecoedge, 2024), neither of which aligns with a Threatened Ecological Community (TEC).

2.5.4.4 Conservation Significant Flora

No Threatened or Priority flora listed under the BC Act or EPBC Act, or flora of other conservation significance were recorded during the 2023 survey (Ecoedge, 2024).

The locations of the *Jacksonia sericea* individuals recorded during the 2014 survey were revisited during the 2023 survey and were determined likely to be the non-conservation significant species *Jacksonia calcicola* (Ecoedge, 2024).

2.5.4.5 Conservation Significant Ecological Communities

The Tuart Woodlands of the Swan Coastal Plain ecological community is listed as a TEC under the EPBC Act and is listed as a Priority Ecological Community (PEC) (Priority 3(iii)) under the BC Act.

The EgEm vegetation type contains Tuart trees as the dominant component of the tree canopy. This unit was identified to align with the Tuart TEC.

Additional assessment of trees onsite was undertaken as part of the fauna and black cockatoo habitat assessment (Terrestrial Ecosystems, 2024). This assessment identified a number of large tuart trees to be present to the south of the mapped EgEm woodland extent. As such, the Tuart TEC boundary has been extended to capture these trees plus a 30 m buffer to each individual tree which also connect to the woodland area. The Tuart TEC boundary is shown on Figure 6.



A further 9 large tuart trees were located to the south of the Tuart Woodland TEC extent. These trees and their associated buffer zone did not form a large enough patch size to be considered part of the TEC extent and did not intercept with the abovementioned TEC boundary.

The total area of the TEC in Lot 107 is 10.66 ha with all Tuart TEC being in a degraded botanical condition.

2.5.5 Weeds

Twenty-three different weed species were recorded during the flora and vegetation survey within the site (Appendix 1). Of these, *Ehrharta calycina* (Perennial Veldtgrass) was the most commonly recorded species, as well as *Hypochaeris glabra*, *Ursinia anthemoides* and *Briza maxima* (Ecoedge, 2024).

There were no declared pest plants or environmental weeds recorded within the site (Ecoedge, 2024).

2.6 Fauna and Habitat

Terrestrial Ecosystems undertook a Basic fauna survey and a targeted Black Cockatoo habitat survey for the site in April 2024, in line with the EPA's *Technical Guidance – Terrestrial vertebrate fauna surveys for environmental impact assessment* (EPA, 2020).

2.6.1 Fauna Habitat

The survey recorded two broad fauna habitat types, being 'Eucalypts over tall grass' and 'Low Eucalypt woodland over grasstree shrubland' (Figure 7). In addition, sand tracks are also present within the project area.

As shown in photography provided within the fauna survey report (Appendix 2) the understorey within these habitat areas is predominantly grass weed, with little native species present. Native species are present within the mid and upper storey vegetation layer at the site, noting that vegetation condition ranges from Degraded to Completely Degraded as discussed in Section 2.5.4.

A summary of results of the fauna survey are discussed below with a copy of the report provided in Appendix 2.

2.6.2 Fauna Overview

The vertebrate fauna assemblage which may be present in this general location includes (Terrestrial Ecosystems, 2024):

- 78 bird species
- 8 amphibian species
- 18 mammal species
- 51 reptile species.

Native macrofauna species which could frequent the site have been identified to include:

- Western Grey Kangaroo (*Macropus fuliginosus*)
- Quenda (*Isoodon fusciventer*)
- Possums including the Common Brushtail Possum (*Trichosurus vulpecula*)
- Snakes including dugites (*Pseudonaja affinis*), Black Striped Snake (*Neelaps canotos*) and Yellow-faced Whip Snakes (*Demansia psammophis*)
- Ground burrowing frogs
- Bobtails (*Tiliqua rugosa*), small geckoes and skinks.

Several species of feral fauna were recorded by secondary evidence (scats, tracks, burrows) across the site. This included (Terrestrial Ecosystems, 2024):

- Feral/domestic cat (*Felis catus*)
- Red fox (*Vulpes vulpes*)
- European rabbit (*Oryctolagus cuniculus*).

2.6.3 Black Cockatoo Habitat

2.6.3.1 Potential Breeding Habitat

A total of 118 trees were considered to be of suitable diameter at breast height (DBH) (i.e. 500 mm or greater) to support potential black cockatoo breeding, should suitable hollows be present or form in the future. Of these trees, the following is noted (Terrestrial Ecosystems, 2024; 2025):

- Composition of trees were:
 - 75 trees are *E. gomphocephala* (tuart)
 - 42 trees are *E. marginata* (jarrah)
 - One tree is a *C. calophylla* (marri)
- 10 of these trees were recorded as dead
- Six of these trees contained at least one hollow that when viewed from ground level appeared to potentially be suitable to support black cockatoo breeding.

Habitat tree locations are shown on Figure 7 with tree data provided in Appendix C of the Terrestrial Ecosystems fauna report (Appendix 2).

In August 2025, Terrestrial Ecosystems undertook a targeted inspection of the trees which contained potentially suitable hollows for black cockatoo breeding (Appendix 3). A total of five hollows were noted to be present onsite as part of the 2024 fauna assessment, plus one additional hollow not previously recorded (Tree 199). Each hollow was inspected and given a rank for suitability, based on the Bamford ranking methodology below:

- Rank 1: Activity at hollow observed; adult (or immature) bird seen entering or emerging from hollow. Can also be used for a known nest tree active in the previous 12 months (although this should be noted in the description). Note that activity at a hollow does not absolutely mean that breeding is occurring unless a young bird in hollow is observed.
- Rank 2: Hollow of suitable size visible with chew marks around entrance. Record if chew-marks are recent or old.
- Rank 3: Potentially suitable hollow visible but no chew marks present at entrance; or potentially suitable hollow suspected to be present - as suggested by structure of tree, such as large, vertical trunk broken off at a height of >8m; but note that hollow height is contextual. Carnaby's Black-Cockatoo will nest in hollows < 5m so in a Wheatbelt breeding site a lower criterion may be more appropriate.
- Rank 4: Tree with large hollows or broken branches that might contain large hollows, but hollows or potential hollows (nest chamber) 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. Trees with low but otherwise suitable hollows can also be assigned a rank of 4, depending on the species of black-cockatoo likely to be present.
- Rank 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.

Details on each hollow are provided in Table 2-7.

Table 2-7: Hollow inspection data

Tree number (species)	Hollow details	Ranking	Justification
T147 (Jarrah)	Entrance size: 10 cm Orientation: East Height above ground: 6 m	Rank 4	Hollow chamber is not vertical or deep enough to support black cockatoo nesting.
T157 (Tuart)	Entrance size: 15 cm Orientation: East Height above ground: 8 m	Rank 2	Old chew mark present around entrance, hollow of suitable size.
T173 (Jarrah)	Entrance size: 10 cm Orientation: North Height above ground: 10 m	Rank 4	Hollow is filled with large pieces of organic matter.
T199 (Tuart)	Recently formed, likely from a dead branch falling.	Rank 3	Recently formed and not enough time has passed for black cockatoos to utilise the hollow.
T202 (Tuart)	Entrance size: 10 cm Orientation: South Height above ground: 4.5 m	Rank 3	Hollow contains large pieces of organic matter.
T226 (Jarrah)	Entrance size: 15 cm Orientation: North Height above ground: 5.25 m	Rank 3	Hollow contains large pieces of organic matter.

Source: *Terrestrial Ecosystems, 2025*

2.6.3.2 Foraging Habitat

Vegetation present onsite contained species which are known to be used for foraging by black cockatoos.

The foraging habitat value for black cockatoos was determined using the Bamford Consulting Ecologists (BCE) method. The foraging value for both Forest Red-tailed Black Cockatoos (*Calyptorhynchus banksii naso*) and Carnaby’s Black Cockatoo (*Zanda latirostris*) were considered to be the same, given the foraging species at the site are ranked equally amongst both species, noting the site is outside the distribution for Baudin’s Black cockatoo (*Zanda baudinii*). The site scored a total of 5 out of a possible 10 for value for black cockatoos, correlating to moderate value foraging habitat (Terrestrial Ecosystems, 2024).

Carnaby’s Black Cockatoo were seen foraging within the site during the fauna and habitat survey (Terrestrial Ecosystems, 2024).

2.6.3.3 Roosting

There was no evidence to suggest that the project area is a black cockatoo roosting site. Nearby confirmed roosting sites are as follows (Terrestrial Ecosystems, 2024):

- The closest confirmed Carnaby’s Black Cockatoo roosting site is ~15 km south of the project area in the Edith Cowan University Joondalup Campus
- The closest confirmed Forest Red-tailed Black Cockatoo roosting site is ~10km south of the project area in Wanneroo.

2.7 Conservation Areas

There are no mapped Environmentally Sensitive Areas (ESAs) within the site (Landgate, 2024b).

The closest Bush Forever Site (Site ID 383 - Neerabup National Park, Lake Nowergup Nature Reserve and adjacent bushland, Neerabup) is located approximately 275 m southwest of Lot 107. This portion of the Bush Forever site is the Nowergup Lake Nature Reserve which is vested with the Conservation and Parks Commission (Landgate, 2024b).

2.8 Heritage

2.8.1 Indigenous heritage

A search of the Department of Planning, Lands and Heritage (DPLH) Aboriginal Cultural Heritage (ACH) Inquiry System on 10 July 2024 Identified that the site does not contain any registered sites or other heritage places (DPLH, 2024).

The closest mapped Aboriginal Heritage site is Nowergup Lake located approximately 275 m southwest of the subject site. Nowergup Lake is a registered site associated with Creation/Dreaming Narrative (ID #17450) (Landgate, 2024b).

2.8.2 Non-indigenous heritage

A search of the Heritage Council InHerit database (Heritage Council, 2024) and the City of Wanneroo Heritage List (CoW, 2024b) indicates that there are four heritage value sites within a 1 km radius of the site, however none within the site itself (Table 2-8).

Table 2-8 Summary of Local heritage sites within 1km of the subject site.

Site Name	ID	Location	Distance from the subject site
Nowergup Lake Fauna Reserve	P9491	2500 Wanneroo Rd, Nowergup	320 m southwest
Lime Kilns - Spiers (37,38,39)	P14299	115 Kiln Rd, Carabooda	780 m north
Perry House (Demolished)	P17932	275 Gibbs Rd, Nowergup	860 m south
House at 465 Gibbs Rd	P17533	465 Gibbs Rd, Nowergup	1 km west

2.9 Surrounding land uses and buffers

Land uses in proximity to the site include:

- Poultry farming
- Intensive horticulture (market gardening)
- Rural residential properties
- Extractive industry sites
- Uncleared bushland.

The separation distance between the poultry farm sheds and the Lot 107 boundary is approximately 30 m. The EPA guidance *Separation Distances between Industrial and Sensitive Land Uses No.3* (EPA, 2005) provides advice identifying a recommended separation distance between poultry farms and sensitive land uses of 300 m. As the proposal within the site is not considered a sensitive land use it is not impacted by this matter.

The separation distance guidance also recommends that for sand and limestone extraction (no grinding or milling works), a separation distance of 300 to 500 m should be considered regarding distance to sensitive land uses.

It is noted that this guidance is intended to provide advice on generic separation distances between specific industry and sensitive land uses to avoid or minimise the potential for land use conflict. The distances outlined in the guidance are not intended to be absolute separation distances, rather they are a default distance for the purposes of (EPA, 2005):

- identifying the need for specific separation distance or buffer definition studies; and
- providing general guidance on separation distances in the absence of site-specific technical studies.

The EPA guidance highlights that the importance of these buffers is to eliminate any unintended offsite impacts potentially caused by the sand excavation on nearby sensitive receptors. Some of these impacts are identified to include noise and dust emissions.

Several houses have been identified within a 500 m buffer of the sand extraction site Table 2-9. Section 4 discusses proposed management and mitigation measures that will be implemented to avoid or minimise any potential noise or dust impacts.

Table 2-9: Houses within a 500 m buffer of the excavation site

Address	Distance to Lot 107 Boundary	Distance to the Proposed Extractive Industries Extent within Lot 107
359 Gibbs Road	c.150 m southwest	c.229 m southwest
379 Gibbs Road	c. 155 m southwest	c.231 m southwest
349 Gibbs Road	c.180 m southwest	c.228 m southwest
397 Gibbs Road	c.220 m southwest	c.290 m southwest
348 Gibbs Road	c.255 m south	c.275 m south
321 Gibbs Road	c.500 m southwest	c.530 m southwest

2.10 Bushfire

The site is located within a mapped Bushfire Prone Area (Landgate, 2024b).

The requirements of SPP 3.7 – *Planning in Bushfire Prone Areas* (DoP & WAPC, 2015) and the associated Guidelines for Planning in Bushfire Prone Areas (DPLH & WAPC, 2021c) identify that a Bushfire Management Plan (BMP) may be requested to accompany an extractive industries application at the discretion of the decision-making authority.

Fire risk management actions are included in Section 4 of this EAMR. As such a BMP has not been prepared at this time.

3 Proposed Works and Excavation Program

3.1 Overview

It is anticipated that approximately 1,123,000 cubic metres of sand and high-quality limestone are to be extracted at the site. Resource extraction works are proposed to access the resource within a 13.94 ha footprint to a maximum depth of 24 mAHD, which maintains a minimum separation to groundwater of 2 m.

The proposed works will consist of the following:

- Extraction of sand and high-quality limestone within a total site area of 18.93 ha and an excavation footprint of 13.94 ha.
- Use of equipment onsite and storage of equipment.
- Dispatch of the extracted sand and limestone off-site in laden trucks.
- Gates will be installed on the access road and perimeter fences will be erected and maintained.
- Tree protection zones for all trees that are being retained will be established before commencing works.
- Three 3 m high temporary bunds are proposed along the southwestern edge of phases 1-3 in the excavation area (Figure 8).

3.2 Excavation Management

3.2.1 Resource Extraction

It is proposed to excavate approximately 112,300 cubic metres of sand and limestone each year, equating to a total of 1,123,000 over an estimated 10-year period.

The proposed post-extraction levels are shown on Appendix 4. As can be seen from this figure the bottom of the pit is proposed at 24mAHD at the lowest point, with batters to be provided between the base of the pit and the retained vegetation zone.

3.2.2 Processing

The sand resource will be dry screened via a mobile dry screening plant onsite. Vegetation and rocks will be separated from the sand material using a mobile screening plant onsite prior to offsite dispatch. Where required (dependent on size), limestone will be crushed prior to screening by a mobile crusher.

All cleared vegetation will be mulched and removed from the site. Topsoil and overburden will be stockpiled onsite for reuse following completion of resource extraction works.

3.2.3 Stages

The operations of the proposed extraction have been designed to be undertaken on a staged basis (Figure 8).

The overall site is 18.93 ha, with the excavation area footprint being 13.94 ha. The seven proposed stages incorporate the following areas:

- Stage 1 - 1.96ha
- Stage 2 – 1.98ha
- Stage 3 – 1.97ha
- Stage 4 – 1.98ha

- Stage 5 – 1.98ha
- Stage 6 – 1.99ha
- Stage 7 – 2.08ha.

Stages and associated extraction works will generally move in a northerly direction.

3.2.4 Site Facilities, Machinery and Equipment

The main plant, equipment and infrastructure on site will include:

- Fencing and security gates
- Wheel wash facility
- Small site office
- Staff amenities facilities
- Weighbridge
- Internal access track
- Mixture of mobile equipment including:
 - Front end loader
 - Grader
 - Diesel power generator
 - Mobile screening plant
 - 15 KL Water Cart.

3.2.5 Workforce

Personnel will commute to the site each day. During vegetation clearing and infrastructure installation there will be between three to five personnel onsite. During operational phase the workforce onsite will consist of approximately two to three personnel plus truck drivers as they access the site.

3.2.6 Water and Energy Usage

Water may be required at the site for the following uses:

- Dust suppression
- Equipment clean down
- Staff amenities.

It is anticipated that the volume of water which may be required per year is approximately 5,000-10,000 KL.

As the site is not connected to a reticulated water supply, water is to be supplied by a 15 KL watercart located onsite. Water to fill the cart will be purchased from a nearby commercial standpipe.

The site does not currently hold a licence to abstract groundwater and based on review of the DWER available allocation it is understood that this sub-area is fully allocated (DWER, 2024a).

The site will be connected to the Western Power energy transmission network, but a diesel generator will also be available onsite to provide power to the site and screening plant, as required.

3.2.7 Fuel Use and Storage

No hydrocarbons for refuelling are to be stored onsite at any time, with the refuelling of machines to occur from an authorised service vehicle.

All machinery onsite are to be serviced by an authorised service vehicle which is to arrive onsite as required. Major servicing is to occur offsite with machinery being transported to offsite premises. Each service and maintenance vehicle is to contain a hydrocarbon spill kit to prevent any potential contamination of the site in the event that a spill was to occur.

3.2.8 Access and Transport

Access and transport arrangements for the site will include:

- Access to the site will be via a sealed entry road entering the site along the southern boundary (Figure 8) which connects to Godel Road.
- Internal access will be provided along the central access track within the site, constructed from limestone.
- Gates and perimeter fences will be erected and maintained to prevent unauthorised access along internal access roads. When the site is not occupied the gates will be securely locked. Warning and security signs will be erected in accordance with the DPIRD and the City of Wanneroo's requirements.
- Truck movements are variable from the site in response to the demand for the resource. During peak haulage periods, there is expected to be a maximum of 15 trucks (in and out) per hour. This equates to a daily maximum of 146 vehicles, including staff vehicles.
- All trucks will have covered trays to prevent spillage on roads.

3.2.9 Hours of Operation

The proposed working hours for the site activities are:

- Monday to Friday – 7.00am to 6.00pm
- Saturday – 7.00am to 12.00pm
- Sunday/Public Holidays – Closed.

3.2.10 Public Safety

Public safety will be ensured by implementing the following measures:

- Fencing will be maintained in good condition
- Warning signs will be erected to the standard required by the City of Wanneroo at any access points into the site.
- Signage detailing unauthorised access being prohibited will be installed along the site's perimeter.
- Security gates at the entrance of the site will be kept locked outside of operating hours.

4 Potential Environmental Impacts and Proposed Management

Potential environmental impacts associated with onsite operation have been identified, with proposed design, management and mitigation actions detailed below (Table 4-1). Responsibility for implementation of these actions will remain with the project proponent.

Table 4-1 Potential Environmental Impact, Management and Mitigation Measures

Activity/Item	Potential Impacts	Design, Management and Mitigation Measures	Management Controls/Monitoring
Vegetation clearing	<p>Site development will involve clearing of 13.94 ha of vegetation from the Cottesloe Complex – Central and South which has 41.7% remaining with the Swan Coastal Plain bioregion. The EPA target for retention of vegetation complexes is 30% of the pre-European extent, or 10% of the pre-European extent in constrained areas including the Perth Metropolitan Region (EPA, 2008). As such the clearing proposed will not reduce the vegetation to below the 30% EPA target within the Swan Coastal Plain bioregion.</p> <p>Site development will involve clearing of the onsite vegetation units as follows:</p> <ul style="list-style-type: none"> • 7.40 ha of vegetation unit EgEm • 3.70 ha of vegetation unit CcEm • 2.85 ha of vegetation unit Em <p>The clearing will encompass the following vegetation condition extents:</p> <ul style="list-style-type: none"> • 13.05 ha of vegetation in degraded condition • 0.89 ha of vegetation in completely degraded condition 	<p>The following design, management and mitigation actions are proposed to reduce impacts to vegetation and flora:</p> <ul style="list-style-type: none"> • Vegetation will be retained around the site perimeter which will allow for continued representation of remnant vegetation onsite as well as providing a vegetated screen to surrounding land uses. The extent of vegetation retention is proposed as follows: <ul style="list-style-type: none"> ▪ 2.37 ha of vegetation unit EgEm ▪ 1.07 ha of vegetation unit CcEm ▪ 0.98 ha of vegetation unit Em • Boundaries of the site and the retained vegetation will be surveyed and clearly marked prior to the commencement of clearing to avoid inadvertent damage to vegetation identified for retention. • Arboricultural advice will be sought for any trees that are being retained in close proximity to the excavation area to maximise their health and longevity. • Clearing extent will be restricted to the open area required to facilitate extraction over the coming 12 months. 	<p>A Native Vegetation Clearing Permit (NVCP) will be sought from DWER for the proposed clearing of vegetation onsite.</p> <p>The proposed development will also be referred to the DCCEEW under the EPBC Act for assessment and approval.</p>

Activity/Item	Potential Impacts	Design, Management and Mitigation Measures	Management Controls/Monitoring
	<p>In the context of the surrounding environment, it is noted that there is 16,857.67 ha of native vegetation present within 10 km of the site. This includes the following nearby reserves and regional parks:</p> <ul style="list-style-type: none"> • Gnangara-Mooe River State Forest – 1 km east of the site • Neerabup National Park – 1.5 km west of the site • Nowergup Lake Nature Reserve – 275 m southwest of the site • Yanchep National Park – 6 km northwest of the site • Bush Forever Site 130 (Link between Yanchep and Neerabup National Parks) – 2.8 km northwest of the site • Bush Forever Site 129 (Bernard Road Bushland, Carabooda) – 3.5 km northwest of the site • Bush Forever Site 384 (Neerabup Lake and Adjacent Bushland, Neerabup) – 3.6 km south of the site • Bush Forever Site 293 (Shire View Hill and Adjacent Bushland, Nowergup/ Neerabup) – 4.2 km southeast of the site • Bush Forever Site 382 (Lake Pinjar and Adjacent Bushland, Pinjar) – 5.6 km east of the site • Bush Forever Site 380 (Rosella Road Bushland, Bullsbrook) – 7.3 km northeast of the site <p>The vegetation present onsite is therefore not an isolated remnant, but rather a small portion of the existing local vegetation.</p>		

Activity/Item	Potential Impacts	Design, Management and Mitigation Measures	Management Controls/Monitoring
	<p>The vegetation units have not been assigned a floristic community type due to their degraded nature. Based on PATN analysis of surrounding Excellent and Very Good condition Eucalypt and Banksia woodland areas it appears likely that the onsite vegetation would be originally represented FCT 24 or FCT 28. These FCTs are not of conservation significance.</p> <p>Site development will include clearing of 8.02 ha of the 10.66 ha of vegetation representing the Tuart Woodlands TEC within the site. Based on DBCA mapping of Tuart TEC occurrence within a 10 km radius of the site it is noted that an estimated 9,427 ha of Tuart Woodland TEC may occur in this area.</p>		
Retained vegetation protection and management	Areas of retained vegetation have the potential to be degraded through impacts including weed and pathogen invasion, unauthorised vehicle disturbance, fly tipping etc.	<p>The following management actions will be undertaken to protect and manage retained vegetation onsite:</p> <ul style="list-style-type: none"> • Fencing will be installed around the perimeter of the site to prevent unauthorised access • The site access gate will be locked outside of operating hours • Vehicle movements will be restricted to excavation areas and designated access tracks only • Excavation depth will remain at least 2 m above the maximum groundwater table and groundwater is not proposed to be abstracted from the site to avoid hydrological changes which may impact vegetation health. • Should any vegetation management works be undertaken in retained vegetation areas, vehicles accessing these areas will be clean on entry to the site. 	<p>Site fencing and access gates will be inspected regulator by the site manager and any damage will be repaired.</p> <p>Any visitors to the site must sign in and will be advised of where access is permitted/not permitted.</p>
Fauna and habitat disturbance	Development of the site may result in the following impacts to fauna and habitat:	The following design, management and mitigation actions are proposed to reduce impacts to fauna and habitat:	A NVCP will be sought from DWER for the proposed clearing

Activity/Item	Potential Impacts	Design, Management and Mitigation Measures	Management Controls/Monitoring
	<ul style="list-style-type: none"> • Clearing of 13.94 ha of native vegetation comprising: <ul style="list-style-type: none"> ▪ 8.31 ha of habitat type Eucalypts over tall grass ▪ 5.01 ha of habitat type Low Eucalypt woodland over grasstree shrubland ▪ 0.63 h Note: All native vegetation present onsite was assessed to have moderate (Score: 5) foraging habitat value for black cockatoos • Clearing of 90 of 118 trees present onsite with a DBH >500 mm which based on their size may have the potential to support black cockatoo breeding should suitable hollows form • Clearing of 5 trees out of 6 trees present onsite which currently have a hollow of a size and shape which may be suitable to support black cockatoo breeding • Potential loss of habitat for quenda and black striped snake • Potential injuries to fauna during vegetation clearing • Degradation of fauna habitat <p>As noted above the vegetation and fauna habitat present onsite is not an isolated remnant but rather a small portion of the existing vegetation in this location. As such fauna habitat opportunities will remain in the local area, as well as within vegetation retained onsite.</p>	<ul style="list-style-type: none"> • Fauna habitat will be retained around the site perimeter which will allow for continued representation of fauna habitat onsite as well as facilitating connectivity between the site and surrounding vegetated areas. The extent of fauna habitat retention is proposed as follows: <ul style="list-style-type: none"> ▪ 2.24 ha of habitat type Eucalypts over tall grass ▪ 1.58 ha of habitat type Low Eucalypt woodland over grasstree shrubland ▪ 28 trees which a DBH >500mm which based on their size may have the potential to support black cockatoo breeding should suitable hollows form ▪ 1 tree which currently has a hollow of a size and shape which may be suitable to support black cockatoo breeding (Rank 2) • Clearing extent will be restricted to the open area required to facilitate extraction over the coming 12 months. • A fauna relocater will be engaged to undertake fauna capture and relocation prior to and during vegetation clearing, which will include inspection of trees and hollows. A Licence to take or disturb Fauna for the purpose of relocating will be submitted to the Department of Biodiversity, Conservation and Attractions (DBCA) prior to vegetation clearing commencing to ensure compliance with this requirement. • Clearing will be undertaken slowly in the direction of existing bushland to give any potentially remaining fauna the opportunity to relocate. • If any fauna is located and not moving away from clearing/site works on their own and/or injured at the site, the site manager will contact the project environmental consultant, fauna relocation consultant or DBCA Wildcare helpline (9474 9055) for instructions. 	<p>of vegetation and fauna habitat onsite.</p> <p>The proposed development will also be referred to the DCCEEW under the EPBC Act for assessment and approval.</p>

Activity/Item	Potential Impacts	Design, Management and Mitigation Measures	Management Controls/Monitoring
		<ul style="list-style-type: none"> Additional fauna management actions as well as an injured fauna protocol which will guide operations at the site is provided in Appendix 5 . 	
Topsoil and overburden removal	<p>Stripping of topsoil and overburden can result in the following potential impacts:</p> <ul style="list-style-type: none"> Dust generation Noise generation Loss of organic material and seed bank. 	<p>Topsoil and overburden are a resource which can be reused at the site post-excavation to stabilise the landscape. This material will be stockpiled following stripping for re-use.</p> <p>Noise and dust management will be undertaken as part of all activities undertaken onsite. This is further discussed below in this table.</p>	Stockpile management will be the responsibility of the Site Manager.
Noise	<p>During operating hours noise has the potential to be generated from the following sources:</p> <ul style="list-style-type: none"> Vehicle, plant and equipment operation Crushing and screening, should this occur Vegetation clearing and mulching. <p>Noise emissions have the potential to disturb neighbouring residents or land users if they are too loud.</p>	<p>The following actions will be undertaken to minimise noise generation and potential impacts:</p> <ul style="list-style-type: none"> The maximum truck speed on site to be 20 km/hr with the engine speed maintained below maximum revolution. Hours of operation are only permitted between 7 am to 6 pm, Monday to Friday, 7am to 12pm Saturday and closed Sunday and public holidays Earthen bunds along the southwestern edge of phases 1-3 in the excavation area will serve to further reduce noise emissions A vegetation screen is to be maintained around the perimeter of the site to further assist to minimise noise emissions offsite Operations, including screening and processing, will be undertaken within the base of the pits whenever possible, to assist to minimise noise exposure external to this area Access road maintained in a good condition to ensure limitation of “banging” noise from empty trucks travelling over rough terrain. Equipment used on site is the quietest available. Noise testing of plant and equipment will occur to identify any extraordinary items of high noise emissions. 	<p>Noise generation will be observed by the Site Manager.</p> <p>Any noise complaints will be registered in the site complaints register stating:</p> <ul style="list-style-type: none"> Where the complaint was from. Where and what was the equipment operating. If a verbal response was given to the complainant, what was it and was the complainant satisfied with the response. After the complaint has been received and responded to, noise emissions from the offending item(s) of equipment should be investigated. If noise levels from offending item/s is

Activity/Item	Potential Impacts	Design, Management and Mitigation Measures	Management Controls/Monitoring
		<ul style="list-style-type: none"> • Equipment is to be well maintained and in a good operating condition. • All vehicle engines will be switched off when not in use. • There will be no unnecessary sounding of horns whilst onsite. • Awareness of noise issues and management requirements will be included in the site induction information. 	<p>found to be excessive, then the item will either be repaired, replaced with a quieter item or noise control applied.</p> <p>The complaints register will be made available to the City of Wanneroo when required.</p>
<p>Air Quality (Dust)</p>	<p>Dust has the potential to be generated from operation onsite including clearing and mulching of vegetation, stripping of topsoil and overburden, resource extraction, stockpiling of materials and resource transport.</p> <p>Potential impacts from dust generation include:</p> <ul style="list-style-type: none"> • Nuisance dust entering neighbouring properties and impacting residents • Deposition on retained vegetation. <p>As noted in Section 2.1, the strongest winds experienced at the site are the summer afternoon south-westerly winds and the summer morning easterly winds. Residential properties and other sensitive land uses are generally located to the south and south-west of the site and would therefore not be impacted by dust based on direction of these winds. Dense vegetation is present to the west and northeast of the site in the direction of these prevailing winds.</p> <p>An assessment of the potential dust generation has been undertaken using the guideline for managing the impacts of dust and associated contaminants from land development sites, contaminated sites remediation and other related activities (DEC 2011). A copy of the assessment is provided in Appendix 6.</p>	<p>The following actions may be undertaken to minimise dust generation and potential impacts:</p> <ul style="list-style-type: none"> • Water trucks are to water down unsealed roads during operation to reduce dust generation. • Trucks transporting extracted resources are to use tarpaulins to ensure dust is not released from loaded sand or limestone product during transport on and off site. • Water trucks are to be available during site operations to water the site on the observation of dust generation. • Vegetation screen is to be maintained around the perimeter of the site to assist to minimise dust spread offsite. • Should any crushing or screening activities be undertaken onsite, a sprinkler or water truck will be available for use in dust suppression, if required. • Maximum speed limit onsite will be restricted to 20 km/hr. • Site access roads/tracks will be maintained in a condition to minimise dust generation. • Operations will be undertaken on the pit floor whenever possible to avoid exposure to surface winds. • Topsoil and overburden stripping will be scheduled for low wind and/or damp weather conditions when dust generation risk is minimised. 	<p>Visual monitoring of dust generation will be undertaken by the Site Manager.</p> <p>A complaints register will be maintained for the site. Should any complaints regarding dust emissions be received the following will be recorded and actioned:</p> <ul style="list-style-type: none"> • Where the complaint was from. • Where and what was the equipment operating. • If a verbal response was given to the complainant, what was it and was the complainant satisfied with the response. • After the complaint has been received and responded to, dust emissions should be investigated and actions to

Activity/Item	Potential Impacts	Design, Management and Mitigation Measures	Management Controls/Monitoring
	<p>This assessment has concluded that the site has a Site Classification Score of 2 which indicates a low dust risk.</p>	<ul style="list-style-type: none"> • Three bunds for dust and noise suppression will be along the southwestern edge of phases 1-3 of the site. This will separate the majority of properties with residential premises from the site operational area. • Awareness of dust issues and management requirements will be included in the site induction information. • Should significant dust generation offsite be observed during site operations, activities causing the dust generation will be suspended until climatic conditions improve to reduce this risk. 	<p>minimize the emissions undertaken, as necessary.</p> <p>The complaints register will be made available to the City of Wanneroo upon request.</p>
<p>Hydrocarbon & Spill (Groundwater management)</p>	<p>The risk of groundwater contamination is considered low on the basis of the following:</p> <ul style="list-style-type: none"> • Extraction areas where machinery will be working will maintain a minimum separation distance to groundwater of 2 m • There will be no storage of fuel onsite 	<p>The following actions will be undertaken to minimise the risk of hydrocarbon spillages:</p> <p><i>Vehicle and Equipment Maintenance</i></p> <ul style="list-style-type: none"> • All non-major machinery onsite are to be serviced by an authorised service vehicle which is to arrive onsite as required. Each service and maintenance vehicle will contain a hydrocarbon spill kit to prevent any potential contamination of the site in the event of a spill occurring. • All major servicing of vehicles will be conducted off site. • Waste material derived from maintenance works will be disposed of offsite. <p><i>Refuelling</i></p> <ul style="list-style-type: none"> • No hydrocarbons for refuelling are to be stored onsite at any time, with the refuelling of machines to occur from authorised service vehicles. <p><i>Incident Response</i></p> <ul style="list-style-type: none"> • Equipment for the containment and clean-up of spills is to be available onsite. • Any potential spillage will be contained in plant and working areas by shutting down plants or equipment if the plant or equipment is the source of the spill. 	<p>The site manager will arrange for refuelling and vehicle servicing, as required.</p> <p>All workers are to be made aware of the incident response procedure.</p>

Activity/Item	Potential Impacts	Design, Management and Mitigation Measures	Management Controls/Monitoring
		<ul style="list-style-type: none"> In the event of a spill or adverse incident, activities will be stopped in that area until the incident is resolved. Areas of soil impacted by spillages will be removed immediately. This may be undertaken by a hand shovel or use of mechanical equipment, if necessary. All significant adverse incidents (such as a fuel spill of >5 litres), will be recorded, investigated and remediated. A record is to be kept of incidents which will be available for inspection by the City of Wanneroo and DWER, if required. 	
<p>Drainage Management</p>	<p>Soil and geological units at the site have a high infiltration capacity. As such infiltration is the dominant drainage process in the landscape.</p> <p>There is also a large depth to groundwater separation distance which will further support infiltration, avoiding drainage issues.</p>	<p>Drainage management will include:</p> <ul style="list-style-type: none"> All stormwater is contained and infiltrated onsite The entry road is not kerbed which facilitates infiltration of runoff at source Rainfall falling on the site office roof is directed to the rainwater storage tanks or to the ground for infiltration. Any ponding on compacted access ways will drain via infiltration at slower rates, evaporation or runoff to the side of the tracks as is the case in most rural areas 	<p>Any drainage issues will be addressed by the Site Manager in the unlikely event that this occurs.</p>
<p>Waste Management</p>	<p>A minor volume of waste may be generated onsite, primarily related to staff amenities, office materials and maintenance works. Unmanaged waste has the potential to result in litter or contamination of the environment.</p>	<p>Waste management at the site will include:</p> <ul style="list-style-type: none"> Hydrocarbons and chemical containers will be regularly removed from site for disposal at a licensed landfill facility. Portable toilets will be available onsite with sewage waste to be transported off-site for treatment and disposal by a licensed contractor. No effluent will be released onsite. General housekeeping onsite will be explained to and expected to be followed by all personnel onsite. Mobile service vehicles will store any waste oil removed from machinery and remove it from-site daily. Any waste bins will be covered to prevent access by wildlife. 	<p>Waste management contractor/s will be engaged to assist with waste removal from the site.</p>

Activity/Item	Potential Impacts	Design, Management and Mitigation Measures	Management Controls/Monitoring
Dieback Management	<p>The site has not been assessed for dieback presence, but it is noted that dead trees and signs of health impact to trees were observed during site inspections. Potential impacts of Phytophthora dieback presence onsite include death of susceptible flora species such as <i>Eucalyptus marginata</i> (Jarrah) and <i>Xanthorrhoea preissii</i>, amongst others. <i>Eucalyptus gomphocephala</i> (Tuart) is noted to be a resistant species to <i>Phytophthora cinnamomi</i> (Groves et al, undated).</p>	<p>The following actions will be undertaken to avoid the potential spread of dieback onsite:</p> <ul style="list-style-type: none"> • Boundary fencing and gates will be maintained to prevent unauthorised site access. • Site access tracks will comprise of a limestone base. Limestone has a high pH and as such is suppressive of Phytophthora dieback. • Haulage trucks offsite will generally run along bitumen roads to their destination and return which is anticipated to be associated with a lower risk of dieback spread. Recognising this, but as a precaution, haulage trucks are restricted to dedicated tracks only. • Access to areas with retained vegetation will be restricted to authorised personnel only. Vehicles entering these areas must be free of plant material and soil. • All vehicles and equipment being used during land clearing or land reinstatement are to be clean and free from soil or plant material prior to arriving at the site. • Construction works entry points will be minimised. 	<p>Site fencing and access gates will be inspected regulator by the site manager and any damage will be repaired.</p> <p>Any vehicles entering the retained bushland areas onsite will need approval from the site manager.</p>
Surrounding Land Uses	<p>The closest sensitive land uses are located approximately 275 m south and approximately 228 m southwest of the proposed extraction area extent. In recognition that this is less than the EPA buffer distance guidance to avoid potential disturbance which the EPA identifies are associated with potential noise and dust impacts (EPA, 2005), potential impact analysis takes into consideration:</p> <ul style="list-style-type: none"> • The dominant winds in this location are the summer south westerly (afternoon) and easterly (morning) winds. The closest sensitive land uses 	<p>The following actions will be undertaken to reduce potential impacts to surrounding land uses:</p> <ul style="list-style-type: none"> • A buffer ranging between 20 m and 90 m from the excavation area to the site boundary will be maintained on the southwestern side of the property. • An additional setback and construction of the three earthen bunds will be undertaken at the southwestern end of the excavation area which will assist to reduce noise emissions and visual impacts. • Management actions proposed in relation to noise and dust emissions are further discussed above in this table which will minimise impacts to surrounding land uses. 	<p>The Site Manager is responsible for management actions related to noise and dust as discussed above.</p>

Activity/Item	Potential Impacts	Design, Management and Mitigation Measures	Management Controls/Monitoring
	<p>are not downgradient of the site in these directions.</p> <ul style="list-style-type: none"> • Native vegetation is present within Lot 201 (#436) Gibbs Road, Nowergup which is located between the site and a number of the southwestern sensitive land use properties • Management practices which will be put in place specifically relating to noise and dust emissions. 		
Visual Amenity	<p>The site is located in a rural area where quarrying activities are already present. The visual aspects of the site will not vary significantly from other nearby similar sites.</p>	<p>Visual amenity will be addressed by:</p> <ul style="list-style-type: none"> • Boundary fencing and gates will be compatible with the rural style of the area. • The location of the site office building will be in an area of low visual impact. • A vegetated buffer zone will be maintained around the edge of the site (excluding at access points into the site). • Earthen bunds along the southwestern edge of phases 1-3 in the excavation area will serve to improve screening of the operations and reduce visual impacts. • Workers will be inducted on good housekeeping practices which will be implemented throughout the project's lifetime. • The site will not operate at night. As such there is no potential for visual impacts associated with light spill 	<p>Visual assessment of bunds, stockpiles, security fencing and housekeeping will be undertaken by the Site Manager</p>
Aboriginal Cultural Heritage	<p>There are no known Aboriginal heritage sites within the landholdings. No impacts to Aboriginal Cultural Heritage are anticipated.</p>	<p>Should any evidence of early aboriginal occupation including presence of potential artefacts be uncovered during works, all activities will be stopped in compliance with the <i>Aboriginal Heritage Act 1972 (AH Act)</i> pending an assessment and advice by DPLH.</p>	<p>Site workers will be made aware of their obligations under the AH Act to avoid disturbance of and to ensure reporting of any potential sites/artefacts of cultural heritage significance.</p>

Activity/Item	Potential Impacts	Design, Management and Mitigation Measures	Management Controls/Monitoring
Fire Management	<p>Fires onsite have the potential to cause injury to site occupants and to damage structure, plant and equipment as well as vegetation.</p>	<p>The following actions will be undertaken in relation to fire risk management:</p> <ul style="list-style-type: none"> • The site will comply with the requirements of the City of Wanneroo 2025/26 Firebreak Notice (and any subsequent notices) which currently requires: <ul style="list-style-type: none"> ▪ A 3 metre wide trafficable firebreak as close as possible to all external boundaries of the property must be installed by 1 November each year and maintained until 30 April the following year ▪ Ensure a minimum vertical clearance of 4 metres is maintained along the firebreaks to enable vehicles to drive along the firebreaks without access being obstructed. 	<p>Annual firebreak maintenance will be arranged by the Site Manager</p>
Karst/cave potential disturbance	<p>The site is within a broad area which is identified as having a medium karst risk (CoW, 2022b).</p> <p>Karst or cave features can provide habitat for Threatened subterranean fauna species, if suitable conditions are present. These two groups of subterranean fauna are:</p> <ul style="list-style-type: none"> • Stygofauna – aquatic and living in groundwater • Troglifauna – air-breathing and living in caves and voids <p>The proposed resource extraction work will not extend below the water table and will not involve abstraction of groundwater.</p> <p>There are currently no known cave or karstic features within the site.</p>	<p>The following management actions are proposed in relation to caves and karst:</p> <ul style="list-style-type: none"> • If karstic features are identified during resource extraction activities onsite, all operations will cease and a karst assessment will be undertaken. • If significant caves or voids are encountered during resource extraction activities, work is to be suspended until potential impact on subterranean fauna is assessed. • The requirements to notify the Site Manager should the presence of karst/caves be observed and the need to cease work in this area until further instructions are provided will be included in the site worker induction package 	<p>Site Manager to seek advice on potential risk to subterranean fauna if substantial caves or karst are found onsite.</p>

5 Post Extraction

5.1 Post-Extractive Industries Land Use

The post-extraction use of the site will be rural or urban development depending on the sites zoning at that time.

5.2 Site Stabilisation

Following completion of resource extraction works onsite, the site will be stabilised through the return of overburden and topsoil to the completed extraction areas. This will occur on a stage by stage basis. In addition, the batters will be landscaped with local native species to support the long-term stabilisation of this portion of the site and provide for an additional native vegetation zone. This is further discussed below.

The final decommissioning actions will involve removal of site infrastructure (e.g. site office etc).

5.3 Progressive Landscaping

In addition to the retained vegetation around the perimeter of the site, progressive landscaping on the batter to the retained vegetation areas (see Appendix 4) is proposed. This will be undertaken on a stage by stage basis commencing when each excavation stage has been completed. The landscaping will involve installation of native species, which will assist with stabilisation of the landscape, dust management and provide an additional post-extraction native vegetation zone.

5.3.1 Species Selection

A preliminary species list is provided below for species which may be planted within the landscape zone. This list contains species which naturally occur in this general location.

Preliminary Landscape Zone Species List

- *Acacia pulchella*
- *Acacia saligna*
- *Acanthocarpus preissii*
- *Banksia dallanneyi*
- *Bossiaea eriocarpa*
- *Conostylis aculeata*
- *Conostylis candicans*
- *Corymbia calophylla*
- *Dianella revoluta var. divaricata*
- *Eucalyptus gomphocephala*
- *Eucalyptus marginata*
- *Hakea lissocarpha*
- *Hakea prostrata*
- *Hardenbergia comptoniana*
- *Jacksonia calcicole*

This list will be refined in consultation with the City of Wanneroo prior to planting commencing.

5.3.2 Weed Control

Weed control works will occur in the retained vegetation buffer and landscaping area to reduce weed presence onsite and support native species establishment and growth.

Weed control areas will reflect the active landscape zone extent for the excavation stages, and will extend into the immediately adjacent retained vegetation zone.

The specific weed control program details will be provided to the City prior to commencement of landscaping works within each stage. This will allow for weed control timing and methods to respond to the weeds present within/adjacent to each specific management area.

5.4 Reporting

A summary report will be provided annually to the City of Wanneroo detailing for each reporting period:

- the current extraction area extent
- areas where extraction has been completed that have moved into the post extraction/closure phase
- landscaping and weed control works proposed for the coming 12 months
- landscape and weed control works completed in the previous 12 months, including success of these works

6 Implementation Summary

Table 6-1 provides a summary of the implementation actions proposed to support the pre, during and post development stages of the resource extraction project.

Responsibility for implementation of these actions will rest with the project proponent Urban Resources until these tasks are completed.

Table 6-1: Implementation Summary

Topic	Action	Timing
Vegetation Clearing	Boundaries of the site are to be clearly marked prior the commencement of clearing.	Pre and during extraction
	Implement advice from Arboriculturist for any trees that are being retained in close proximity to the excavation area.	
	NVCP and EPBC Act referral application submission, assessment and obtain approvals.	Pre-extraction
Retained vegetation protection and management	Installation and maintenance of site fencing and access gates.	Pre-extraction
	Regulate site access control by utilising a visitor registry and briefing all site visitors on permitted and restricted access areas.	During extraction
	Ensure vehicle movement will be limited to designated access tracks and the excavation areas.	
	If any access is required within the retained vegetation areas, vehicles are to be cleaned on entry to the site.	
Fauna and habitat disturbance	Obtain a licence to take or disturb fauna from the DBCA prior vegetation clearing commencing.	Pre-extraction
	A fauna relocater is to be present during vegetation removal works to manage/attend to any fauna which may be impacted by these works.	During extraction
	Fauna relocation to be in accordance with DBCA licence conditions.	During extraction
	Contractors to abide by the Injured Fauna Protocol, should injured fauna be encountered on site.	During extraction
Topsoil and overburden removal	Topsoil and overburden is to be stockpiled following stripping for reuse post-excavation.	Pre, during and post extraction
Noise	Noise management will be implemented and undertaken as part of all site works.	During and post extraction
	A complaint register is to be maintained and will be made available to the City of Wanneroo upon request.	
Air quality (Dust)	Dust management will be implemented and undertaken as part of all site works.	During and post extraction
	A complaint register is to be maintained and will be made available to the City of Wanneroo upon request.	
Hydrocarbon & Spill (Groundwater Management)	All non-major machinery are to be serviced on-site by an authorised service vehicle equipped with a hydrocarbon spill kit.	During extraction
	Waste materials from spills are to be disposed of off-site by a licensed waste contractor.	



Topic	Action	Timing
	All machinery will be refuelled directly from authorised service vehicles.	
	Strict reporting protocol for all significant incidents will be required. Any fuel spills exceeding 5 L will be recorded, investigated and remediated promptly.	
	The incident log will be made available for inspection by the City of Wanneroo and DWER if requested.	
Drainage Management	Any drainage issues to be addressed promptly.	During extraction
Waste Management	A waste management strategy is to be implemented.	Pre and during extraction
	A waste management contractor will be engaged to assist with waste removal from the site.	
Dieback Management	Site access tracks are to be constructed of a limestone base.	During extraction
	Site fencing and access points will be inspected regularly and maintained.	
	All vehicles and equipment utilised during land clearing or land reinstatement are to be cleaned and free from soil or plant material prior to arriving at the site. Vehicles, equipment and machinery to remain within designed work areas only.	
	Any vehicles entering the retained bushland areas onsite will need approval.	Pre, during and post extraction
Surrounding Land Uses	Maintenance of the buffer area from the southwestern side of excavation area to the site boundary.	During extraction
	Construction of three-earthen bunds at the southwestern end of the excavation area.	
Visual Amenity	Visual assessment of bunds, stockpiles, security fencing and housekeeping to be undertaken regularly.	Pre and during extraction
Aboriginal Cultural Heritage	All contractors working onsite will be made aware of their obligations under the <i>Aboriginal Heritage Act 1972</i> . Should any potential Aboriginal heritage areas or artefacts be identified during site works, activities in this area will cease until advice from DPLH is received.	Pre and during extraction
Fire Management	Fire risk management to be implemented.	Pre, during and post extraction
	Annual firebreak maintenance to be arranged and implemented.	
Karst/cave potential disturbance	Site worker induction package to be implemented.	Pre-extraction
	If karstic features are identified during works, then all works are to be ceased, and a karst assessment will be undertaken.	During extraction
Project extraction	Site stabilisation through the return of overburden and topsoil once extraction has been completed.	During/ post extraction.



Topic	Action	Timing
	Consultation with the City of Wanneroo to agree species selection, planting density and weed control program prior to landscape planting for each stage commencing.	During extraction
	Progressive landscaping to include planting within the landscape batter zone.	During/ post extraction.
	Weed control within the landscape batter zone and retained vegetation zone	Post extraction to be undertaken in stages reflecting the annual landscaping zone extent.
	Annual progress reports to be prepared and submitted to the City of Wanneroo. These report are to contain details of the work undertaken in the previous 12 months, and the work proposed for the coming 12 months.	During/ post extraction.
	Determination of the post-extractive industries land use.	During/ Post-extraction

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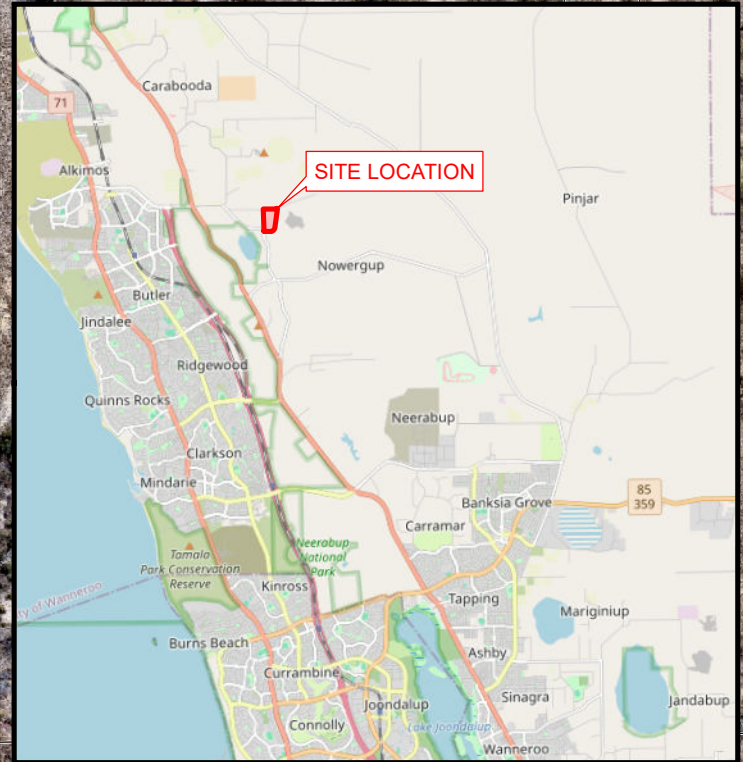
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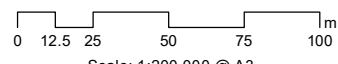
Figures



LEGEND

- Site Boundary
- Cadastre


 N


 0 12.5 25 50 75 100 m
 Scale: 1:200,000 @ A3
 GDA2020 MGA Zone 50

Source: Cadastre - Landgate
Orthophoto - NearMaps, 06.04.24

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ENVIRONMENT




Job: URENOW01
Doc: 001
Date: 26/08/2024
Ph: (08) 9381 5513
Fax: (08) 9381 5514
E: info@coterra.com.au

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LOT 107 GODEL ROAD, NOWERGUP


SITE LOCATION

Figure 1





LEGEND


-  Site Boundary
-  Cadastre
-  Contour (mAHD)

Acid Sulphate Soil Risk Mapping

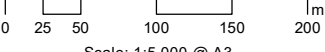
-  High to moderate risk

Geology

-  LS1: LIMESTONE - light yellowish brown, fine to coarse-grained, sub-angular to well rounded, quartz, trace of feldspar, shell debris, variably lithified, surface kankar, of eolian origin.
-  LS2: LIMESTONE - light yellowish brown, fine to coarse-grained, sub-angular to well rounded, quartz, trace of feldspar, shell debris, variably lithified, surface kankar, of eolian origin, abundant karstic.
-  S7: SAND - pale and olive yellow, medium to coarse-grained, sub-angular quartz with a trace of feldspar, moderately sorted, of residual origin.
-  Water

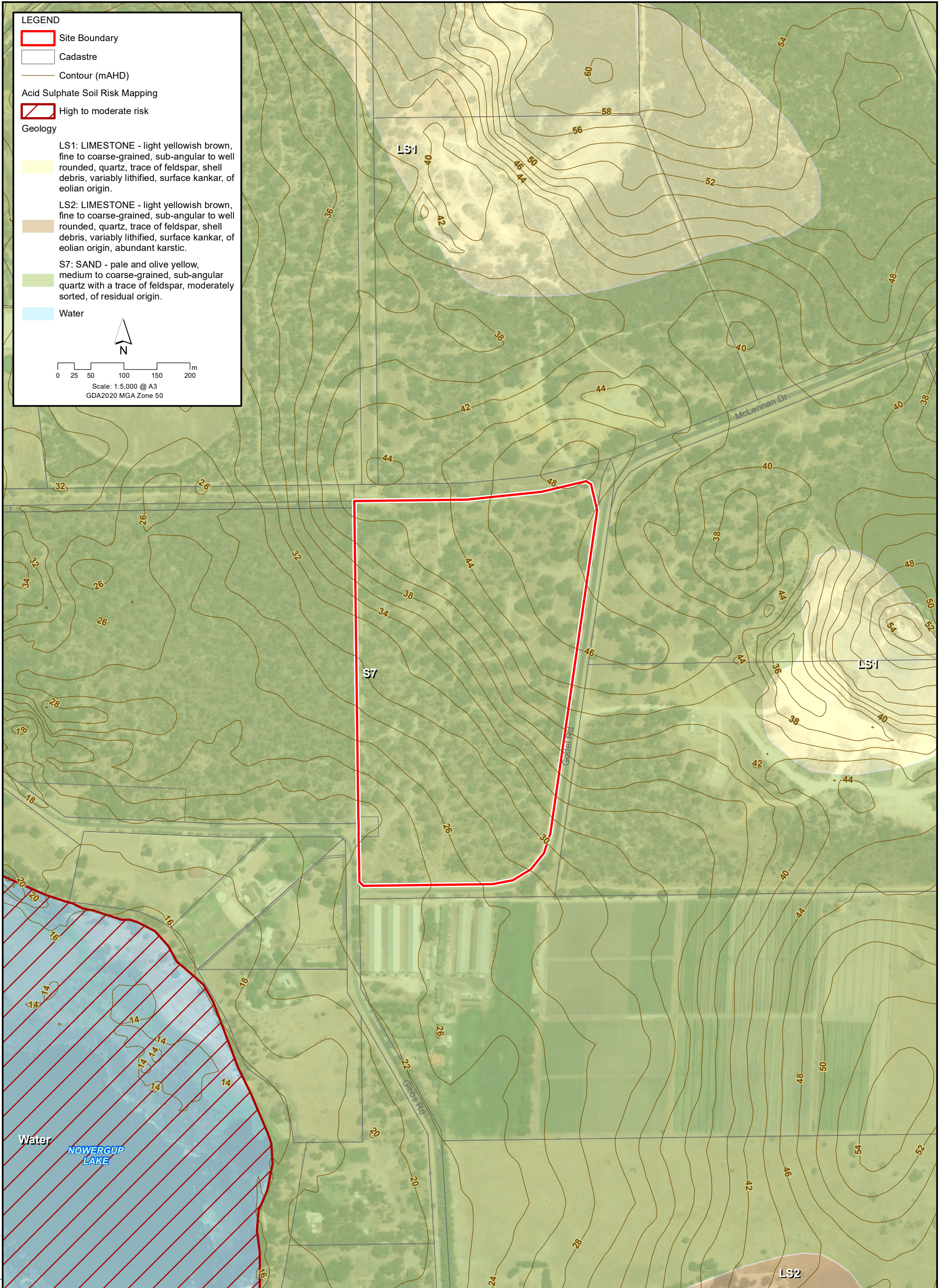


N



0 25 50 100 150 200 m

Scale: 1:5,000 @ A3
GDA2020 MGA Zone 50



Source: ASS - DWER
Cadastre - Landgate
Orthophoto - NearMaps, 06.04.24
Geology & Contours - DPIRD

COTERRA
ENVIRONMENT

Job: URENOW01
Doc: 002
Date: 26/08/2024
Ph: (08) 9381 5513
Fax: (08) 9381 5514
E: info@coterra.com.au

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TOPOGRAPHY AND SOILS


Figure 2

LEGEND

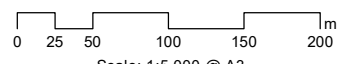
- Site Boundary
- Cadastre
- Lake - perennial
- Swamp - perennial

Wetlands

- Conservation

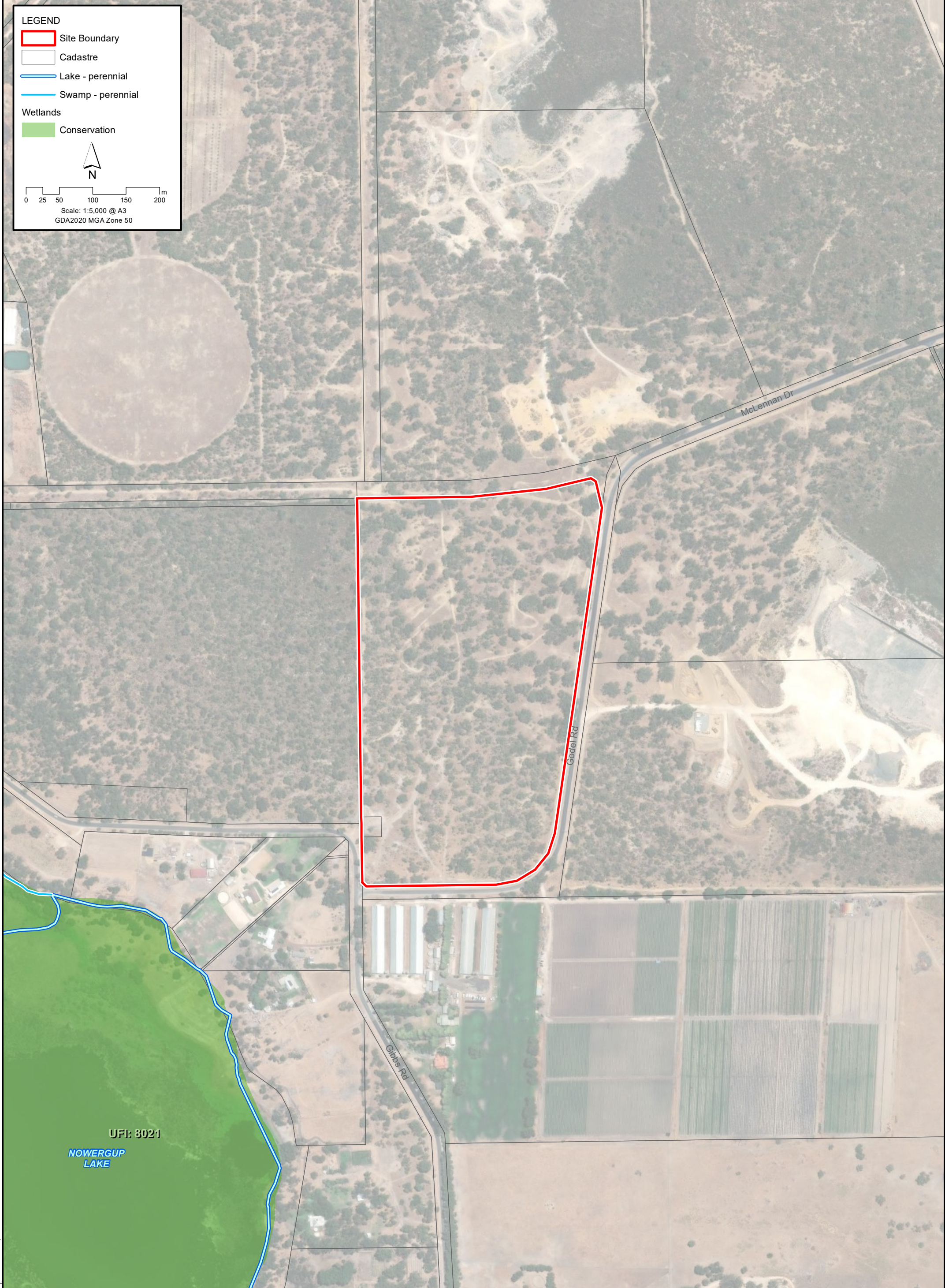


N



0 25 50 100 150 200 m

Scale: 1:5,000 @ A3
GDA2020 MGA Zone 50



ENVIRONMAPS | t: 0406 590 006
Environmental Mapping Solutions | www.environmentmaps.com.au

Source: Cadastre - Landgate
Hydrography - DWER
Wetlands - DBCA, 2024
Orthophoto - NearMaps, 06.04.24

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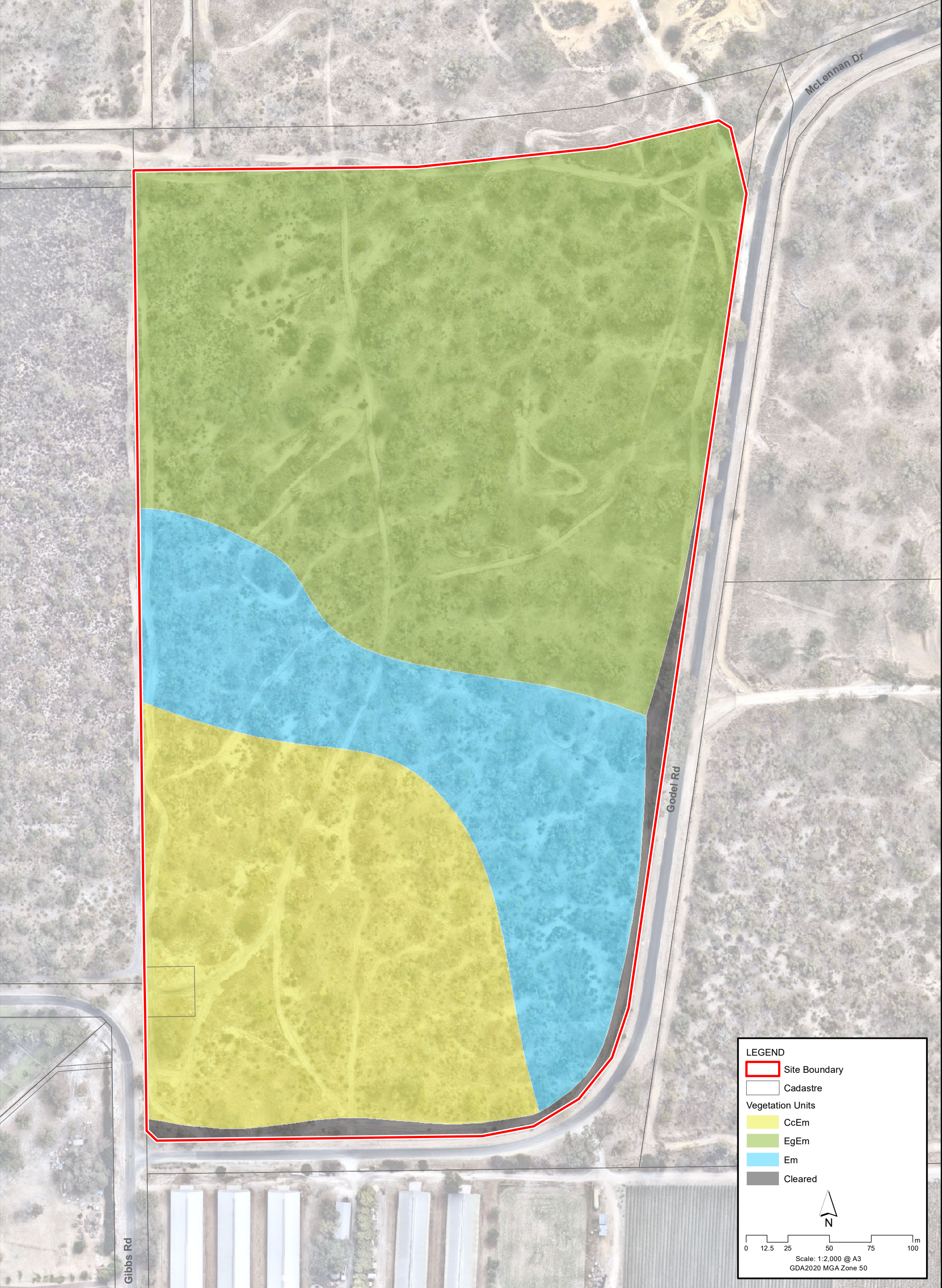
ENVIRONMENT

Job: URENOW01
 Doc: 003
 Date: 26/08/2024
 Ph: (08) 9381 5513
 Fax: (08) 9381 5514
 E: info@coterra.com.au

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 LOT 107 GODEL ROAD, NOWERGUP

HYDROLOGY AND WETLANDS

Figure 3



LEGEND

- Site Boundary
- Cadastre

Vegetation Units

- CcEm
- EgEm
- Em
- Cleared

N

0 12.5 25 50 75 100 m

Scale: 1:2,000 @ A3
GDA2020 MGA Zone 50

Source: Cadastre - Landgate
Orthophoto - NearMaps, 06.04.24

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Job: URENOW01
Doc: 004
Date: 3/09/2024
Ph: (08) 9381 5513
Fax: (08) 9381 5514
E: info@coterra.com.au

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VEGETATION UNITS

Figure 4



LEGEND

- Site Boundary
- Cadastre

Vegetation Condition

- Degraded
- Completely Degraded

N

0 12.5 25 50 75 100 m

Scale: 1:2,000 @ A3
GDA2020 MGA Zone 50

Source: Cadastre - Landgate
Orthophoto - NearMaps, 06.04.24

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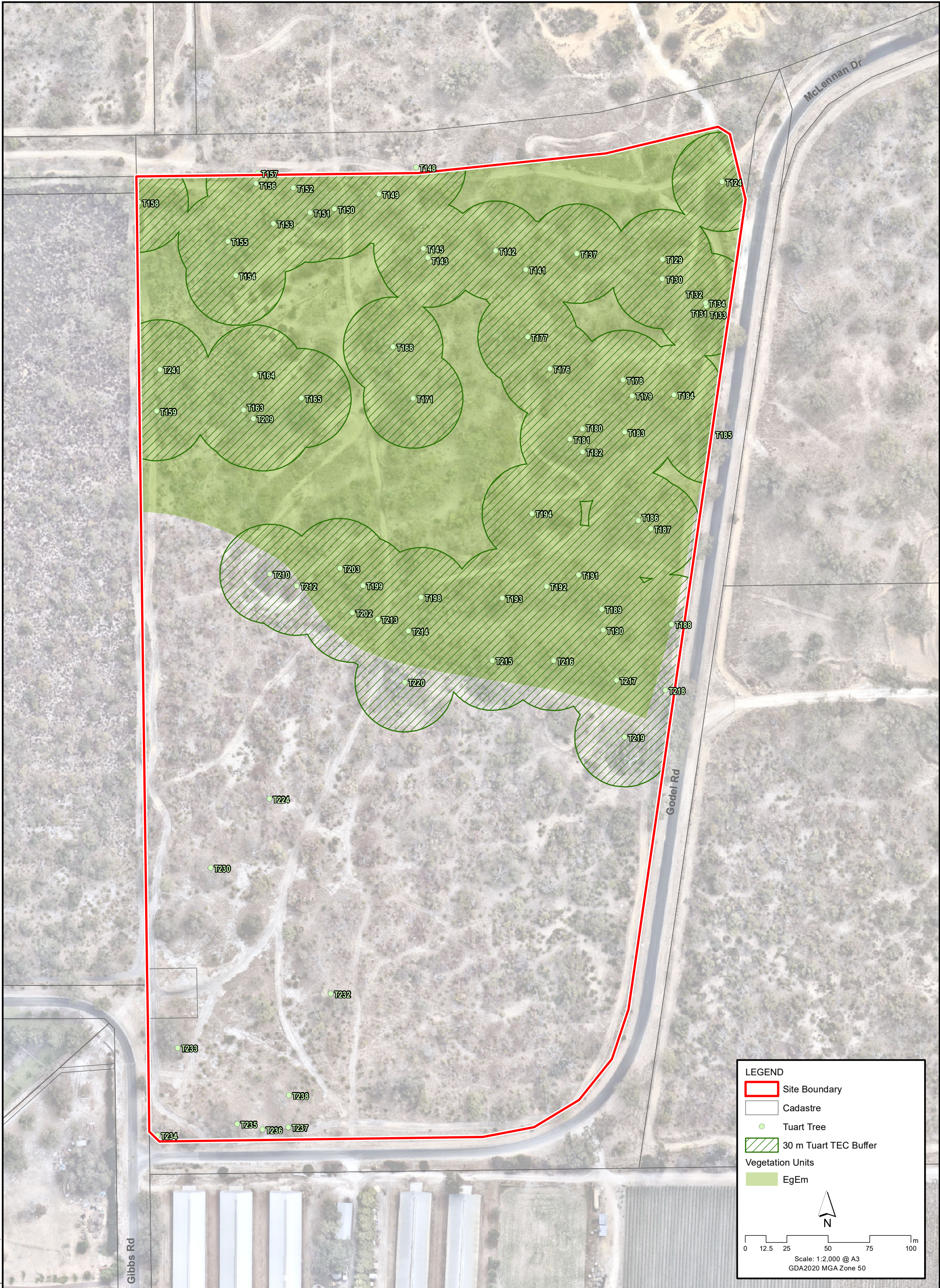
ENVIRONMENT

Job: URENOW01
Doc: 005
Date: 26/08/2024
Ph: (08) 9381 5513
Fax: (08) 9381 5514
E: info@coterra.com.au

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VEGETATION CONDITION

Figure 5




LEGEND

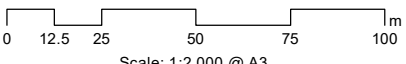
- Site Boundary
- Cadastre
- Tuart Tree
- 30 m Tuart TEC Buffer

Vegetation Units

- EgEm



N



0 12.5 25 50 75 100 m

Scale: 1:2,000 @ A3
GDA2020 MGA Zone 50

Source: Cadastre - Landgate
Orthophoto - NearMaps, 06.04.24

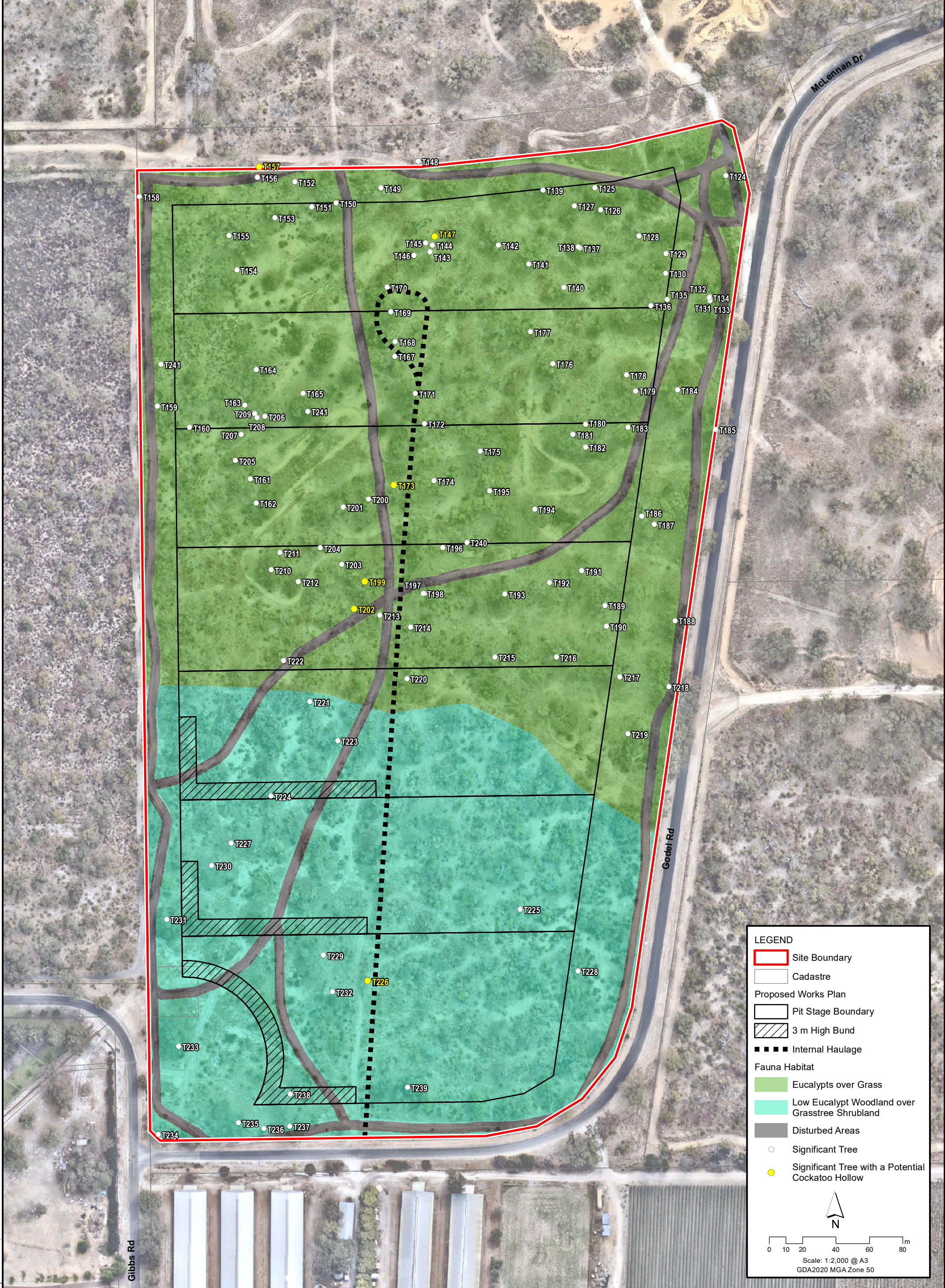
COTERRA ENVIRONMENT

Job: URENOW01
Doc: 001
Date: 30/08/2024
Ph: (08) 9381 5513
Fax: (08) 9381 5514
E: info@coterra.com.au

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TUART TEC BUFFER

Figure 6



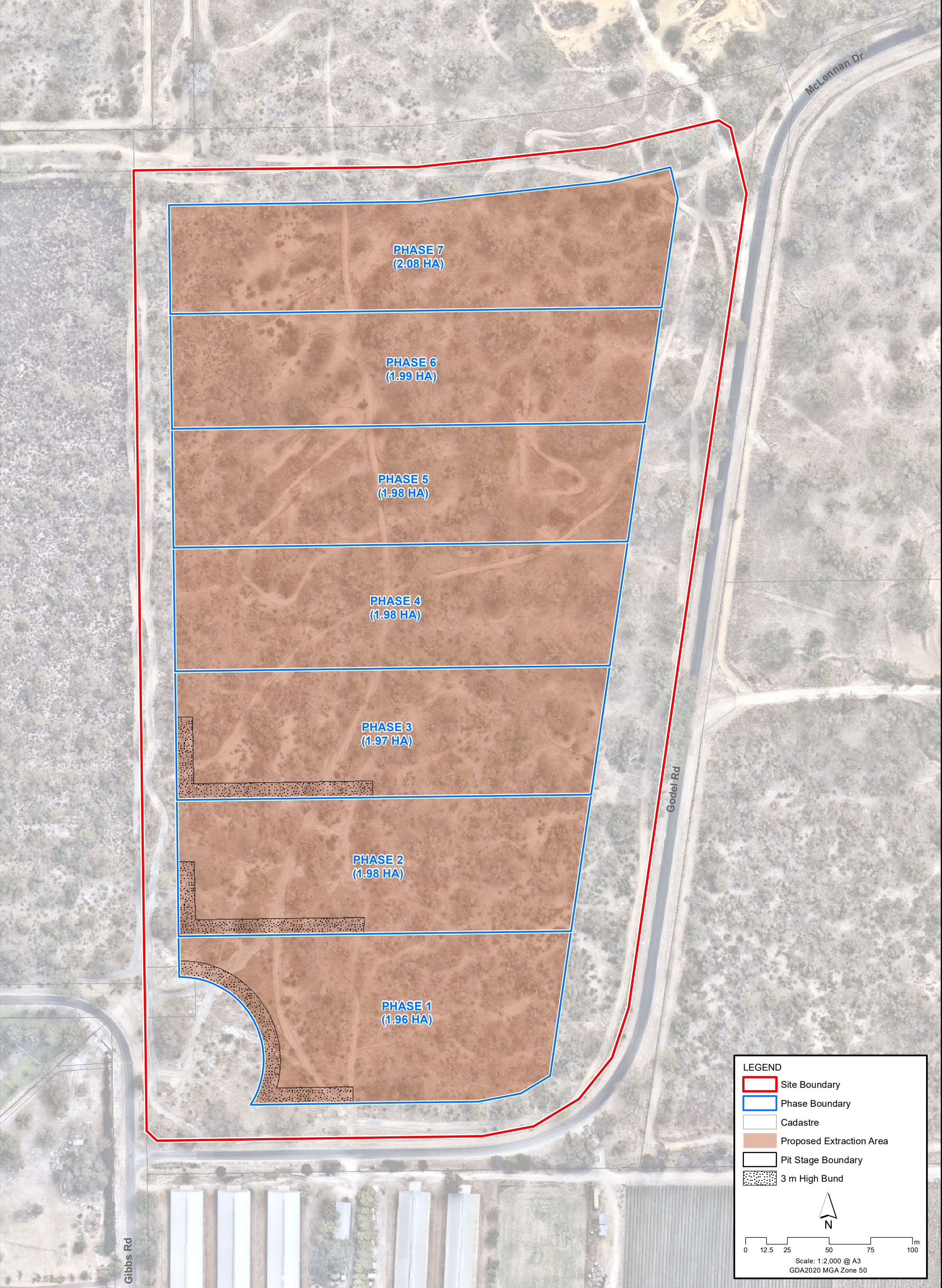
LEGEND

- Site Boundary
- Cadastre
- Proposed Works Plan**
- Pit Stage Boundary
- 3 m High Bund
- Internal Haulage
- Fauna Habitat**
- Eucalypts over Grass
- Low Eucalypt Woodland over Grasstree Shrubland
- Disturbed Areas
- Significant Tree
- Significant Tree with a Potential Cockatoo Hollow

N


0 10 20 40 60 80 m

Scale: 1:2,000 @ A3
GDA2020 MGA Zone 50

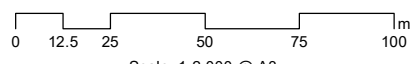


LEGEND

- Site Boundary
- Phase Boundary
- Cadastre
- Proposed Extraction Area
- Pit Stage Boundary
- 3 m High Bund



N



0 12.5 25 50 75 100 m

Scale: 1:2,000 @ A3
GDA2020 MGA Zone 50

Source: Cadastre - Landgate
Orthophoto - NearMaps, 06.04.24

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ENVIRONMENT

Job: URENOW01
Doc: 007
Date: 3/10/2024
Ph: (08) 9381 5513
Fax: (08) 9381 5514
E: info@coterra.com.au

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LOT 107 GODEL ROAD, NOWERGUP

PROPOSED EXTRACTION AREA PHASES

Figure 8



Appendix 1 Detailed Flora and Vegetation Survey

Detailed Flora and Vegetation Survey
Lot 107 Godel Road,
Nowergup



September 2024



PO Box 9179, Picton WA 6229

0484 771 825 |

enquiries@ecoedge.com.au

COTERRA
ENVIRONMENT

Level 1, 98 Colin Street, West
Perth WA 6005

Ph: (08) 9381 5513

www.coterra.com.au

Version	Origin	Review	Review date	Release approval	Issue date
V1	C. Norman (Coterra)	D. Brace	8/8/2024		
Final Draft	Ecoedge	Coterra	26/08/2024		
Final	Coterra	Ecoedge	27/08/2024	Ecoedge	2/9/2024
Note: original data supplied by PGV Environmental not Ecoedge					

Executive Summary

Ecoedge Environmental Services (Ecoedge) was engaged by Coterra Environment (Coterra) in May 2024, to provide a report for Lot 107 Godel Road, Nowergup, Western Australia (the survey area).

The survey area is approximately 19 hectares in size and is currently undeveloped, containing native vegetation in varying condition.

The report was compiled from the findings of two surveys conducted by PGV Environmental in 2014 and 2023 which were supplied by Coterra.

The 2023 survey determined that some areas of vegetation within the survey area met the definition of a Threatened Ecological Community (TEC). The vegetation type containing Tuart trees was considered to be representative of the Tuart Woodlands and Forests of the Swan Coastal Plain ecological community which is a TEC at both Commonwealth and State levels. The total area of Tuart Woodland TEC within the survey area is 9.77 hectares.

The 2014 and 2023 surveys were both undertaken by Dr Paul van der Moezel of PGV Environmental, who has extensive botanical survey experience on the Swan Coastal Plain. In 2014 the flora and vegetation survey was conducted on the 7 October and in 2023, Lot 107 Godel Road was surveyed on the 25 September. The 2023 survey has been conducted in accordance with the Environmental Protection Authority (EPA) (2016) Technical Guidance, Flora and Vegetation Surveys for Environmental Impact Assessment.

No Threatened flora listed under either the State *Biodiversity Conservation Act 2016* or Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* were found nor were there any State listed Priority flora, or flora of otherwise significance were found in the survey area.

The Cottesloe Complex – Central and South is above the 30% retention of pre-European extent vegetation target across the SCP and at a local government level it is well represented with 41.65% pre-European extent vegetation remaining.

In the City of Wanneroo the amount of extent vegetation remaining is 41.65%, which exceeds the 30% national retention target.

There are no mapped watercourses or wetlands within the survey area. The closest wetland is the conservation category Nowergup Lake (UFI 8021) which is approximately 280 m to the south west of the survey area.

The survey area is not identified as a Bush Forever site. Similar vegetation from the Cottesloe – Central and South vegetation complex occurs in two nearby Bush Forever sites to the east and south-west.

The survey area does not occur within an Environmentally Sensitive Area (ESA) buffer. There are ESAs that are associated with Bush Forever sites to the east and southwest of the survey area and an ESA associated with the indicative location of TEC 'Aquatic Root Mat Community Number 1 of Caves of the Swan Coastal Plain' located approximately 1.4 kilometres to the northeast of the survey area.

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Statement of limitations

Reliance on data

In the preparation of this report, Ecoedge has relied on data, surveys, analyses, designs, plans and other information provided by the Client and other individuals and organisations, most of which are referred to in the report. Unless stated otherwise in the report, Ecoedge has not verified the accuracy or completeness of the data. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in the report are based in whole or in part on the data, those conclusions are contingent upon the accuracy and completeness of the data. Ecoedge will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, withheld, unavailable, misrepresented or otherwise not fully disclosed to Ecoedge.

Original data was supplied by PGV Environmental and site survey was not conducted by Ecoedge's botanists.

Report for the benefit of the Client

The report has been prepared for the benefit of the Client and no other party. Ecoedge assumes no responsibility and will not be liable to any other person or organisation for or in relation to any matter dealt with or conclusions expressed in the report or for any loss or damage suffered by any other person or organisation arising from matters dealt with or conclusions expressed in the report (including, without limitation, matters arising from any negligent act or omission of Ecoedge or for any loss or damage suffered by any other party relying on the matters dealt with or conclusions expressed in the report). Other parties should not rely upon the report or the accuracy or completeness of any conclusions and should make their own enquiries and obtain independent advice in relation to such matters.

1 Introduction

Ecoedge Environmental Services (Ecoedge) was engaged by Coterra Environment (Coterra) in May 2024, to provide a report for Lot 107 Godel Road, Nowergup, Western Australia (the survey area). The survey area is shown in **Figure 1**.

The survey area is approximately 19 hectares (ha) in size and is currently undeveloped, containing native vegetation in Degraded and Completely Degraded condition.

The survey area is located in the City of Wanneroo, approximately 38 kilometres (km) north-north-west of the Perth Central Business District.

The report is compiled from the findings of two surveys conducted by PGV Environmental in 2014 and 2023, the details of which are described below.

1.1 2014 survey

Urban Resources Pty Ltd engaged PGV Environmental in 2014 to undertake a Level 2 spring flora and vegetation survey for Lots 105 McLennan Drive and 107 Godel Road, Nowergup, Western Australia.

A preliminary flora and vegetation survey had also been previously conducted by EnviroWorks Consulting (2014) in February, a time of the year when most ephemeral plant species are not able to be identified.

1.2 2023 survey

In 2023, a detailed flora and vegetation survey was conducted by PGV Environmental over a larger area which included Lot 105 McLennan Drive for Carabooda Landowners Pty Ltd.

The 2023 survey area was approximately 660 ha in size and is used for a variety of purposes including market gardens, turf farms, sand and limestone mining (past, present and possible future), rural retreats and undeveloped bushland.

2 Scope and objectives

The scope of the PGV surveys required a desktop assessment to be conducted prior to the field survey to identify relevant key features and constraints which were in or nearby the survey area, such as Threatened and Priority Flora, Threatened and Priority Ecological Communities (TEC and PECs), riparian vegetation, unusual soil/landscape systems, conservation estates, poorly represented vegetation associations and or vegetation complexes and environmentally sensitive areas (ESAs). The desktop assessment area (study area) encompassed a 10 km buffer to the survey area.

The field component of the PGV survey was required to ground truth the desktop assessment findings and delineate all significant flora and vegetation components within the survey area, including TECs and PECs and Threatened and Priority flora. In particular, a targeted assessment was required of the condition of Tuart woodland within the survey area to assist in the determination of *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) TEC status.

The 2014 survey was undertaken in accordance with now superseded Guidance Statement 51: *Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia* (EPA, 2004) which was at the time the requirement for assessment of environmental factors in accordance with the Environmental Protection Act 1986.

The 2023 survey and report were required to be undertaken in accordance with the Environmental Protection Authority's (EPA) *Technical Guidance - Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016) and meet requirements of other relevant State and Commonwealth guidelines for threatened species and communities, such as approved conservation advice for threatened species and communities under the EPBC Act 1999.

The 2023 survey included the following

- Desktop search and review of the Department of Biodiversity, Conservation and Attractions (DBCA) Threatened and Priority flora database.
- A search of Atlas of Living Australia for records of Threatened or Priority species.
- A search of the Commonwealth Government's Protected Matters Search Tool to identify species potentially occurring within the area that are protected under the EPBC Act.
- Field survey using quadrats to record native and introduced species as well as a thorough survey area walkover of any areas of native vegetation.
- Analysis of quadrat data to ascertain the conservation significance of the vegetation.
- Recording of any significant plant species using a hand-held GPS.
- Description and mapping of vegetation types and vegetation condition.
- Compilation of a flora list.

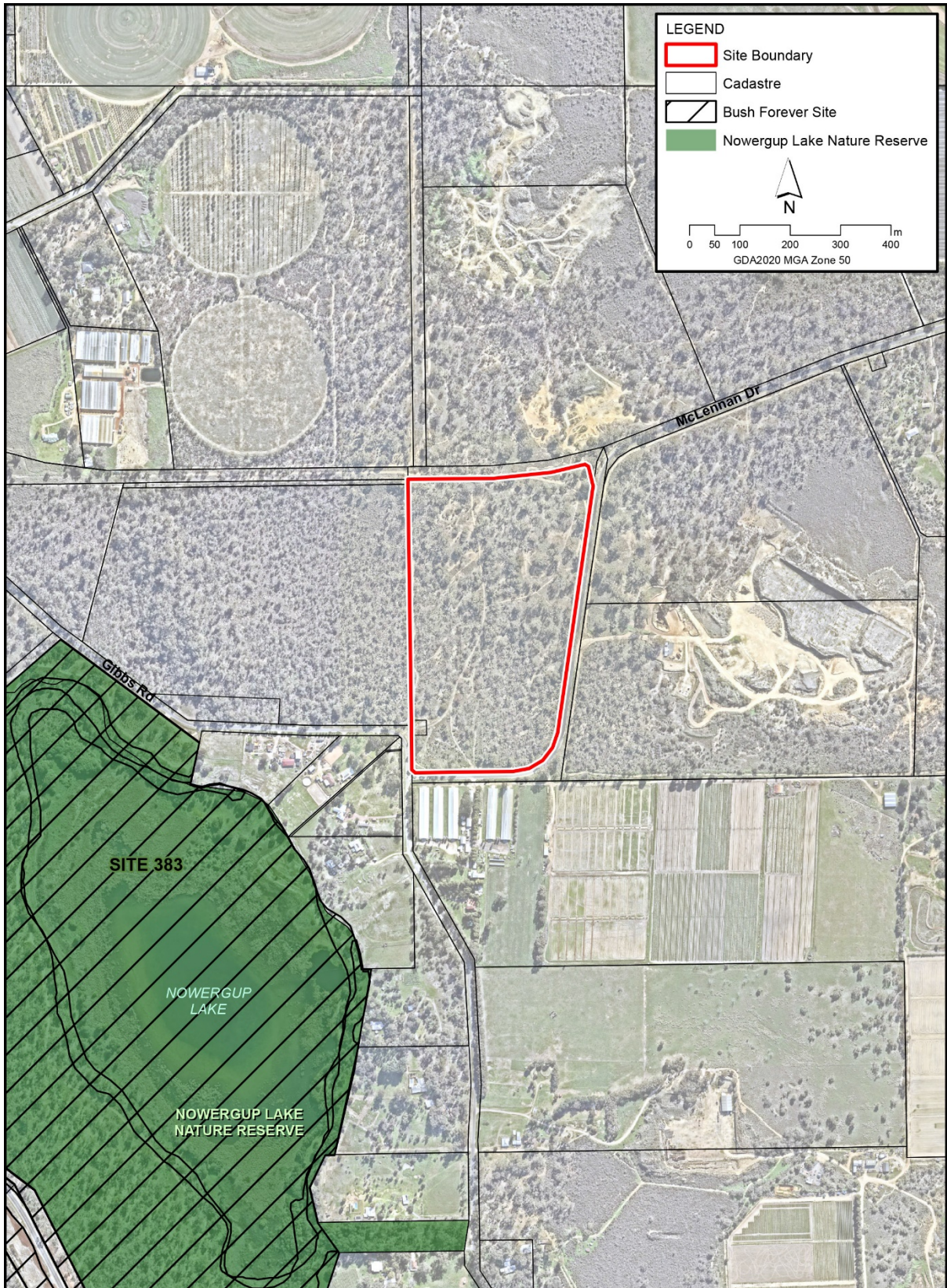


Figure 1. Aerial photograph showing the location of the survey area and surrounding area.

3 Methods

3.1 Desktop assessment

Prior to the 2023 PGV field survey, a desktop assessment was undertaken to provide contextual information on the flora and vegetation within the survey area. The desktop studies included a review of the following information.

- Regional geology and soil mapping (Schoknecht et al. 2004; van Gool 1990).
- Vegetation complex mapping of the South West Forest Region of Western Australia (Mattiske and Havel 1998) and the System 6 area (Hedde et al. 1980) as updated by Webb et al. (2016).
- Beard's pre-European vegetation association mapping dataset (DPIRD-006) (Beard et al. 2013).
- WA Threatened and Priority Ecological Communities DBCA database extracts from the Department of Biodiversity, Conservation and Attractions (DBCA 2023a) and TEC and PEC listings (DBCA 2023b, DBCA 2023c).
- Federal Protected Matters Search Tool results (DCCEEW 2023a).
- Extract from the Department's Threatened Flora database and the Western Australian Herbarium database (DBCA 2023d).
- Geomorphic Wetlands, Swan Coastal Plain (SCP) dataset DBCA-019 (DBCA 2022a).
- Tuart Woodlands dataset (DBCA-048) (DBCA 2018).
- Environmentally sensitive areas distribution maps and dataset (DWER 2021).
- Surface Hydrology Lines (National) (Crossman & Li 2015).
- State Planning Policy 2.8 Bushland Policy for the Perth Metropolitan Region dataset (DPLH-054) (DPLH 2019).

The assessment also included a review of the following surveys:

- EnviroWorks Consulting (2014). Preliminary Flora and Vegetation Assessment Lots 105 and 107 McLennan Dr., Nowergup 2014.
- PGV Environmental (2014) Flora and Vegetation Survey - Lot 105 & 107 McLennan Drive, Nowergup, 21 November 2014.

3.2 Field survey

3.2.1 2014 survey

A flora and vegetation survey of Lot 107 was conducted by Dr Paul van der Moezel of PGV Environmental on 7 October 2014. The survey included sampling from four non-permanent 10 m x 10 m quadrats on Lot 107 as well as a thorough walk through the survey area. Survey area coverage was high due to the ease of access on foot through the understorey.

3.2.2 2023 survey

The 2023 detailed flora and vegetation survey was conducted by Dr Paul van der Moezel of PGV Environmental in September and 17 October 2023 over 8 separate field days for the overall area (660 ha), with Lot 107 Godel Road being surveyed on 25 September 2023. The survey across the 660 ha site included sampling from 39 permanently marked 10 m x 10 m quadrats as well as sampling from outside of the quadrats within the different vegetation types on the survey area. Four quadrats were sampled on Lot 107.

Information on flora composition and vegetation structure was recorded in the quadrats.

Most plant species were identified in the field. Some specimens were photographed or taken for identification at the Perth Reference Herbarium or office using standard reference guides.

Vegetation condition was assessed using the method provided by Government of Western Australia (GoWA 2000). **Appendix 1** shows the quadrat location, and track logs relevant to Lot 107.

3.3 Floristic Community Type Analysis

Floristic Community Types (FCT) are based on the whole floristic composition of the vegetation (trees, shrubs, herbs, sedges etc) rather than being determined by soil type and geomorphology (Vegetation Complex) or the nature of the dominant species (Vegetation Types). Many of the Threatened and Priority Ecological Communities on the Swan Coastal Plain are based on the FCT level of vegetation description.

The FCTs of the southern Swan Coastal Plain were initially identified in a study undertaken by the (then) Department of Conservation and Land Management and the Conservation Council of Western Australia (Gibson et al. 1994). The study analysed the floristic composition of 509 10m x 10m quadrats by computer programmes. The analysis resulted in the definition of 43 community types and sub- types.

The database searches undertaken in 2023 identified three FCTs that could potentially occur within the overall survey area:

- SCP20a *Banksia attenuata* woodlands over species rich dense shrublands
- SCP23b Swan Coastal Plain *Banksia attenuata* - *Banksia menziesii* woodlands
- SCP26a *Melaleuca huegelii* - *Melaleuca systema* shrublands on limestone ridges

To determine whether any of these FCTs occur within the survey area, quadrat data can be analysed using the PATN computer programme. This computer analysis of FCTs requires high quality quadrat data to achieve meaningful results. Based on the degraded vegetation condition onsite (see Section 6.5), PATN analysis was not able to be undertaken for Lot 107.

4 Survey limitations

Rainfall for Perth (Measured at Wanneroo, Site Number 009105) was above average in June and below average in July being 199.4mm and 66.4mm respectively, compared to an average of 160.9mm and 160.6mm (BOM, 2023). Rainfall in August and September was below average with 98.3mm and 73.5mm respectively, compared to 123.5 and 82.6mm (BoM, 2023). The below average rainfall in for most of the year was not sufficient to be considered a constraint on the survey.

Limitations with regards to the assessment are addressed in **Table 1**.

Table 1. Limitations of the 2014 and 2023 field surveys with regard to assessment adequacy and accuracy.

Aspect	Constraint *	Comment
Competency/experience of the consultant conducting the survey	Not a constraint	2014 & 2023 surveys- Dr Paul van der Moezel has extensive botanical survey experience on the Swan Coastal Plain, including the Wanneroo area.
Proportion of the flora identified [^]	Not a constraint	2014 survey– The timing of the survey in early October should have identified most of the native species on the survey area. 2023 survey- The timing of the survey in September-October was optimal to identify most flora species in the survey area including all potential Threatened and Priority Flora.
Sources of information (historic/recent or new data)	Not a constraint	2014 & 2023 surveys- The flora of the Swan Coastal Plain is well documented.
Timing/weather/season/cycle	Not a constraint	2014 survey– Generally, slightly below average rainfall in winter 2014. Early October survey ideal for identifying rare orchids and maximising flowering of most species. 2023 survey– The spring survey was optimal for most flora species. 2023 was a good year for ephemeral species, although the season finished early due to the small amount of rainfall in September.
Disturbances (Fire)	Not a constraint	2014 survey– n/a 2023 survey– the survey area has not been recently burnt.

Aspect	Constraint *	Comment
Intensity of survey (e.g. In retrospect was the intensity adequate)	Not a constraint	2014 survey- The open understorey made access and coverage easy. Tracklogs show approximately 8 hours spent on the Lot 105 and Lot 107 survey areas. 2023 survey- The time spent on the overall site, 8 person days, was considered adequate to sample a high proportion of the flora.
Completeness (e.g. was relevant area fully surveyed)	Not a constraint	
Resources (e.g. degree of expertise available for plant identification)	Not a constraint	2014 & 2023 surveys – An experienced botanist undertook plant identifications mostly on site with some identification off-site using standard reference material.
Remoteness and/or access problems	Not a constraint	2014 & 2023 surveys- Easily accessible site in the Perth Metropolitan Region, traversed entirely on foot.
Availability of contextual (e.g. bioregional) information for the study area.	Not a constraint	2014 survey- Heddle et al. (1980), Government of Western Australia (2000), Gibson et al. (1994). 2023 survey– WALA statistics on remnant bushland.

*Constraints have been rated as Significant, Moderate or Not a constraint

^Fungi and nonvascular flora (e.g. algae, mosses and liverworts) were not specifically surveyed for during the survey.

5 Results desktop assessment

5.1 Biogeographic region and location

The survey area is situated within the Perth (SWA02) sub-region of the Swan Coastal Plain (SCP) biogeographic region as defined in the Interim Biogeographical Regionalisation for Australia (IBRA) (Commonwealth of Australia 2016).

5.2 Landform and soils

The survey area occurs on the SCP, which is bounded by the Darling Scarp to the east, Indian Ocean to the west, Moore River to the north and Dunsborough to the south. The SCP is built up of two belts of sediments that differ in origin: aeolian sediments in the west and alluvial sediments in the east. The aeolian sediments comprise three major dune systems: The Bassendean Dune System is the most easterly and oldest system; the Quindalup System is the most westerly and youngest system, with the Spearwood system located in between. These wind-deposited dunes press up against the Pinjarra plain, which is built up of alluvium deposited by streams from the Darling Plateau. Its alluvial soils are predominantly clays and silts; in places, low dunes of aeolian sands from the west may overlay the alluvial soils (Seddon 1972).

The survey area occurs across the Spearwood land system (211Sp) which is comprised predominantly of sand dunes and plains of aeolian deposited yellow deep sands, pale deep sands and yellow/brown sands over limestone (van Gool 1990). The Spearwood land system is commonly associated with Tuart-Marri forest and woodland in the south and heath and open woodland in the north of the SCP. The systems of the SCP have been divided into soil phases based on local soil conditions, with the soil phases found in the survey area described in **Table 2** and shown in **Figure 2**.

Table 2. Soil Mapping Units occurring within the survey area (Schoknecht et al. 2004).

System	Subsystem	Description
Spearwood (211Sp)	211Sp_Ky	Karrakatta sand yellow phase consisting of low hilly to gently undulating terrain, yellow sand over limestone at 1-2 m.
	211Sp_Sp	Spearwood sand phase consisting of irregular banks of karst depressions, some limestone outcrop and shallow brown sands.

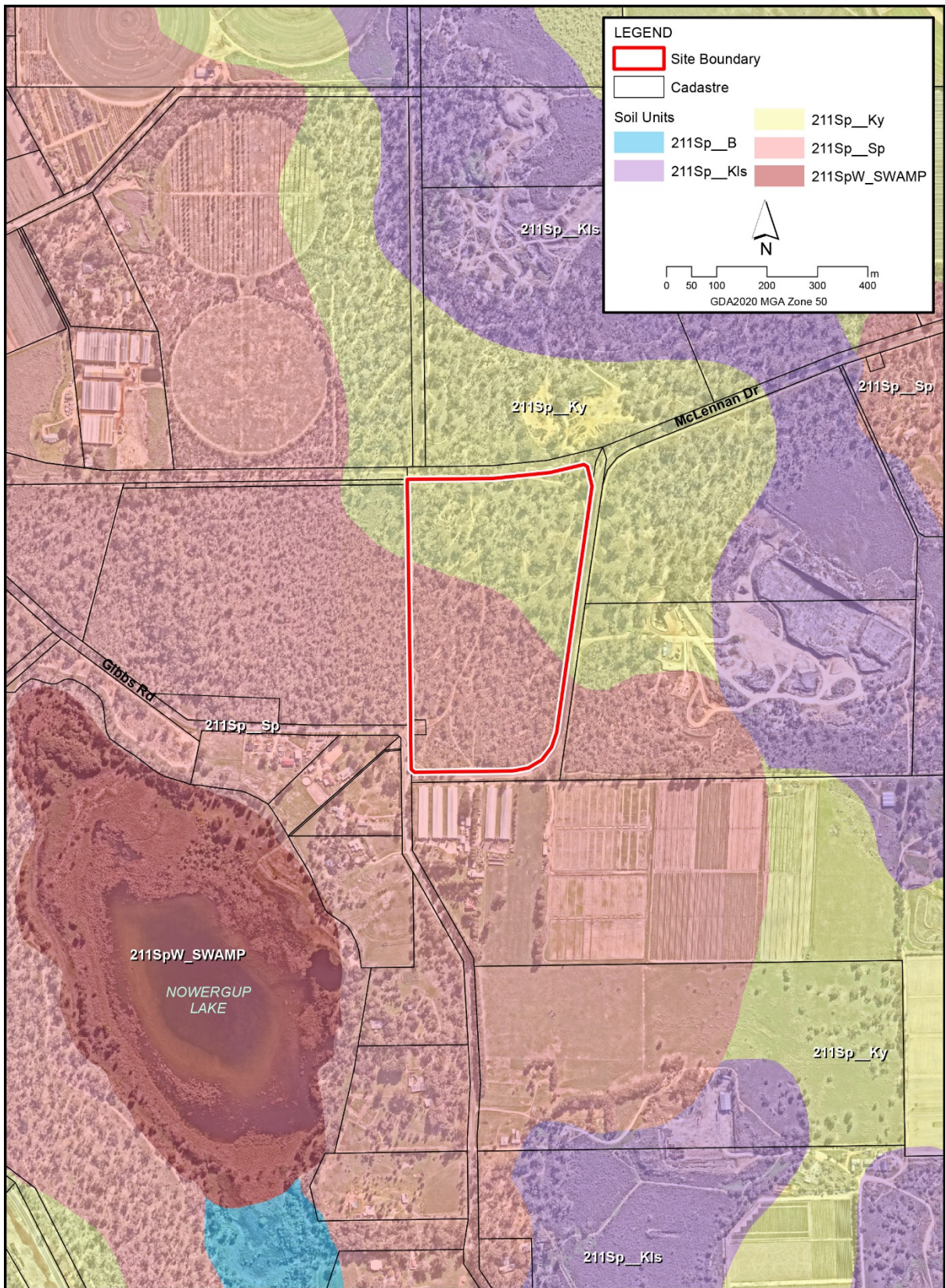


Figure 2. Land units mapped in and nearby the survey area (DPIRD 2017).

5.3 Vegetation description according to pre-European mapping datasets

5.3.1 Vegetation complexes

The comprehensive pre-1750 distribution of vegetation complexes¹ across the southwest of Western Australia is based on two main data sets. Heddle et al.'s 1980 1:250,000 scale vegetation complex mapping of the 'System 6' area comprising of the greater Perth and Darling Range Region and Mattiske and Havel's 1998 1:50,000 scale mapping of forest vegetation covered by the Regional Forest Agreement 1999² (Webb et al. 2016). Both data sets were prepared in order to inform the adequacy of biodiversity conservation through state managed reserves (EPA 1993, South-West Regional Forest Agreement 1999). In 2016, these data sets were revised by the Department of Parks and Wildlife (DPaW) (Webb et al. 2016) in order to fill data gaps and improve alignment and correlation between the data sets.

According to the vegetation complex mapping as updated by Webb et al. in 2016, there is one vegetation complex – the Cottesloe Complex - Central and South – mapped across the survey area. This vegetation complex is described in **Table 3** and shown in **Figure 3**.

Table 3. Vegetation complexes mapped for the survey area (Webb et al. 2016).

Vegetation Complex	Description
Cottesloe Complex – Central and South (52)	Mosaic of woodland of <i>Eucalyptus gomphocephala</i> (Tuart) and open forest of <i>Eucalyptus gomphocephala</i> (Tuart) - <i>Eucalyptus marginata</i> (Jarrah) - <i>Corymbia calophylla</i> (Marri); closed heath on the Limestone outcrops.

5.3.2 Vegetation associations

A systematic survey of native vegetation in Western Australia was undertaken by J. S. Beard (along with others) during the 1970s, which described vegetation systems in the southwest of Western Australia at a scale of 1:250,000. Beard's vegetation maps attempted to depict the vegetation as it might have been prior to European settlement in terms of type and extent (Beeston et al. 2001). The Beard Vegetation Association dataset, also referred to as the pre-European native vegetation extent dataset, was digitised by Shepherd et al. (2002).

¹ Vegetation complex mapping is based on broadscale assessment of regional patterns of vegetation in relation to underlying landforms, soils and climatic trends.

² Mattiske and Havel's (1998) mapping also included an assessment of an area of the very southern portion of the Swan Coastal Plain landform (Webb et al. 2016).

Beard vegetation associations have been described to a minimum standard of Level 3 “Broad Floristic Formation” for the National Vegetation Inventory System (NVIS) (state-wide to regional scale)³ (NVIS 2017)

The survey area is comprised of one Beard vegetation association, being 998 ‘Medium woodland; tuart’ (**Figure 4**).

³ Beard’s vegetation mapping units are referred to as ‘associations’ however these do not correspond to the NVIS Level 5 ‘Associations’. The NVIS system was developed long after Beard’s work was completed, and while both classification systems use the same term, NVIS ‘Associations’ describe vegetation in more detail than do Beard’s.

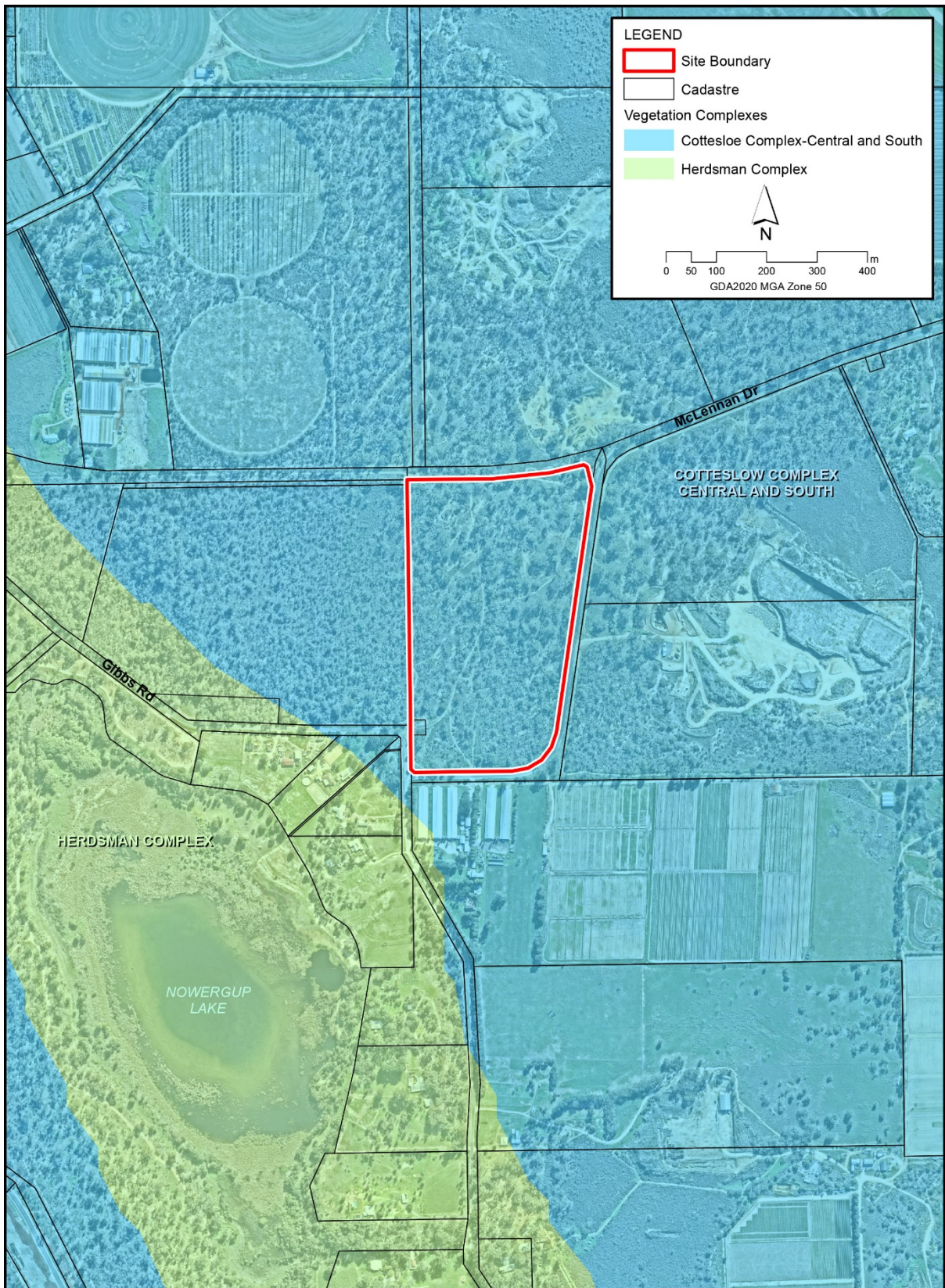


Figure 3. Vegetation complexes mapped in and nearby the survey area (Webb et al. 2016).

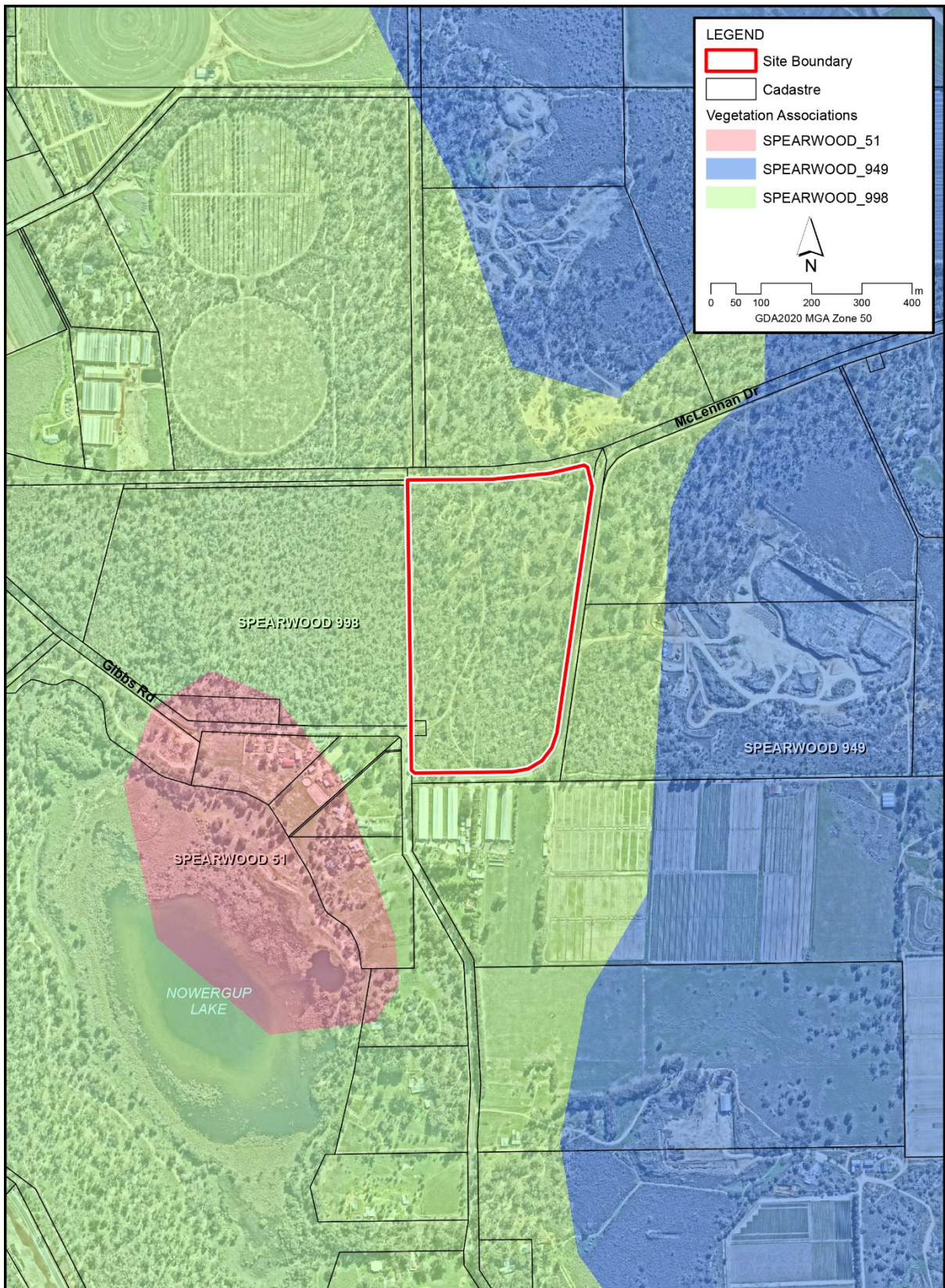


Figure 4. Vegetation associations mapped in and nearby the survey area (Beard et al. 2013).

5.3.3 Assessment of remaining extent against pre-European extent

In 2001, the Commonwealth of Australia stated National Targets and Objectives for Biodiversity Conservation, which recognised that the retention of 30%, or more, of the pre-clearing extent of each ecological community was necessary if Australia's biological diversity was to be protected (Environment Australia 2001).

In its report on the Statewide Vegetation Statistics incorporating the Comprehensive, Adequate and Representative (CAR) Reserve Analysis, the Government of Western Australia (GoWA) provides information on the pre-European and current extent of the ecological communities of Western Australia and reports on the status of the CAR reserve system for WA (GoWA 2019a). This system is also based on the National retention targets of 30% overall. Only reserves managed by DBCA under the *Conservation and Land Management Act 1984* are considered for inclusion in the “CAR Reserve Analysis”. In Western Australia, these statistics have been based on Beard’s vegetation associations and Webb et al.’s (2016) updated vegetation complexes.

The percentage remaining of the pre-European extent vegetation and the percentage of current extent in DBCA managed land for the vegetation complex and association described for the survey area are presented in **Table 4** and **Table 5** respectively.

The Cottesloe Complex – Central and South is above the 30% retention of pre-European extent vegetation target across the SCP and at a local government level it is well represented with 41.65% pre-European extent vegetation remaining.

Association 998 is well represented across all boundaries, exceeding the 30% of pre-European extent vegetation remaining and meeting national retention targets.

The red, orange and yellow shading in the tables indicates the status of the Commonwealth 30% retention target.

Status of the Commonwealth retention target	>30%	<30%	<10%
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Table 4. The vegetation complex (Cottesloe Complex – Central and South) mapped within the survey area with regards to the Commonwealth retention targets (GoWA 2019b).

Region	Pre-European (ha)	Current Extent (ha)	% Remaining	% Remaining in DBCA reserves ⁴
Cottesloe Complex – Central and South (52)				
Swan Coastal Plain	45,299.61	14,567.87	32.16	10.01
City of Wanneroo	13,313.58	5,545.39	41.65	n/a

* Excludes Crown Freehold Department Interest Lands that are managed under Section 8(a) of the CALM Act.

Table 5. The vegetation association within the survey area with regards to the Commonwealth retention targets (GoWA 2019a).

Region	Pre-European (ha)	Current Extent (ha)	% Remaining	% Remaining in DBCA Managed Land*
Association 998				
State-wide	51,015.33	18,492.63	36.25	17.65
IBRA region: Swan Coastal Plain (SWA)	50,867.50	18,492.32	36.35	17.70
IBRA sub-region Perth (SWA02)	50,867.50	18,492.32	36.35	17.70
City of Wanneroo	4,635.30	2,787.40	60.13	31.72

* Excludes Crown Freehold Department Interest Lands that are managed under Section 8(a) of the CALM Act.

⁴ The % remaining in DBCA land is not calculated for the vegetation complex mapping data set.

5.4 Threatened and Priority ecological communities.

Ecological communities are defined by Western Australia's DBCA as "...naturally occurring biological assemblages that occur in a particular type of habitat. They are the sum of species within an ecosystem and, as a whole, they provide many of the processes which support specific ecosystems and provide ecological services." (DEC 2013).

Under Section 27 of the *Biodiversity Conservation Act 2016* (BC Act), the Western Australian Minister for Environment may list communities considered under significant threat as a TEC. These TECs can be listed under one of three conservation categories. These categories are Critically Endangered (CR), Endangered (EN) and Vulnerable (VU). The BC Act also provides for listing communities as collapsed ecological communities.

Possible TECs that do not meet survey criteria are added to the DBCA's Priority ecological community lists under Priorities 1, 2 or 3 (referred to as P1, P2, P3). Ecological communities that are adequately known, are rare but not threatened, that meet criteria for near Threatened, or that have been recently removed from the Threatened list, are placed in Priority 4 (P4). These ecological communities require regular monitoring. Conservation Dependent ecological communities are placed in Priority 5 (P5) (DEC 2013).

The current listing of Threatened and Priority ecological communities is specified in DBCA (2023b, 2023c). The conservation categories for these Threatened and Priority ecological communities are defined in **Appendix 2**.

TECs can also be listed under the Commonwealth EPBC Act, 1999. There are three categories of TEC under the EPBC Act: Critically Endangered (CR), Endangered (EN) and Vulnerable (VU) (DCCEEW 2022). These are defined in **Appendix 3**.

In 2023, a search of DBCA's TEC and PEC database was conducted within a radius of 10 km around the survey area (10-0822EC) (**Appendix 4**).

These searches identified five TECs and seven PECs within the 10 km area, listed at a State level. Six TECs listed at a Commonwealth level were also identified.

The communities identified in the database searches are outlined in **Table 6**.

Outcomes of these searches are presented in **Table 6**. The results of the DBCA records are shown in **Figure 5**.

Of the TECs and PECs identified in the database search one community 'Tuart (*Eucalyptus gomphocephala*) woodlands and forests of the Swan Coastal Plain' was mapped as potentially occurring across the survey area (**Figure 5**).

Based on the preliminary assessment of vegetation types, the following additional communities are considered to potentially occur on the survey area (PGV 2023):

- SCP20a *Banksia attenuata* woodlands over species rich dense shrublands

- SCP23b Swan Coastal Plain *Banksia attenuata* - *Banksia menziesii* woodlands
- SCP26a *Melaleuca huegelii* - *Melaleuca systema* shrublands on limestone ridges
- Banksia Woodlands of the Swan Coastal Plain ecological community

Table 6. Threatened and Priority ecological communities occurring within 10 km study area (DBCA 2023a).

Number	Description	Conservation Status under the WA BC Act	Conservation Status under the Commonwealth EPBC Act
CAVES SCP01	Aquatic Root Mat Community Number 1 of Caves of the Swan Coastal Plain	Critically Endangered	Endangered
SCP19b	Woodlands over Sedgeland in Holocene dune swales of the southern Swan Coastal Plain (floristic community type 19 as originally described in Gibson et al. 1994)	Critically Endangered	Endangered
SCP10a	Shrublands on dry clay flats (floristic community type 10a as originally described in Gibson et al. (1994))	Endangered	Critically Endangered
SCP26a	<i>Melaleuca huegelii</i> - <i>Melaleuca systema</i> shrublands on limestone ridges (floristic community type 26a as originally described in Gibson et al. (1994))	Endangered	Critically Endangered
SCP20a	<i>Banksia attenuata</i> woodlands over species rich dense shrublands (floristic community type 20a as originally described in Gibson et al. (1994))	Endangered	Endangered as part of the Banksia WL SCP
SCP22	<i>Banksia ilicifolia</i> woodlands	Priority 3	Endangered as part of the Banksia WL SCP
SCP23b	Swan Coastal Plain <i>Banksia attenuata</i> - <i>Banksia menziesii</i> woodlands	Priority 3	Endangered as part of the Banksia WL SCP
SCP24	Northern Spearwood shrublands and woodlands	Priority 3	-
SCP30b	Quindalup <i>Eucalyptus gomphocephala</i> and/or <i>Agonis flexuosa</i> woodlands	Priority 3	Critically Endangered as part of the Tuart Woodlands
SCP29b	<i>Acacia</i> shrublands on taller dunes	Priority 3	-
Banksia WL SCP	Banksia Woodlands of the Swan Coastal Plain ecological community	Priority 3	Endangered
Tuart woodlands	Tuart (<i>Eucalyptus gomphocephala</i>) woodlands and forests of the Swan Coastal Plain	Priority 3	Critically Endangered

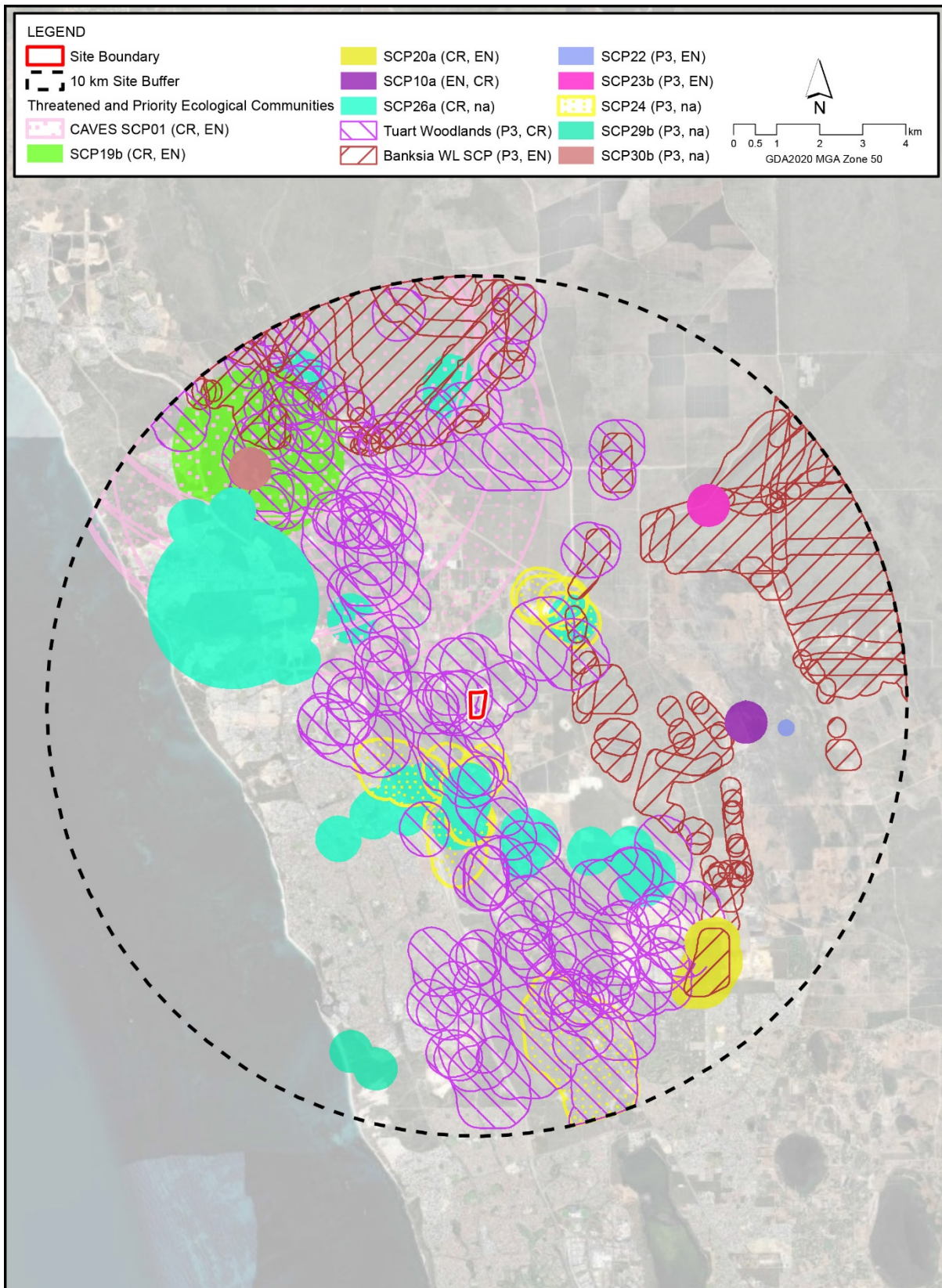


Figure 5. Threatened and Priority ecological communities within the desktop study area (DBCA 2018, DBCA 2023a).

5.5 Threatened and Priority flora

Species of flora and fauna are defined as having a Threatened or Priority conservation status where their extant populations are restricted geographically and/or under threat of possible extinction. The DBCA recognises these threats and consequently applies regulations towards population and species protection.

Threatened extant flora species are listed under Section 19 of the BC Act. They are ranked according to their level of threat using the International Union for Conservation of Nature (IUCN) Red List categories and criteria. The categories are Critically Endangered (CR), Endangered (EN), Vulnerable (VU). It is an offence to “take” or damage Threatened flora without Ministerial approval. Section 5 of the Act defines “to take” as “... to gather, pluck, cut, pull up, destroy, dig up, remove, harvest or damage flora by any means”.

Priority flora is under consideration for future declaration as “Threatened flora”, dependent on more information. Species classified as Priority One to Three (referred to as P1, P2 and P3) are in need of further survey to determine their status, while Priority Four (P4) species are adequately known rare or Threatened species that require regular monitoring.

Threatened flora lists are formally reviewed annually with the current listing updated on 1 May 2024 (DBCA 2024). The Priority flora list is subject to ongoing review with updates regularly published on the Western Australian Herbarium Florabase website.

Categories of Threatened and Priority flora as defined by the BC Act are presented in **Appendix 5** (DBCA 2019).

Threatened flora may also be protected under the Commonwealth EPBC Act and can be listed in one of six categories. Definitions of these categories are summarised in **Appendix 6** (DCCEEW 2020).

Threatened or Priority flora occurring within 10 km of the survey area were generated from a Protected Matters Search Tool query in 2023 (DCCEEW 2023a). DBCA and WA Herbarium Threatened and Priority flora data downloads generated in 2023 (DBCA 2023d) are shown in **Figure 6** and provided in **Appendix 4**.

The results from the database searches are shown in **Table 7**. A total of 37 species were identified in the database searches, including 13 Threatened and 24 Priority species. There was one Threatened species identified that appears to be an error within the databases as it does not grow in the Perth region.

A breakdown of the likelihood of occurrence (possible and likely) of all potential species according to conservation status is provided in **Table 7**.

5.5.1 Significant flora likelihood of occurrence

Prior to undertaking the survey, an assessment of the likelihood of occurrence of Threatened and Priority flora occurring within the survey area was undertaken. PGV Environmental (2023) categorise the pre-survey likelihood as Not Likely, Unlikely, Highly Unlikely, or Possible. **Table 7** shows significant flora possible and likely to occur within the survey area.

Table 7. List of flora species identified from database searches within 10 km of the survey area and their likelihood of occurrence (DBCA 2023a).

Scientific Name	Common Name	Conservation Status (WA)	Status under EPBC Act	Habitat*	Likelihood to occur on the survey area
<i>Caladenia huegelii</i>	King Spider-orchid, Grand Spider-orchid, Rusty Spider-orchid	Critically Endangered	Endangered	The Grand Spider-orchid prefers deep grey-white sand usually associated with the Bassendean sand-dune system, however, rare plants have been known to extend into the Spearwood system (in which calcareous yellow sands dominate) in some areas (DEC, 2009). This species generally does not survive in disturbed areas.	Unlikely – the location is further north of known populations
<i>Drakaea elastica</i>	Glossy-leafed Hammer Orchid	Critically Endangered	Endangered	The Glossy-leafed Hammer Orchid prefers low-lying situations adjoining winter-wet swamps and grows on bare patches of sand within otherwise dense vegetation in low-lying areas alongside winter-wet swamps, typically in banksia (<i>Banksia menziesii</i> , <i>B. attenuata</i> and <i>B. ilicifolia</i>) woodland or spearwood (<i>Kunzea glabrescens</i>) thicket vegetation (DEC, 2009).	Highly Unlikely – not suitable habitat
<i>Diuris purdiei</i>	Purdie's Donkey-orchid	Endangered	Endangered	Purdie's Donkey Orchid occurs in grey-black sand in moist winter-wet swamps with winter inundation in dense heath with scattered trees and amongst native sedges and dense heath with scattered emergent <i>Melaleuca preissiana</i> , <i>Eucalyptus calophylla</i> , <i>E. marginata</i> and <i>Nuytsia floribunda</i> .	Highly Unlikely – not winter-wet habitat
<i>Drakaea micrantha</i>	Dwarf Hammer-orchid	Endangered	Vulnerable	Dwarf Hammer-orchid usually occurs on cleared fire breaks or open sandy patches in Banksia, Jarrah and Sheoak woodlands or forest and often found under Spearwood thickets.	Highly Unlikely – not suitable habitat and not recorded north of the Swan River
<i>Macarthuria keigheryi</i>	Keighery's Macarthuria	Endangered	Endangered	Keighery's Macarthuria prefers white or grey sand on low-lying winter-wet damp sands growing among heathland, Jarrah and Sheoak/Banksia woodland and Banksia/Eucalypt Woodland (DEC, 2008).	Highly Unlikely – not suitable habitat

Scientific Name	Common Name	Conservation Status (WA)	Status under EPBC Act	Habitat*	Likelihood to occur on the survey area
<i>Marianthus paralius</i>		Endangered	Endangered	<i>Marianthus paralius</i> occurs in white sand and brown loam amongst heath on coastal limestone cliffs (DEC, 2009).	Highly Unlikely – not suitable habitat
<i>Melaleuca</i> sp. Wanneroo (G.J. Keighery 16705)		Endangered	Endangered	<i>Melaleuca</i> sp. Wanneroo occurs in very shallow soils over limestone 'caprock' on ridges.	Possible – potential habitat occurs on the survey area
<i>Andersonia gracilis</i>	Slender Andersonia	Vulnerable	Endangered	Slender Andersonia occurs in white/grey sand, sandy clay, gravelly loam in winter-wet areas, near swamps. Vegetation type is low open heath with shrubs over sedges (DEC, 2006).	No – outside of species range, record is in error
<i>Anigozanthos viridis</i> subsp. <i>terraspectans</i>	Dwarf Green Kangaroo Paw	Vulnerable	Vulnerable	The Dwarf Green Kangaroo Paw occurs on grey sand, clay loam in winter-wet depressions.	Highly Unlikely – not suitable habitat
<i>Banksia mimica</i>	Summer Honeypot	Vulnerable	Endangered	Summer Honeypot prefers white or grey sand over laterite, sandy loam.	Highly Unlikely – not suitable habitat and not recorded in the vicinity of the survey area
<i>Diuris micrantha</i>	Dwarf Bee-orchid	Vulnerable	Vulnerable	The Dwarf Bee-orchid is usually found on brown loamy clay in winter-wet swamps, in shallow water.	Highly Unlikely – not suitable habitat
<i>Eleocharis keigheryi</i>	Keighery's Eleocharis	Vulnerable	Vulnerable	Keighery's Eleocharis occurs in clay, sandy loam and is emergent in freshwater: creeks, claypans.	Highly Unlikely – not suitable habitat
<i>Eucalyptus argutifolia</i>	Yanchep Mallee, Wabbling Hill Mallee	Vulnerable	Vulnerable	The Yanchep Mallee occurs in shallow soils over limestone on slopes or gullies of limestone ridges, outcrops.	Highly Likely – habitat occurs on the survey area and has been previously recorded
<i>Baekkea</i> sp. Limestone (N. Gibson & M.N. Lyons 1425)		Priority 1		<i>Baekkea</i> sp. Limestone is recorded from limestone outcrop/ridge in yellow sand derived from Tamala Limestone - Spearwood Dune System in bushland burnt 5+ years (Western Australian Herbarium, 2012).	Possible – habitat may occur on the survey area

Scientific Name	Common Name	Conservation Status (WA)	Status under EPBC Act	Habitat*	Likelihood to occur on the survey area
<i>Leucopogon maritimus</i>		Priority 1		<i>Leucopogon maritimus</i> occurs in Quindalup deep, calcareous sands, on the mid to upper slopes of dunes or in shallow sand over limestone, but avoiding the thicker vegetation of the swale (Hislop, 2011)	Highly Unlikely – not Quindalup habitat
<i>Acacia benthamii</i>		Priority 2		<i>Acacia benthamii</i> grows on sand, typically on limestone breakaways	Highly Unlikely – not limestone breakaway habitat
<i>Fabronia hampeana</i>		Priority 2		<i>Fabronia hampeana</i> occurs on sheltered wet trunk of <i>Macrozamia dyeri</i> in shrub layer (Western Australian Herbarium, 2005).	Highly Unlikely – host plant not recorded from the survey area
<i>Netrostylis</i> sp. Chandala (G.J. Keighery 17055)		Priority 2		<i>Netrostylis</i> sp. Chandala occurs in peaty sand on swamp edges.	Highly Unlikely – not suitable habitat
<i>Adenanthos cygnorum</i> subsp. <i>chamaephyton</i>		Priority 3		<i>Adenanthos cygnorum</i> subsp. <i>chamaephyton</i> occurs in grey sand, lateritic gravel.	Highly Unlikely – not suitable habitat
<i>Conostylis bracteata</i>		Priority 3		<i>Conostylis bracteata</i> occurs in sand, limestone on consolidated sand dunes.	Unlikely – not typical Habitat
<i>Hibbertia leptotheca</i>		Priority 3		<i>Hibbertia leptotheca</i> grows near-coastal limestone ridges, outcrops and cliffs in coastal heaths and thickets usually dominated by species of <i>Melaleuca</i> and <i>Acacia</i> (Thiele, 2019).	Highly Unlikely – not suitable habitat
<i>Jacksonia gracillima</i>		Priority 3		<i>Jacksonia gracillima</i> occurs in grey and brown well-drained sand.	Unlikely – not typical habitat
<i>Lasiopetalum membranaceum</i>		Priority 3		<i>Lasiopetalum membranaceum</i> grows in sand over limestone.	Unlikely – not typical habitat

Scientific Name	Common Name	Conservation Status (WA)	Status under EPBC Act	Habitat*	Likelihood to occur on the survey area
<i>Leucopogon</i> sp. Yanchep (M. Hislop 1986)		Priority 3		<i>Leucopogon</i> sp. Yanchep occurs in light grey-yellow sand, brown loam, limestone, laterite, granite on coastal plain, breakaways, valley slopes, low hills.	Unlikely – not typical habitat
<i>Pimelea calcicola</i>		Priority 3		<i>Pimelea calcicola</i> occurs in sand on coastal limestone ridges.	Possible – habitat likely to occur on the survey area
<i>Pithocarpa corymbulosa</i>		Priority 3		<i>Pithocarpa corymbulosa</i> occurs in gravelly or sandy loam amongst granite outcrops.	Highly Unlikely – not suitable habitat
<i>Sarcozona bicarinata</i>	Ridged Noon-flower	Priority 3		Ridged Noon-flower is found in white sand in coastal areas.	Highly Unlikely – not suitable habitat
<i>Sphaerolobium calcicola</i>		Priority 3		<i>Sphaerolobium calcicola</i> grows in white-grey-brown sand, sandy clay over limestone, black peaty sandy clay on tall dunes, winter-wet flats, interdunal swamps, low-lying areas.	Highly Unlikely – not suitable habitat
<i>Stylidium maritimum</i>		Priority 3		<i>Stylidium maritimum</i> occurs in sand over limestone on dune slopes and flats in coastal heath and shrubland, open Banksia woodland.	Highly Likely – habitat occurs on the survey area and has been previously recorded
<i>Conostylis pauciflora</i> subsp. <i>euryrhipis</i>		Priority 4		<i>Conostylis pauciflora</i> subsp. <i>euryrhipis</i> occurs in white, grey or yellow sand on consolidated dunes in coastal areas.	Highly Unlikely – not suitable habitat
<i>Conostylis pauciflora</i> subsp. <i>pauciflora</i>		Priority 4		<i>Conostylis pauciflora</i> subsp. <i>pauciflora</i> occurs in grey sand, limestone on hillslopes, consolidated dunes in coastal areas.	Unlikely – not typical habitat
<i>Eucalyptus foecunda</i> subsp. <i>foecunda</i>	Fremantle Mallee	Priority 4		Fremantle Mallee grows on yellowish coastal sands overlying limestone, often on limestony hills and dunes, in shrubland or very open woodland (Nicolle and French, 2021).	Unlikely – not typical habitat

Scientific Name	Common Name	Conservation Status (WA)	Status under EPBC Act	Habitat*	Likelihood to occur on the survey area
<i>Jacksonia sericea</i>	Waldjumi	Priority 4		Waldjumi grows in calcareous and sandy soils.	Possible – habitat may occur on the survey area
<i>Lepidium pseudotasmanicum</i>		Priority 4		<i>Lepidium pseudotasmanicum</i> occurs in loam, sand associated with granite.	Highly Unlikely – not suitable habitat
<i>Stylidium longitubum</i>	Jumping Jacks	Priority 4		Jumping Jacks prefer sandy clay, clay in seasonal wetlands.	Highly Unlikely – not suitable habitat
<i>Stylidium striatum</i>	Fan-leaved Triggerplant	Priority 4		The Fan-leaved Triggerplant grows in brown clay loam over laterite on hillslopes in Jarrah/Marri forest, Wandoo woodland.	Highly Unlikely – not suitable habitat
<i>Tripterococcus</i> sp. <i>Brachylobus</i> (A.S. George 14234)		Priority 4		<i>Tripterococcus</i> sp. <i>Brachylobus</i> occurs in grey, black or peaty sand winter-wet flats.	Highly Unlikely – not suitable habitat

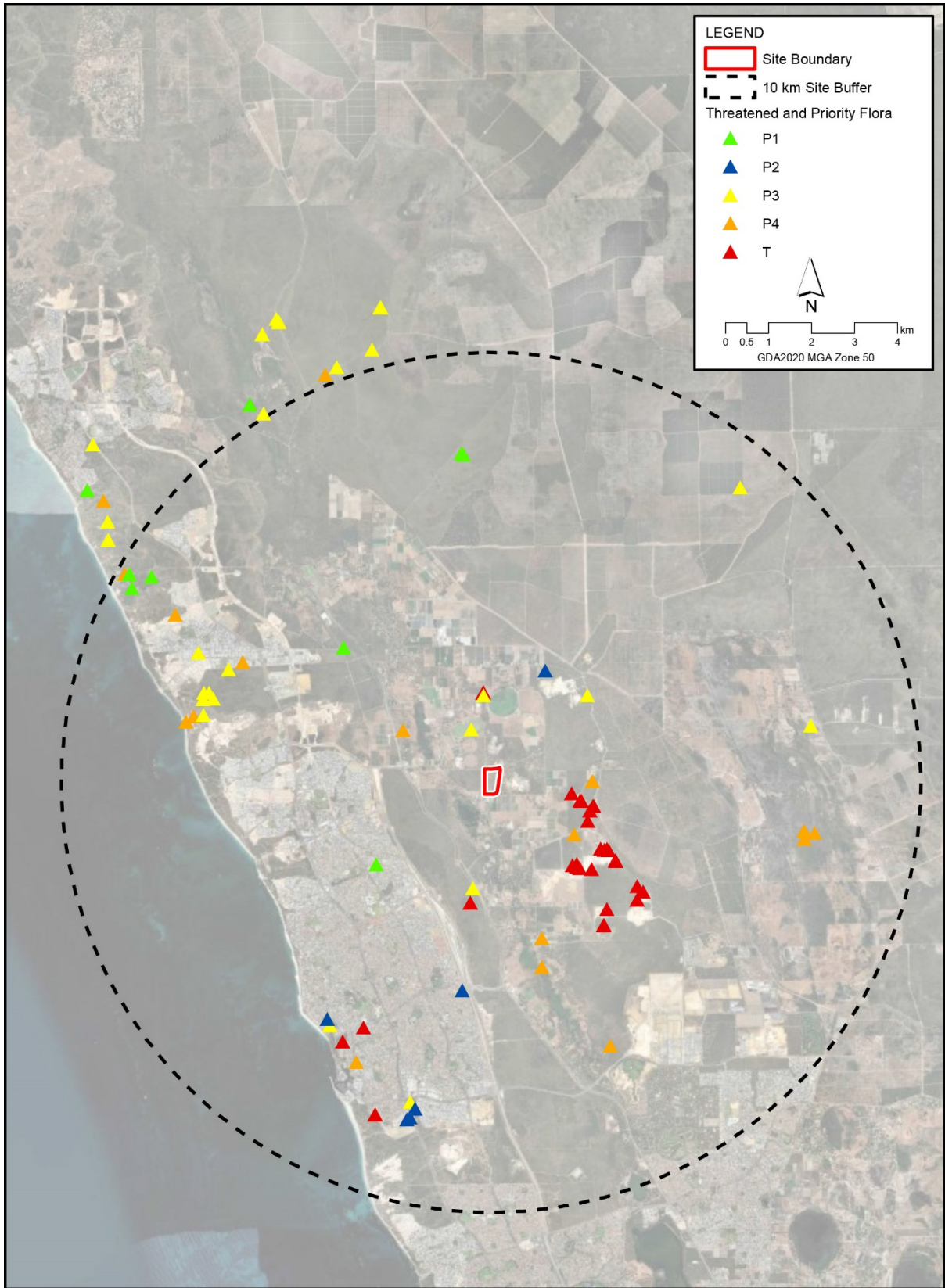


Figure 6. Threatened and Priority flora within the 10 km study area (DBCA 2023d).

5.6 Wetlands and water courses

5.6.1 Wetlands

Wetlands on the SCP have been classified into types using the geomorphic wetland classification system of Semeniuk & Semeniuk (1995), which is based on the characteristics of landform and water permanence, for example, lakes, palusplains and damplands. These are described in **Table 8**. The SCP wetlands have also been evaluated and assigned an appropriate management category and corresponding category objective, providing guidance on the nature of the management and protection the wetland should be afforded. These categories are described in **Table 9**.

Table 8. Wetland types (adapted from Semeniuk & Semeniuk 1995).

Management Category	Basin	Flat	Channel	Slope	Highland
Permanently inundated	Lake		River		
Seasonally inundated	Sumpland	Floodplain	Creek		
Intermittent inundation	Playa	Barlkarra	Wadi		
Seasonally waterlogged	Dampland	Palusplain	Trough	Paluslope	Palusmont

Table 9. Definitions of and objectives for the different wetland management categories (EPA 2008).

Management Category	Definition	Category Objective
Conservation	Wetlands with high conservation value for both natural or human use	To preserve wetland (natural) attributes and functions
Resource Enhancement (RE)	Wetlands with moderate natural and human use attributes that can be restored or enhanced	To restore wetlands through maintenance and enhancement of wetland functions and attributes
Multiple Use (MU)	Wetlands that score poorly on both natural and human use attributes	To use, develop and manage wetlands in the context of water, town and environmental planning

There are no wetlands mapped across the survey area according to the Geomorphic Wetlands of the Swan Coastal Plain dataset (DBCA 2022a). The outer margins of the conservation category Nowergup Lake (UFI 8021) are approximately 275 m to the south west of Lot 107 (**Figure 7**).

5.6.2 Watercourses

There are no mapped watercourses within the survey area (Crossman & Li 2015) (**Figure 7**).

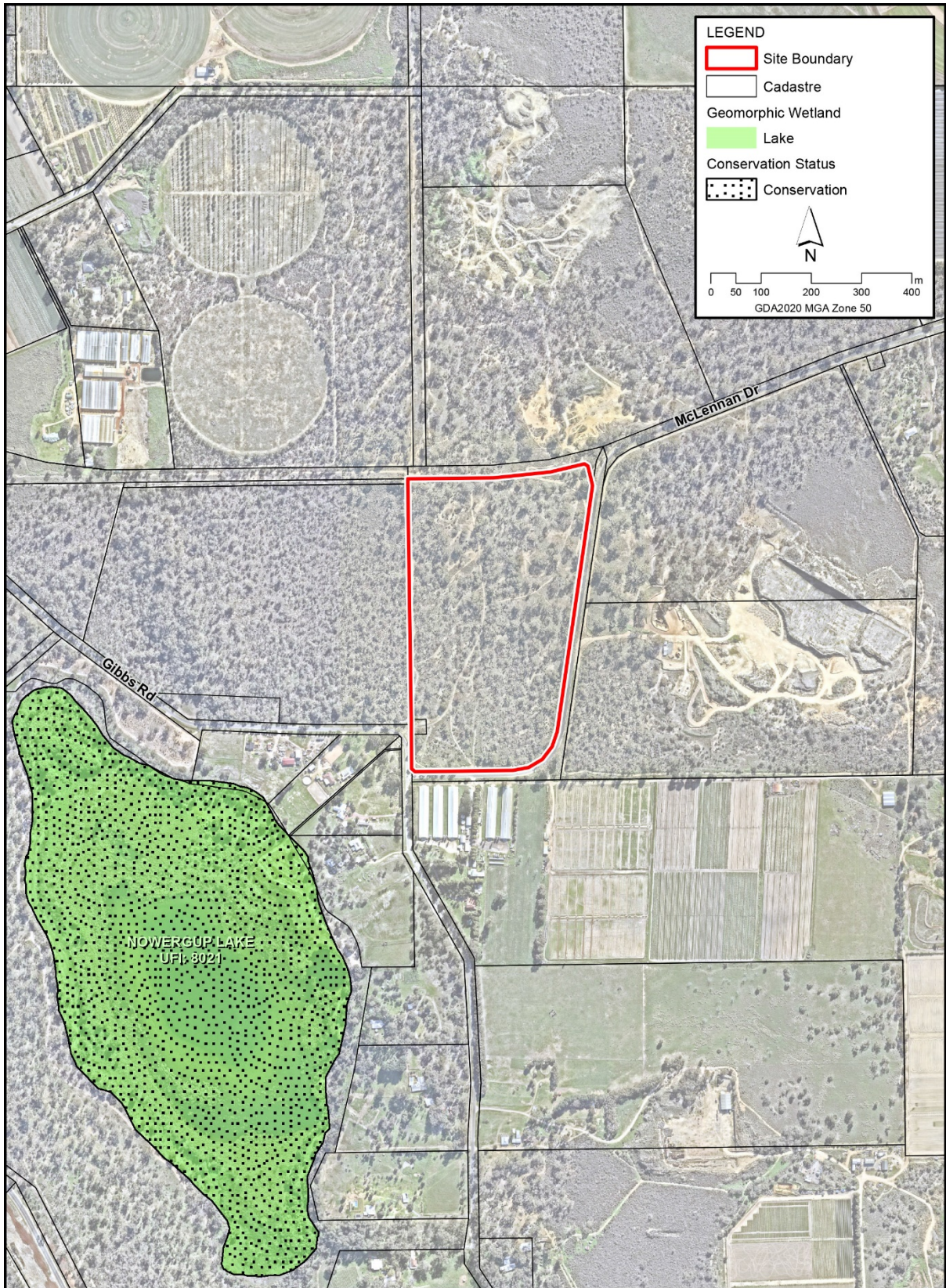


Figure 7. Geomorphic wetland types and their conservation management status in proximity to the survey area (DBCA 2022a).

5.7 Bush Forever sites

The State Government's Bush Forever process aimed to protect areas of regionally significant vegetation on the Swan Coastal Plain in the Perth Metropolitan Region. Bush Forever adopted one of the key commitments in the Urban Bushland Strategy (Government of Western Australia, 1995) which was to protect (rather than retain) at least 10% or 400 ha, whichever is the largest, of each vegetation complex in at least five separate areas.

There are two Bush Forever sites mapped in proximity to the survey area. Site 290 'Hopkins Road Bushland, Nowergup' contains 406.9 ha of bushland and is located approximately 1 km east of the survey area. Site 383 'Neerabup National Park, Lake Nowergup Nature Reserve and Adjacent Bushland, Neerabup' is comprised of 1736.1 ha of bushland and water and is located approximately 300 m southwest of the survey area (**Figure 8**).

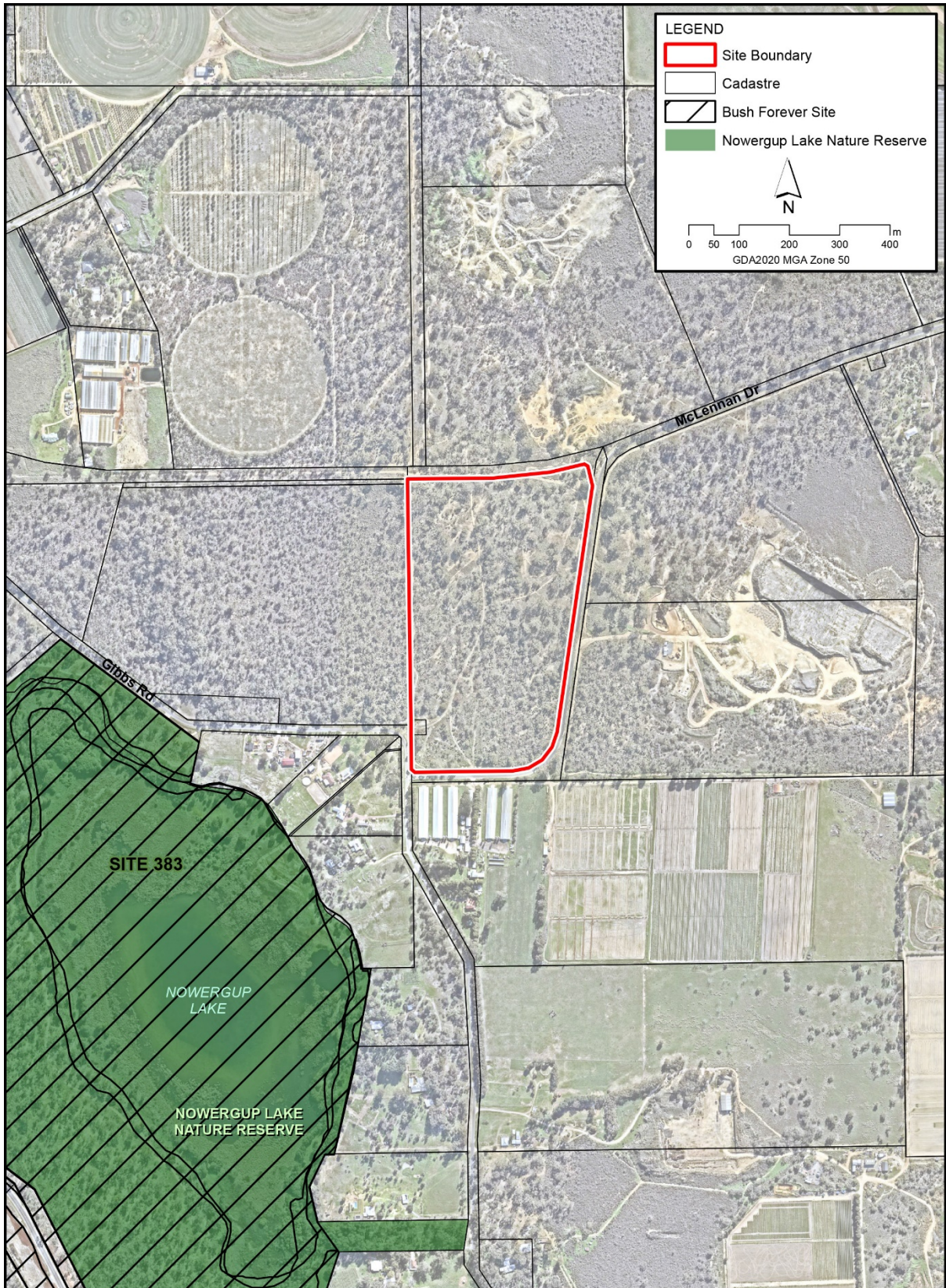


Figure 8. The survey area in relation to Bush Forever sites and DBCA managed land (DBCA 2017; DPLH 2019).

5.8 Environmentally Sensitive Areas

Environmentally sensitive areas (ESAs) are protected under the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*. They are selected for their environmental values at State or National levels (Government of Western Australia 2005). They include:

- Defined wetlands and riparian vegetation within 50 m of the wetland
- Areas covered by Threatened ecological communities
- Area of vegetation within 50 m of Threatened flora
- Bush Forever sites
- Declared World Heritage property sites.

The survey area does not occur within a mapped ESA buffer. There are ESAs that are associated with the Bush Forever sites discussed in Section 5.7 to the east and south west of the survey area, as well as an ESA occurring in association with Nowergup Lake (Conservation Category Wetland, UFI 8,021) and an ESA associated with the TEC 'Aquatic Root Mat Community Number 1 of Caves of the Swan Coastal Plain' located approximately 1.4 km to the northwest of the survey area (**Figure 9**).

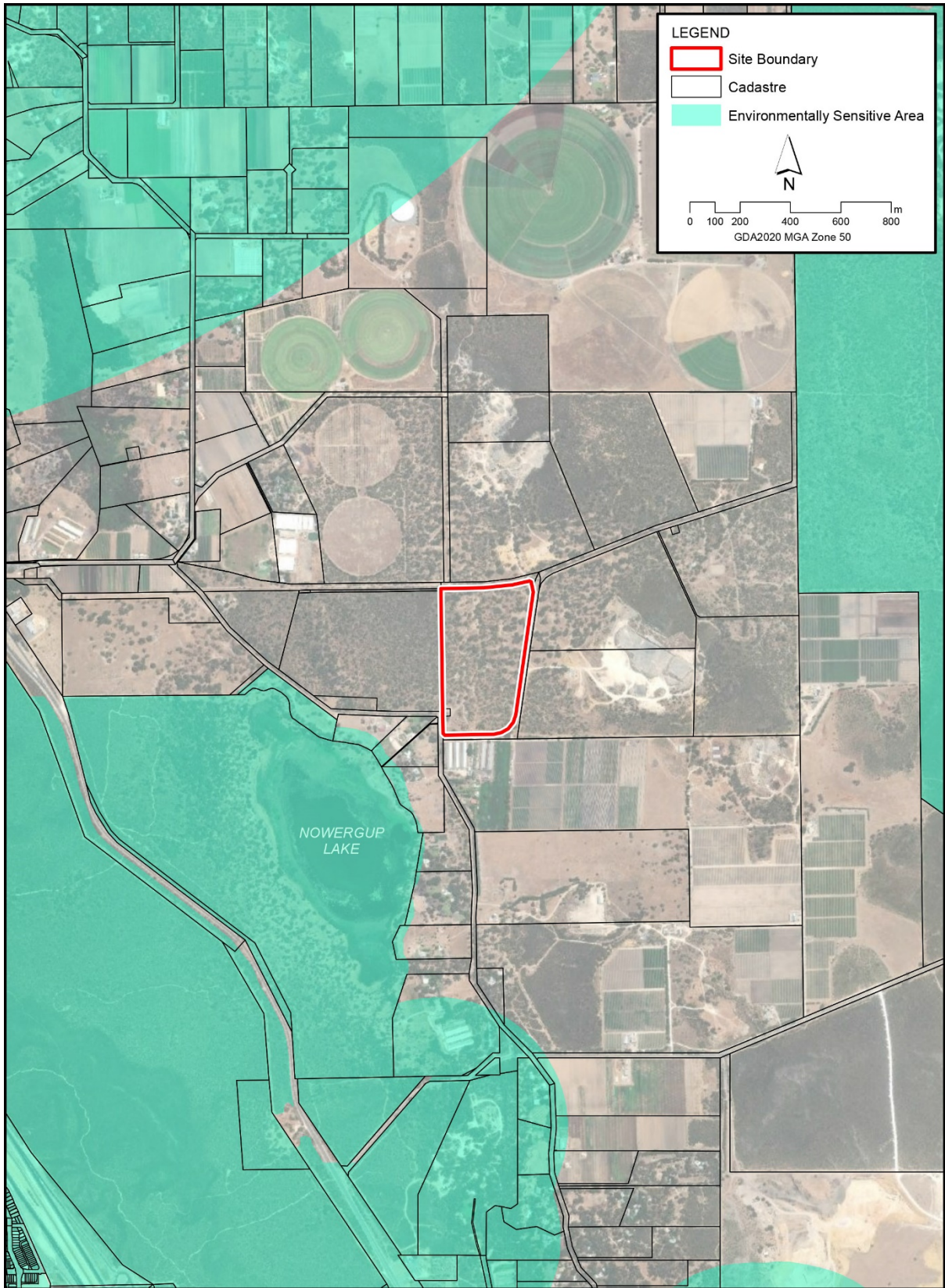


Figure 9. ESAs in proximity to survey area (DWER 2021).

5.9 Other reports

EnviroWorks Consulting (2014). Preliminary Flora and Vegetation Assessment Lots 105 and 107 McLennan Dr., Nowergup 2014.

A Preliminary Flora and Vegetation Assessment undertaken by EnviroWorks Consulting (2014) identified 46 native species on both lots from within three plant communities. The conservation significant Priority 4 species *Jacksonia sericea* was identified as occurring on Lot 107. This species was not recorded in the 2023 survey.

6 Survey results

6.1 Flora

6.1.1 2014 survey

No Threatened flora listed under either the State BC Act or Commonwealth EPBC Act were found within the survey area. Neither was there any State listed Priority flora or flora of other significance found within the survey area. PGV Environmental stated that the occurrences of Priority 4 species *Jacksonia sericea* recorded in near the north-west boundary of the survey area in the EnviroWorks Consulting (2014) report were more likely to be the more common *Jacksonia calcicola*.

6.1.2 2023 survey

The plant Families with the highest representation of species were the Fabaceae (Wattle and Pea family – 22 species, 19 native and 3 introduced), Asteraceae (Daisy family – 19 species, 11 native, 8 introduced), Proteaceae (Banksia family – 18 species, all native), Poaceae (Grass family – 17 species, 5 native, 12 introduced), Myrtaceae (Myrtle family – 16 species, 15 native and 1 introduced), Orchidaceae (Orchid family – 12 species, 11 native, 1 introduced) and Asparagaceae (Asparagus family - 10 species, 9 native and 1 introduced).

Species richness in the 4 quadrats within the Lot 107 survey area ranged from 9-23 with a range of 5-14 native species, averaging 8 native species. The average number of weed species was 7. Quadrat data for Lot 107 is provided in **Appendix 7** with quadrat locations shown in **Appendix 1**.

No Threatened flora listed under either the State BC Act or Commonwealth EPBC Act were found within the survey area, nor any State listed Priority flora or flora of other significance.

6.2 Declared pest plants and environmental weeds.

There were no declared pest plants or environmental weeds recorded in Lot 107.

6.3 Vegetation units

Vegetation types are a finer level of vegetation description and mapping used for small scale sites, such as the survey area. Vegetation types are described based on the structure of the vegetation (e.g. woodland, heath) and the dominant species in each structure.

6.3.1 2014 survey

A total of three separate vegetation types were mapped and described for the survey area based on the structure and composition of the dominant layers.

The vegetation mapping is similar to that prepared by EnviroWorks Consulting (2014) with Tuart-Jarrah woodland in the northern upper slopes, however EnviroWorks Consulting (2014) mapped the lower slopes of the site as containing a Banksia-Eucalyptus Low Woodland. The PGV Environmental survey recorded only scattered *Banksia attenuata* and *Banksia menziesii* in numbers too low to describe as a vegetation type.

A description of each of the units is provide in **Table 10**.



Table 10. Vegetation units identified and described in the 2014 survey.


Name	Description
EgEm	<p><i>Eucalyptus gomphocephala</i>/E. <i>marginata</i> Woodland over <i>Xanthorrhoea preissii</i>/<i>Hibbertia hypericoides</i> Open Low Heath</p> <p>This vegetation type occurred on the northern upper slopes of the site. Tuart (<i>Eucalyptus gomphocephala</i>) and Jarrah (<i>E. marginata</i>) occur in mixed proportions. The understorey ranges from almost parkland cleared with few native species and dense Veldtgrass (<i>Ehrharta calycina</i>) to slightly better condition with common native shrubs including <i>Xanthorrhoea preissii</i>, <i>Acacia pulchella</i> and the climber <i>Hardenbergia comptoniana</i>. The soils are brown sands with occasional surface limestone in places. Quadrats MC1 and MC2 are representative of this vegetation type.</p>
EmCc	<p><i>Eucalyptus marginata</i>/ <i>Corymbia calophylla</i> Low Woodland over <i>Xanthorrhoea preissii</i> Shrubland</p> <p>Marri (<i>Corymbia calophylla</i>) become more common with the Jarrah in the lower part of the site. The understorey mostly consists of dense Veldtgrass and a few native shrubs such as <i>Xanthorrhoea preissii</i> and <i>Acacia pulchella</i>. The soils were dark brown sand. Quadrat MC3 is representative of this vegetation type.</p>
Em	<p><i>Eucalyptus marginata</i> Low Woodland over <i>Xanthorrhoea preissii</i> Shrubland</p> <p>Tuart trees drop out in the lower southern half of the site and Jarrah occurs by itself over an similar to the Tuart/Jarrah understorey containing <i>Xanthorrhoea preissii</i>, <i>Acacia pulchella</i>, <i>Hardenbergia comptoniana</i> as well as <i>Macrozamia fraseri</i> and <i>Hakea lissocarpha</i>. The soil type is dark brown sand. Quadrat MC4 is representative of this vegetation type.</p>

6.3.2 2023 survey

Vegetation type analysis was further refined and updated in 2023 with three vegetation types in addition to cleared vegetation being described and mapped on the survey area (**Figure 10**) The vegetation types are described in **Table 11**. Quadrat data are in **Appendix 7**.

Table 11. Vegetation types recorded on 2023 survey area.

Type	Photo	Description	Area (ha)
EgEm		<p><i>Eucalyptus gomphocephala</i> Woodland over <i>Xanthorrhoea preissii</i> Shrubland over <i>Mesomelaena pseudostygia/Phyllanthus calycinus</i> Open Low Heath</p> <p>Occurs on the lower slopes of limestone hills, mostly in the central part of the survey area. <i>Eucalyptus gomphocephala</i> (Tuart) is up to 25m high and moderately dense (15-25% cover). Typical understorey species include <i>Xanthorrhoea preissii</i>, <i>Mesomelaena pseudostygia</i>, <i>Phyllanthus calycinus</i>, <i>Hakea lissocarpha</i> and <i>Desmocladius flexuosus</i>.</p> <p>The soils are orange-brown sand with some surface limestone.</p> <p>Quadrat C22 is a representative of this vegetation type.</p>	9.77 ha
CcEm		<p><i>Corymbia calophylla/Eucalyptus marginata</i> Low Woodland over <i>Xanthorrhoea preissii</i> Shrubland</p> <p>Only one area containing Marri (<i>Corymbia calophylla</i>) mixed with Jarrah was recorded on the site, at the southern end of Lot 107 Godel Road. The vegetation is in Degraded to Completely Degraded condition with Perennial Veldtgrass dominating the understorey. <i>Xanthorrhoea preissii</i> is the only common native species.</p> <p>The soils are dark brown sand.</p> <p>Quadrat C18 is representative of this vegetation type.</p>	4.79 ha

Type	Photo	Description	Area (ha)
Em		<p><i>Eucalyptus marginata</i> Low Woodland over <i>Xanthorrhoea preissii</i> Tall Shrubland</p> <p>Occurs on lower areas in the central part of the survey area. All of the areas mapped have a very weedy understorey. The <i>Eucalyptus marginata</i> (Jarrah) trees have mostly been coppiced with few to no old, mature single stem trees.</p> <p><i>Xanthorrhoea preissii</i> is the most common native understorey species while the most common weed species is Perennial Veldtgrass (<i>Ehrharta calycina</i>). The soils are dark brown sand.</p>	3.83 ha
Cleared			0.53 ha
Total			18.92 ha

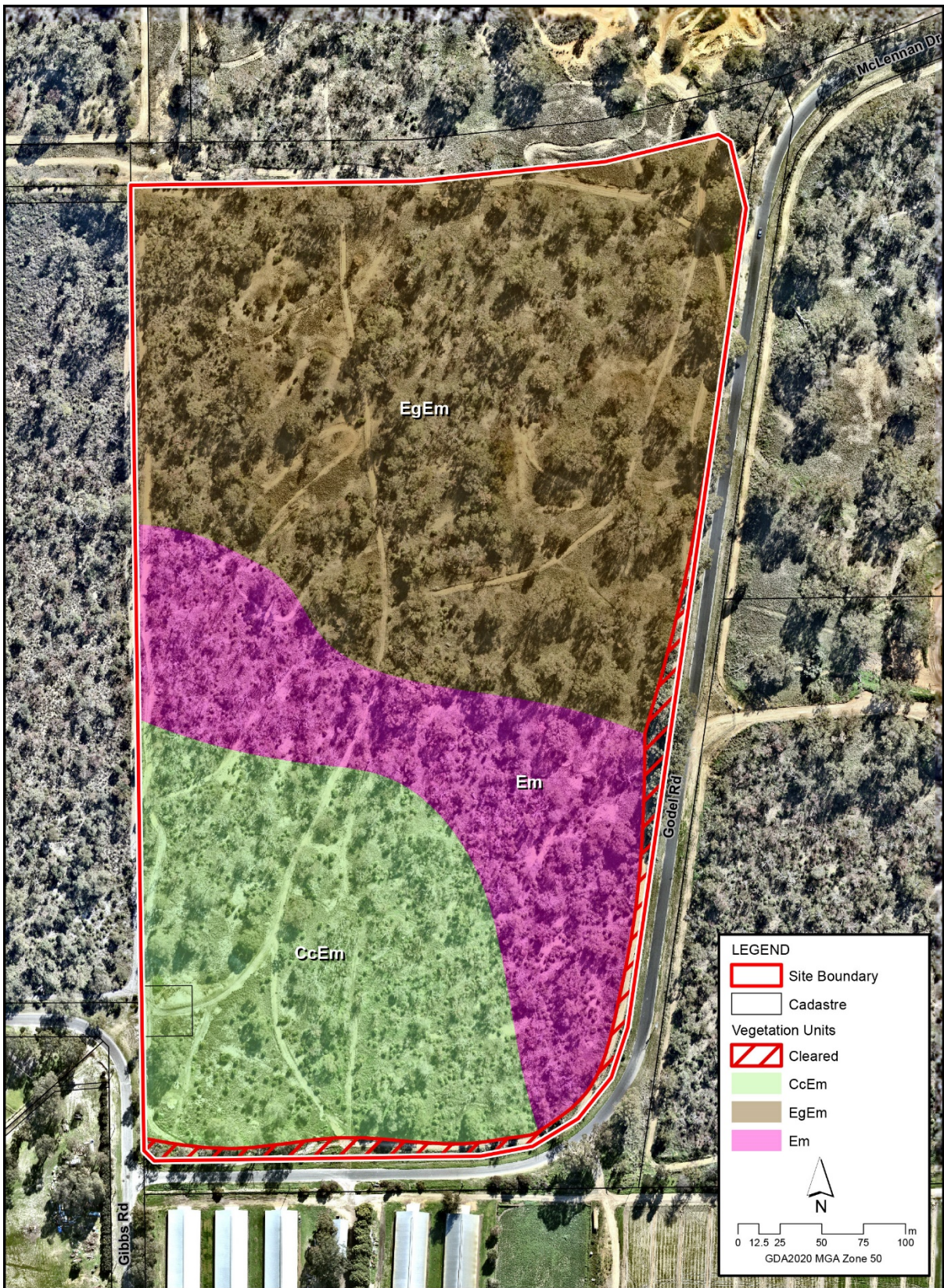


Figure 10. Location of vegetation units described and mapped by the 2023 survey within the survey area.

6.4 Floristic community types

No FCT analysis was undertaken as vegetation present within the site was considered too degraded to allow an accurate statistical analysis to be performed.

Based on PATN analysis outcomes for Eucalyptus dominated vegetation units on Very Good and Excellent condition in the surrounding survey area (PGV Environmental, 2023), it appears likely that the vegetation onsite would have originally represented FCT 24 and/or FCT 28.

6.5 Vegetation condition

6.5.1 2014 survey

The vegetation condition over the survey area was assessed using the condition scale adopted in Bush Forever (**Table 12**).

The 2014 survey found the vegetation condition on the survey area ranged from Completely Degraded to Degraded. The vegetation condition on Lot 107 was assessed as Completely Degraded in the northern and southwestern corner due to limited presence of native shrubs and abundance of introduced species, particularly grasses such as Veldtgrass. Where the understorey contained a higher density of native species the vegetation was rated as Degraded. The poor condition of the vegetation is consistent with the historic aerial photographs that show the lot was parkland cleared prior to 1965.

6.5.2 2023 survey

The condition of the vegetation was assessed according to the system devised by Keighery and described in Bush Forever (Government of Western Australia, 2000) (**Table 12**).

Table 12. Vegetation condition rating scale (Government of Western Australia, 2000).

Condition	Description
Pristine	Pristine or nearly so, no obvious signs of disturbance.
Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species.
Very Good	Vegetation structure altered, obvious signs of disturbance. For example, disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.
Good	Vegetation structure significantly altered by very obvious signs of multiple disturbance. Retains basic vegetation structure or ability to regenerate it. For example, disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds at high density, partial clearing, dieback and grazing.
Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. For example, disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.

Condition	Description
Completely Degraded	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These are often described as 'parkland cleared' with the flora comprising weed or crop species with isolated native trees or shrubs.

The vegetation condition ranged from Completely Degraded to Degraded (**Figure 11**). Generally, the areas with the best quality vegetation were the areas of outcropping and shallow limestone. The areas of deeper sand over limestone contained more weeds, with Perennial Veldtgrass the most common weed species.

A breakdown of the condition of the survey area vegetation is shown in **Table 13**. The distribution of vegetation condition in the survey area is provided in **Figure 11**.

Table 13. Area and percentage of the survey area in vegetation condition classes.

Condition	Area (ha)	%
Degraded	16.73	88%
Completely Degraded	2.19	12.%
Total	18.92 ha	100.00%

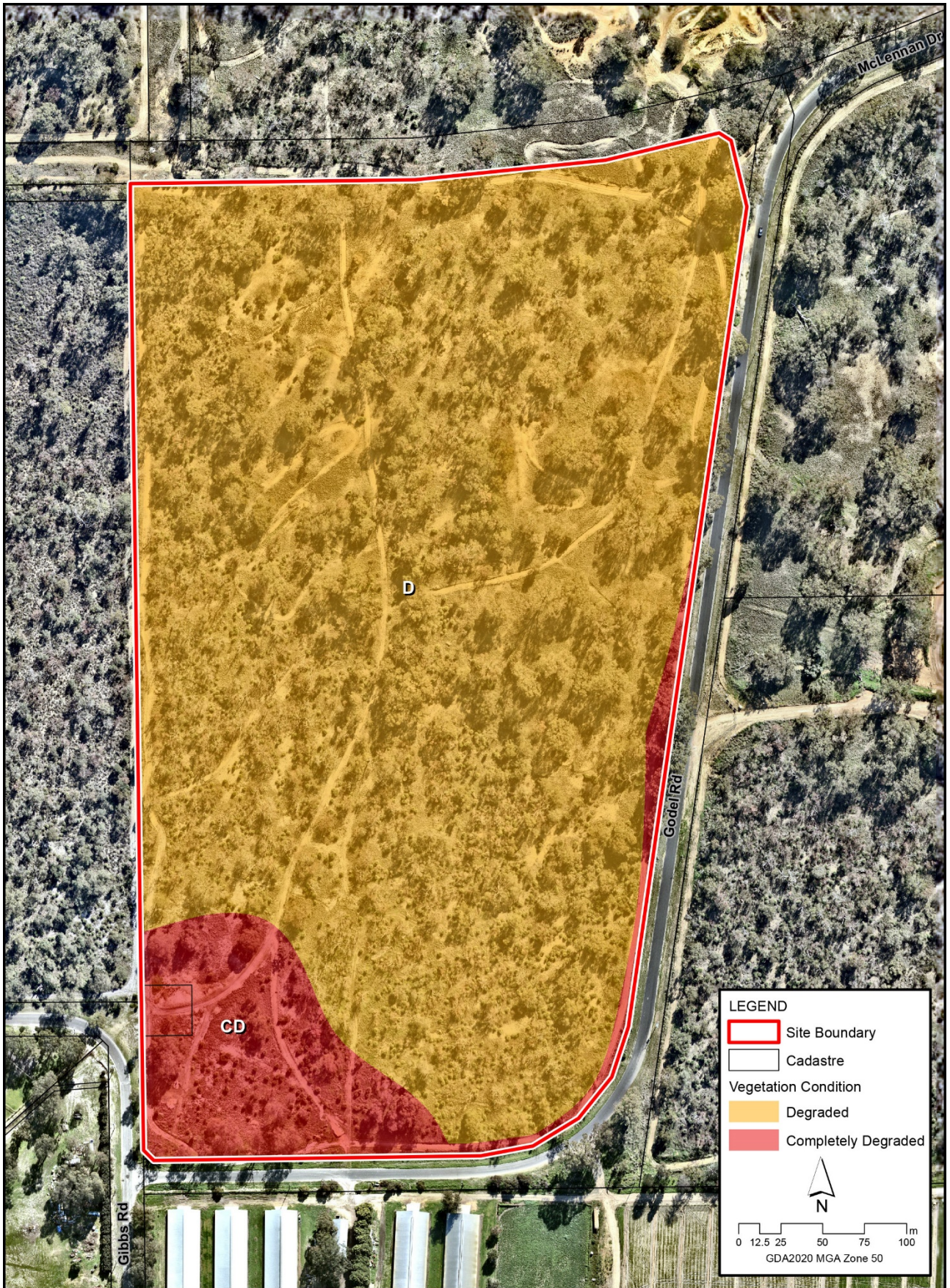


Figure 11. 2023 Vegetation condition for survey area

6.6 Threatened and Priority Ecological Communities

6.6.1 Banksia Woodlands of the SCP TEC and PEC Assessment

The Banksia Woodlands of the Swan Coastal Plain ecological community was listed as an Endangered community under the Commonwealth EPBC Act on 16 September 2016. The Banksia Woodland ecological community is listed as a Priority Ecological Community at State level.

The Approved Conservation Advice (incorporating listing advice) for the Banksia Woodlands of the Swan Coastal Plain ecological community (Commonwealth of Australia, 2016) (Conservation Advice) describes the Banksia Woodland TEC as:

The ecological community is a woodland associated with the Swan Coastal Plain of southwest Western Australia. A key diagnostic feature is a prominent tree layer of Banksia, with scattered eucalypts and other tree species often present among or emerging above the Banksia canopy. The understorey is a species rich mix of sclerophyllous shrubs, graminoids and forbs. The ecological community is characterised by a high endemism and considerable localised variation in species composition across its range (Commonwealth of Australia, 2016).

The Banksia Woodland TEC is most commonly dominated by *Banksia attenuata* and/or *B. menziesii* and in some examples *B. prionotes* or *B. ilicifolia*. For an area of Banksia woodland to meet the criteria of the Banksia Woodland TEC it needs to be in at least Good condition and meet a minimum patch size depending on the condition of the vegetation.

The vegetation onsite is not dominated or co-dominated by Banksia, but there were scattered Banksia present onsite as noted in the quadrat data presented in **Appendix 7**.

Based on the scattered nature of the Banksia present, as well as the condition being Degraded and Completely Degraded, the vegetation does not meet the definition of the Banksia Woodlands TEC.

6.6.2 Tuart (*Eucalyptus gomphocephala*) woodlands and forests of the SCP TEC and PEC assessment

The Tuart Woodlands and Forests of the Swan Coastal Plain was listed as a Threatened Ecological Community (TEC) with a rating of Critically Endangered under the Commonwealth EPBC Act on 4 July 2019 (for brevity the community will be called the Tuart Woodland TEC in this report). The Tuart Woodland ecological community is listed as a Priority Ecological Community at State level.

A description of the Tuart Woodland TEC is contained in the Approved Conservation Advice (incorporating listing advice) for the Tuart (*Eucalyptus gomphocephala*) woodlands and forests of the Swan Coastal Plain ecological community (Commonwealth of Australia, 2019). Key diagnostic characteristics according to the Conservation Advice are outlined below.

6.6.2.1 Key diagnosis characteristics

The Tuart Woodlands ecological community is limited to patches of vegetation (with their associated biota) that meet all of the following key diagnostic characteristics:

- Occurs in the Swan Coastal Plain Bioregion, Western Australia (IBRA v7. Department of the Environment 2012).
- Primarily occurs on the Spearwood and Quindalup dune systems but can also occur on the Bassendean dunes and Pinjarra Plain. It can occur on the banks of rivers and wetlands.
- The primary defining feature is the presence of at least two living established *Eucalyptus gomphocephala* (Tuart) trees in the uppermost canopy layer, although they may co-occur with trees of other species. There is a gap of no more than 60 m between the outer edges of the canopies of adjacent Tuart trees. These trees may occur either as single stemmed trees or as a mallee growth form.
- Most often occurs as a woodland but can occur in other structural forms, For example, forest, open forest, woodland, open woodland, and various mallee forms.
- Other tree species may be present in the canopy or sub-canopy. They commonly include: *Agonis flexuosa* (Peppermint) and *Banksia grandis* (Bull Banksia) (both in the southern part of the range), *Banksia attenuata* (Candlestick Banksia), *Eucalyptus marginata* (Jarrah); and less commonly, *Corymbia calophylla* (Marri), *Banksia menziesii* (Firewood Banksia) and *Banksia prionotes* (Acorn Banksia).
- An understorey of native plants is typically present, which may include grasses, herbs and shrubs, although this is often modified by disturbance. Some understorey plant species that are most commonly present are listed in Section 2.3.3 of the Conservation Advice.
- Native fauna species that are most commonly present are noted in Section 2.4 of the Conservation Advice (Commonwealth of Australia, 2019).

6.6.2.2 Defining a patch of the Tuart Woodlands ecological community

- A patch of the ecological community is a discrete and mostly continuous area of vegetation that meets the key diagnostic characteristics.
- Boundaries for a patch can extend beyond a site or property boundary, or potential area of impact for a proposed action.
- The patch boundary is 30 m beyond the outer canopy of the established Tuart trees (≥ 15 cm diameter at breast height (DBH)), including dead Tuart trees (stags) (**Figure 12**).
- Where a dead Tuart tree (stag) is being considered for inclusion in a patch of the ecological community, the vertical projection of its outermost remaining branches is used to define the edge of its canopy. If the species of a stag tree is unclear, if the edge of its canopy is within 60 m of an identified Tuart tree the stag is presumed to be a Tuart.
- Patches of Tuart woodlands and forests may contain areas that vary in structural or biological complexity. One part of a patch may have a larger number of mature trees and more ecological diversity, whereas another part of the same patch may demonstrate fewer mature trees and less groundcover. Areas with soil exposed and/or plant litter can also be expected within this ecological community.
- Variation in quality or condition of vegetation across a patch should not necessarily be considered to be evidence of multiple patches. Patches of the ecological community can be spatially variable and are often characterised by one or more areas within a patch that meet higher condition thresholds amongst areas of lower condition.
- If an area meets the key diagnostic characteristics but the average condition across that

area falls below the minimum condition thresholds, the largest area or areas of at least 0.5 ha that meet minimum condition thresholds on average, should be specified as the patch or patches of the nationally listed ecological community. This may result in multiple patches of the ecological community being identified within the overall area first identified as meeting the key diagnostics.

- A patch may include small areas without understorey vegetation, such as bare ground, as well as waterbodies or hardscape (e.g. roads, paths, car parks, or buildings) that do not significantly alter the overall function of the ecological community. These small areas do not break up a patch, or divide a patch into multiple patches, as long as there are some parts of the canopy within 60 m of the outer edges of the canopies of adjacent Tuart trees (as **Figure 12**). However, existing buildings and other human-made structures and gardens are not part of the nationally protected ecological community and should be excluded from the calculation of patch size and condition. See **Figure 13** (Commonwealth of Australia, 2019).

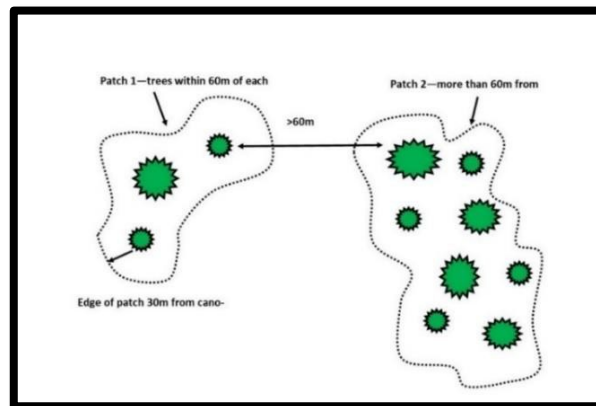


Figure 12. Tuart Patch Boundaries. Source: Commonwealth of Australia, 2019.

Plate 9: Variation Within a Patch*

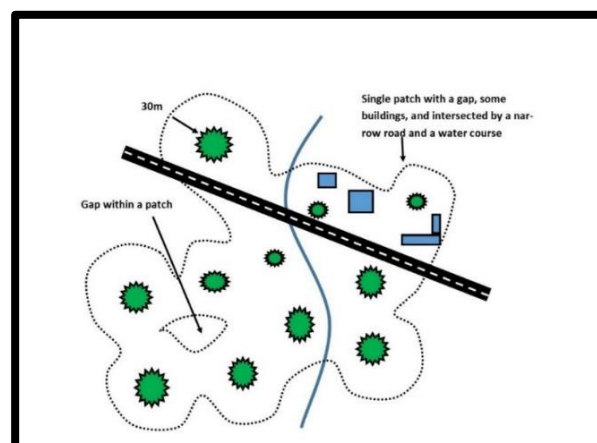


Figure 13. Variation within a Tuart patch⁵.

⁵ * including small areas without understorey vegetation, and a small gap within a patch due to part of the Tuart canopy being >60 m apart

Source: Commonwealth of Australia, 2019

6.6.2.3 Condition thresholds and categories

For confirmed patches of the ecological community, following the key diagnostic characteristics and patch definition above (Step 1), determine the following requirements for information on condition to indicate if they are part of the nationally protected ecological community:

- If the patch is smaller than 0.5 ha it is **not** part of the nationally protected ecological community.
- If **the patch is at least 0.5 ha and up to 5 ha** in size, conduct on ground surveys. Patches in this size range are presumed to be part of the nationally protected ecological community unless surveys indicate they do not meet the minimum condition required for national protection. For patches in this size range inclusion in the nationally protected ecological community is determined by surveyed characteristics such as native plant species richness and contribution to cover, habitat values, evidence of regeneration and landscape characteristics.
- **All patches of 5 ha or greater** that meet the key diagnostic characteristics **are part of the nationally protected ecological community**. It is not necessary to conduct additional surveys to confirm that they meet biotic condition thresholds (**Table 14**) and that they are protected.

Table 14. Tuart TEC condition categories and thresholds.

All patches ≥ 5 ha are part of the nationally protected ecological community, regardless of their understorey condition. That is, thresholds in this table do not apply to patches ≥ 5 ha, but the key diagnostic characteristics and patch definition must be met.

Biotic thresholds		
Patch size	≥ 2 ha < 5 ha	≥ 0.5 ha < 2 ha
Very high condition		
≥ 80 % of all understorey [^] vegetation cover is native# Or At least 12 native understorey [^] species per 0.01 ha (10 m x 10 m plot or equivalent sample unit)	Medium sized patches with very high condition understorey. PART OF THE PROTECTED ECOLOGICAL COMMUNITY	Smaller patches with very high condition understorey. PART OF THE PROTECTED ECOLOGICAL COMMUNITY
High condition		
≥ 60 % of all understorey [^] vegetation cover is native# Or At least 8 native understorey [^] species per 0.01 ha (10 m x 10 m plot or equivalent sample unit)	Medium sized patches with high condition understorey. PART OF THE PROTECTED ECOLOGICAL COMMUNITY	Smaller patches with high condition understorey. AND That either: have an important landscape role (≤ 100 m to native vegetation)* OR have a habitat role (≥ 2 very large trees per 0.5 ha)* OR show regeneration (≥ 15 seedlings and/or saplings per 0.5 ha)*

Biotic thresholds		
Patch size	≥2 ha <5 ha	≥0.5 ha <2 ha
		PART OF THE PROTECTED ECOLOGICAL COMMUNITY
Moderate condition		
≥50 % of all understorey [^] vegetation cover is native# Or At least 4 native understorey [^] species per 0.01 ha (10 m x 10 m plot or equivalent sample unit)	Medium sized patches with moderate condition understorey. AND That either: have an important landscape role (≤100 m to native vegetation)* OR have a habitat role (≥2 very large trees per 0.5 ha)* OR show regeneration (≥15 seedlings and/or saplings per 0.5 ha)* PART OF THE PROTECTED ECOLOGICAL COMMUNITY	<u>NOT</u> PART OF THE PROTECTED ECOLOGICAL COMMUNITY (but may be a focus for local protection or restoration)
Poor condition		
Has minimal or no native cover and species richness. That is: <50 % of all understorey [^] vegetation cover is native# And Less than 4 native understorey [^] species per 0.01 ha (10 m x 10 m plot or equivalent sample unit)	<u>NOT</u> PART OF THE PROTECTED ECOLOGICAL COMMUNITY (but may be a focus for local protection or restoration)	<u>NOT</u> PART OF THE PROTECTED ECOLOGICAL COMMUNITY (but may be a focus for local protection or restoration)

6.6.2.4 Tuart Woodland TEC Assessment

One vegetation type within the survey area (Unit EgEm) contains Tuart trees as the dominant component of the tree canopy. The presence of Tuart trees does not automatically mean that the Tuart Woodland TEC occurs in the survey area. The Conservation Advice contains the following step-wise approach in determining if the TEC occurs on a site:

- Step 1: Is the Tuart Woodlands and Forests ecological community in your proposed project site? Is it in other adjacent or off-site areas that may be impacted (for example, by introducing weeds)?
- Step 2: What is the patch size and condition category of the Tuart Woodlands and Forests in the proposed project site and in the surrounding area?

The assessment of the Tuart Woodland TEC within the survey area is outlined in **Table 15** and **Table 16**.

In summary, all vegetation types within the survey area containing Tuart trees are large enough (i.e. greater than 5ha, irrespective of vegetation condition) to be considered patches of the Tuart Woodland TEC. The location of the Tuart Woodland TEC is shown on **Figure 14**.

The total area of Tuart Woodland TEC onsite is 9.77 ha. The Tuart Woodland TEC on Lot 107 being in Degraded condition.

Step 1: Is the Tuart Woodlands and Forests ecological community in your proposed project site? Is it in other adjacent or off-site areas that may be impacted (for example, by introducing weeds)?

Table 15: Tuart Woodland TEC Step 1 diagnostics (DoEE 2019)

Key diagnostic characteristics [†]	Information	Key diagnostic questions* (Refer to Section 3.2 of the Approved Conservation Advice for a complete explanation of these diagnostic features – other sections of the Approved Conservation Advice are referenced where relevant)	Response (yes/no/possibly) and detailed comments. Use as much space as you need to fully answer the question [#]
Location and physical environment	Bioregion	Is the proposal site within the Swan Coastal Plain IBRA bioregion?	Yes
Soils and Landform	Soil type	Is the soil type consistent with where the Tuart Woodlands and Forests may occur? (see Section 2.2.1 [†])	Yes, Spearwood Dune soil type
	Location in the landscape, topography	Is the topography/physical environment consistent with where the Tuart Woodlands and Forests may occur? Is the site associated with any hydrology (groundwater/surface water)?	Yes, Tuarts commonly found in the Wanneroo area. Not associated with any wetlands
Structure	Presence of Tuart trees	How many Tuart trees are present and are they consistent with the characteristics set out in the Approved Conservation Advice? Note: Please present this information in terms of total number of trees (dead, established, seedlings etc.) and trees per hectare of the footprint. Diagrams/maps should also be provided.	The fauna assessment identified that 75 tuart trees with a DBH>50cm were present onsite (Terrestrial Ecosystems, 2024). Additional tuart trees with a smaller DBH were also present but not counted.
	Structural form	What structural form is the vegetation?	Low Open Woodland to Woodland
Composition	Dominant tree species, emergent tree layer, understory	Is the composition of the community consistent with the characteristics set out in the Approved Conservation Advice? What other tree species are present? How many native understorey species are present and what is the number of weedy species/proportion of weeds?	Tuarts occur in many areas as the sole tree species and in other areas co-dominant with Jarrah trees. Native understorey species from onsite Tuart Woodland quadrats (C17 and C18) ranges from 7-13 in 2 quadrats. Number of weed species ranges from 7-9. Refer to quadrat data in Appendix 7 .

Key diagnostic characteristics [†]	Information	Key diagnostic questions* (Refer to Section 3.2 of the Approved Conservation Advice for a complete explanation of these diagnostic features – other sections of the Approved Conservation Advice are referenced where relevant)	Response (yes/no/possibly) and detailed comments. Use as much space as you need to fully answer the question [#]
Defining a patch of Tuart Woodlands and Forests	Patch definition	<p>What is the extent of the patch?</p> <p>Note: Descriptions of patch extent must include analysis of canopy extent and associated understorey vegetation (see Section 3.2.2•). Patches may extend beyond the project area or include areas of infrastructure (i.e. road, powerline). The referral should make clear how, and how much of the patch will be directly or indirectly impacted.</p>	<p>Given the large number of tuart trees present onsite (i.e. 75 trees with a DBH>50cm, plus smaller trees) the location of all trees has not been mapped. However, based on site investigations the density of Tuarts on the survey area is highly likely that the 30 m perimeter overlaps in all areas mapped with Tuart trees.</p>
Relationship with other ecological communities	Other vegetation communities	<p>Are other vegetation communities present? What are they and how do they intergrade and/or interact with the Tuart Woodlands and Forests TEC? (see Section 3.2.3•)</p>	<p>The survey area contains other dryland woodland vegetation that does not contain Tuart trees as well as wetland vegetation in the south-east corner.</p>

The complete key diagnostic characteristics are provided in the Approved Conservation Advice.

* The Tuart Woodlands and Forests may include restored, planted or revegetated flora. Do not exclude vegetation from being classed as the Tuart Woodlands and Forests because it is a planted, restoration or revegetation site (unless it is a garden).

[#] Comments should include references to appropriate supporting information and data.

Step 2: What is the patch size and condition category of the Tuart Woodlands and Forests in the proposed project site and in the surrounding area?

Table 16: Tuart Woodland Step 2 diagnostics (DoEE 2019)

Size and condition [♦]	Information	Relevant content to be discussed in the referral (Refer to Section 3.3 of the Approved Conservation Advice for a complete explanation of these diagnostic features)	Detailed comments. Use as much space as you need to fully answer the question [#]
Patch Size	Patch size in hectares	Is the patch size large enough to meet the minimum patch size in this section? (Section 3.3 [♦]) Note: Patch boundaries are not limited to the proposal site. You must make clear that the patch boundary is consistent with Section 3.2.2 [♦] .	The areas mapped with Tuart trees are above the minimum 5ha to meet the criteria for the TEC regardless of understorey condition.
Patch condition	Condition thresholds	Using the condition categories in this section, what is the patch condition? (Section 3.3.1 [♦]) What is the quality and size (hectares) of the vegetation community in and around the site where the proposed action will occur? Is the patch expected to improve in condition (e.g. after appropriate fire management) or is there a threatening process underway that will reduce the current size and/or condition? Note: Refer to Section 3.4 – Step 3 – Further information to assist in identifying patches of the protected ecological community and avoiding significant adverse impacts. If patch quality varies over the site; characterisation of the variation should be provided. Patch condition includes consideration of thresholds for characteristics such as plant species richness, landscape features, Tuart tree age and size and other habitat roles of the vegetation. Other vegetation condition measures (e.g. Keighery scale) do not necessary reflect the condition thresholds and both should be provided, where relevant. Where threats are identified (i.e. those listed in Appendix C of the Approved Conservation Advice) please provide further information on what these are and how they have impacted the condition.	The 2 Tuart Woodland quadrats assessed have 8 and 14 native understorey species per 0.1ha. Quadrats that have more than 12 species are considered to have a Very High rating.

♦ Further information on the key diagnostic characteristics is provided in the Approved Conservation Advice.

Comments should include references to appropriate supporting information and data. The response which includes the information does not need to be presented in table form.

6.7 Bush Forever sites

The survey area was not identified as a Bush Forever site. Similar vegetation from the Cottesloe – Central and South vegetation complex and FCT 28 occurs in two nearby Bush Forever sites to the east and south-west.

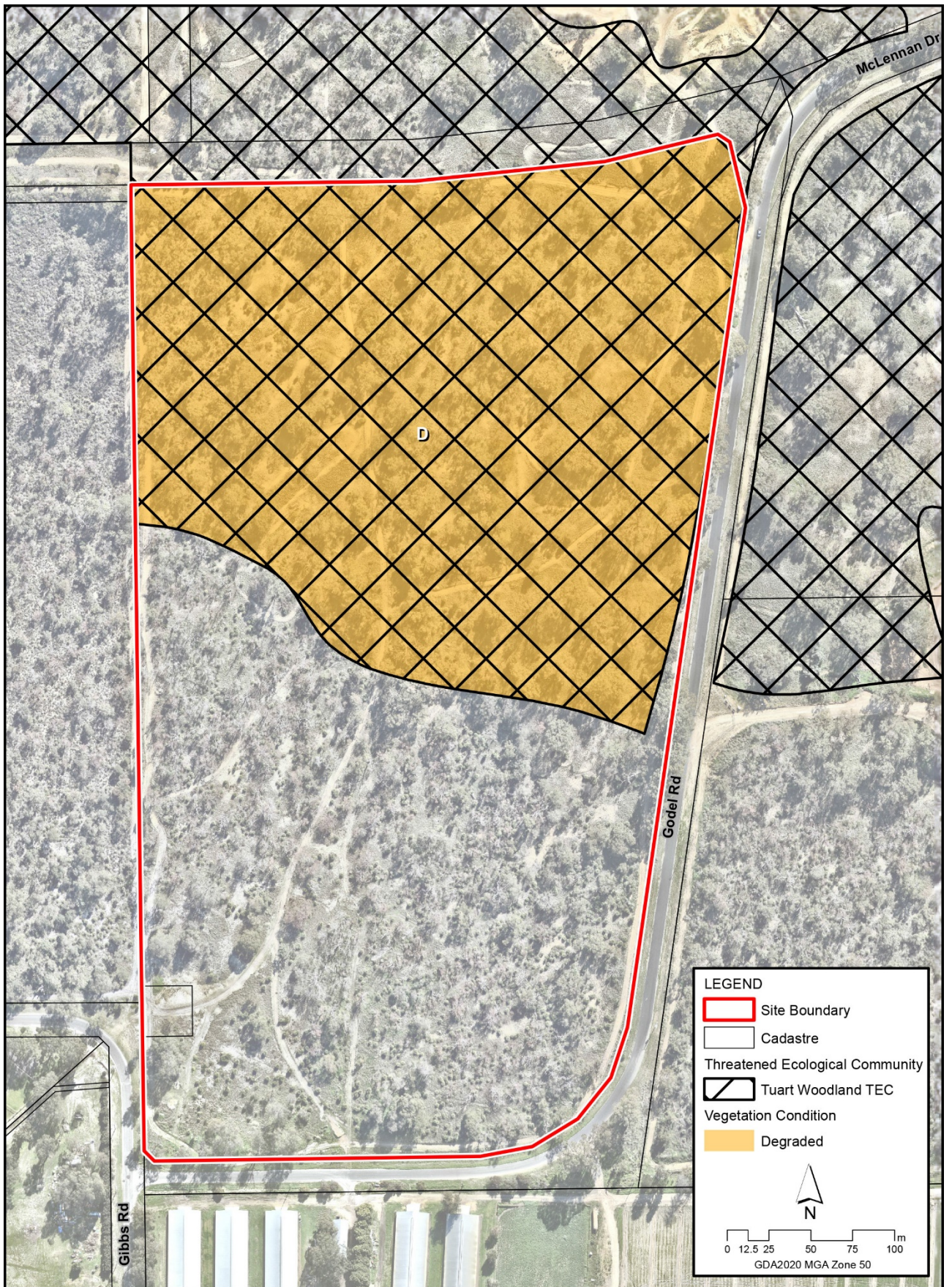


Figure 14. Location and condition of TECs within the survey area.

7 Discussion and conclusions

7.1 Significance of flora

Species richness in the 4 quadrats surveyed within Lot 107 in 2023 ranged from 9-23 with a range of 5-14 native species, averaging 8 native species. The average number of weed species was 7.

There were no Threatened or Priority-listed flora, or other flora of conservation significance recorded within the survey area in the 2014 or 2023 surveys.

Declared pest plants

There were no declared pest plants or environmental weeds recorded during the survey of Lot 107.

7.2 Significance of vegetation

Three vegetation types were recorded and mapped on the survey area, with soils consisting of dark brown to orange brown sand. The condition of the vegetation ranged from Completely Degraded to Degraded.

The vegetation at the site was too degraded to undertake FCT analysis, but based on PATN analysis outcomes for Eucalyptus dominated vegetation units on Very Good and Excellent condition in the surrounding survey area (PGV Environmental, 2023), it appears likely that the vegetation onsite would have originally represented FCT 24 and/or FCT 28.

The vegetation type containing Tuart trees (Unit EgEm) was considered to be representative of the Tuart Woodlands and Forests of the Swan Coastal Plain ecological community which is a TEC at Commonwealth level and State level. The total area of Tuart Woodland TEC within the survey area is 9.77 ha.

7.3 Vegetation complexes and associations

Vegetation onsite was found to align with the Cottesloe – Central and South vegetation complex as mapped by Heddle et al. (1980). 2018 Statewide vegetation statistics (GoWA 2019) show approximately 26.87% of the original 87,476.26 ha of the vegetation complex remains on the SCP, below the 30% required to meet the national retention target, with 5% remaining in DBCA reserves. In the City of Wanneroo the amount of extent vegetation remaining is 41.65%, which exceeds the 30% national retention target.

These figures show a decline in extent of the vegetation complex remaining when compared to the 2002 data used in the 2014 survey, where approximately 18,474 ha (41%) of the original 44,995 ha of the complex's vegetation remained on the Southern Swan Coastal Plain (EPA, 2006). Of this, 3,951 ha, or 8.8% of the original extent, was contained in secure tenure nature reserves (EPA, 2006).

7.4 Bush Forever sites

The survey area was not identified as a Bush Forever site. Similar vegetation from the Cottesloe – Central and South vegetation complex and FCT 28 occurs in two nearby Bush Forever sites to the east and south-west which ensures its long-term retention within the local area.

7.5 Watercourses and wetlands

There are no mapped watercourses or wetlands within the survey area. The closest wetland is the conservation category Nowergup Lake (UFI 8021) which is approximately 275 m to the southwest.

7.6 Environmentally sensitive areas

The survey area does not occur within a mapped ESA buffer. There are ESAs that are associated with the Bush Forever sites discussed in Section 5.7 to the east and southwest of the survey area, as well as an ESA occurring in association with Nowergup Lake (Conservation Category Wetland, UFI 8021) and an ESA associated with the TEC 'Aquatic Root Mat Community Number 1 of Caves of the Swan Coastal Plain' located approximately 1.4 km to the northwest of the survey area.

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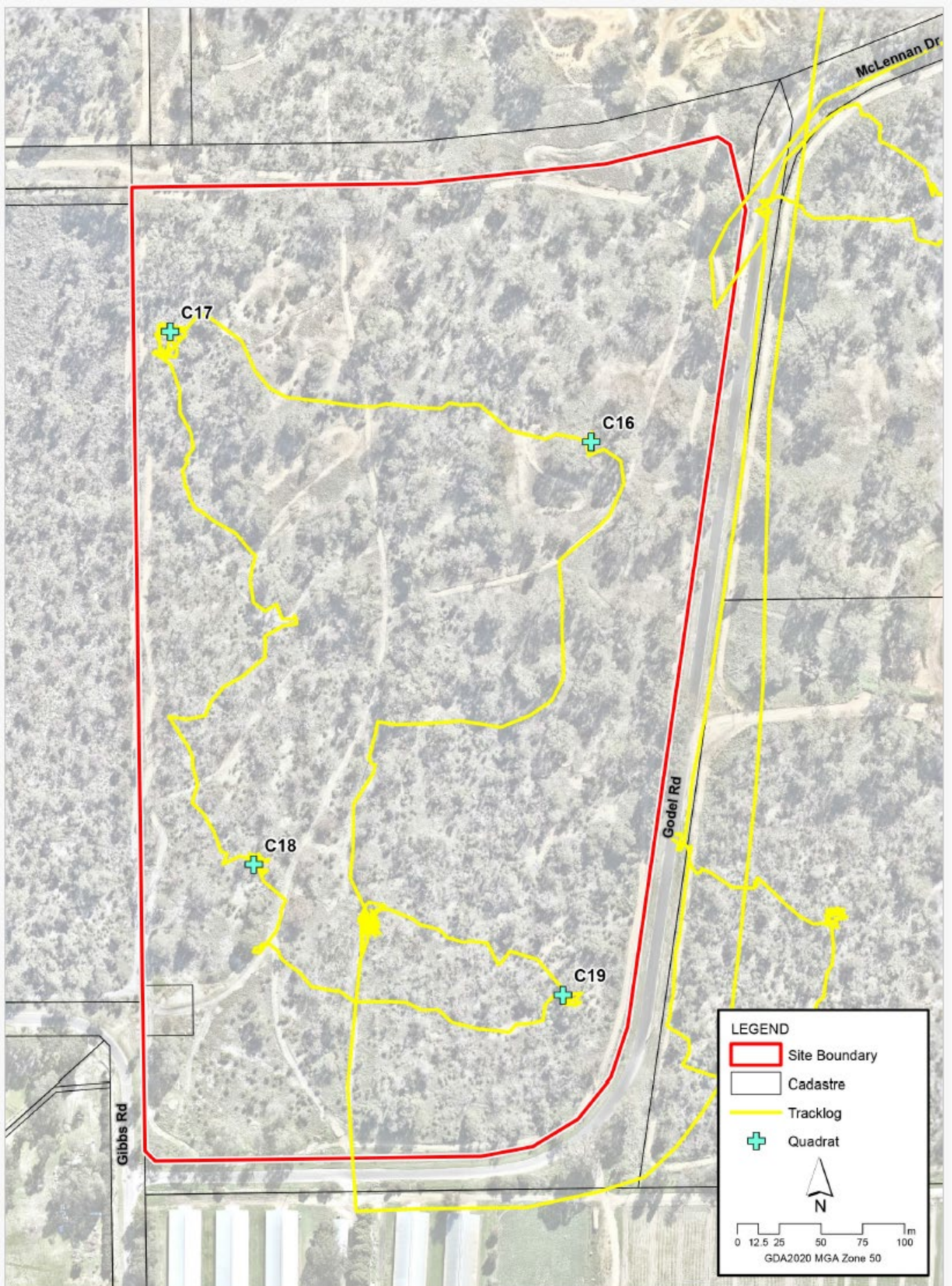
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Appendix 1. Quadrat location and track log.



Appendix 2. Categories of Threatened ecological communities under the EPBC Act.

Category	Definition
Critically endangered (CR)	If, at that time, an ecological community is facing an extremely high risk of extinction in the wild in the immediate future (indicative timeframe being the next 10 years).
Endangered (EN)	If, at that time, an ecological community is not critically endangered but is facing a very high risk of extinction in the wild in the near future (indicative timeframe being the next 20 years).
Vulnerable (VU)	If, at that time, an ecological, community is not critically endangered or endangered but is facing a high risk of extinction in the wild in the medium-term future (indicative timeframe being the next 50 years).

Appendix 3. Categories of threatened and priority ecological communities under the BC Act.

Conservation code	Category
(T) Threatened ecological community pursuant to Sect 27 of the <i>Biodiversity Conservation Act 2016</i> .	
T	<p>(T) CR – Critically endangered</p> <p>An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or that was originally of limited distribution and is facing severe modification or destruction throughout its range in the immediate future, or is already severely degraded throughout its range but capable of being substantially restored or rehabilitated.</p>
	<p>(T) EN - Endangered</p> <p>An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or was originally of limited distribution and is in danger of significant modification throughout its range or severe modification or destruction over most of its range in the near future.</p>
	<p>(T) VU - Vulnerable</p> <p>An ecological community that has been adequately surveyed and is found to be declining and/or has declined in distribution and/or condition and whose ultimate security has not yet been assured and/or a community that is still widespread but is believed likely to move into a category of higher threat in the near future if threatening processes continue or begin operating throughout its range.</p>
(P) Priority species – possible threatened communities.	
p1	<p>Poorly known communities</p> <p>Ecological communities that are known from very few occurrences with a very restricted distribution (generally ≤ 5 occurrences or a total area of ≤ 100ha). Occurrences are believed to be under threat either due to limited extent, or being on lands under immediate threat (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) or for which current threats exist. May include communities with occurrences on protected lands. Communities may be included if they are comparatively well-known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range.</p>

Conservation code	Category
P2	<p>Poorly known communities</p> <p>Communities that are known from few occurrences with a restricted distribution (generally ≤ 10 occurrences or a total area of ≤ 200ha). At least some occurrences are not believed to be under immediate threat (within approximately 10 years) of destruction or degradation. Communities may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under threat from known threatening processes.</p>
P3	<p>Poorly known communities</p> <ul style="list-style-type: none"> a) Communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation or: b) communities known from a few widespread occurrences, which are either large or with significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat (within approximately 10 years), or; c) communities made up of large, and/or widespread occurrences, that may or may not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, inappropriate fire regimes, clearing, hydrological change etc. <p>Communities may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and/or are not well defined, and known threatening processes exist that could affect them.</p>
P4	<p>Ecological communities that are adequately known, rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list. These communities require regular monitoring.</p> <ul style="list-style-type: none"> 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.
P5	<p>Conservation dependent ecological communities</p> <p>Ecological communities that are not threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming threatened within five years.</p>

Appendix 4. Protected Matters Search Tool and data searches.

FID	Sheet	NameID	Taxon	Cons _Cod e	Plant_Desc	Site	Vegetation	Frequency	Notes
749	1218697	3237	Acacia benthamii	2					
770	8982627	3237	Acacia benthamii	2	Shrub, 1.3 m high.	Flat. Yellow brown sand.	Low open forest of Allocasuarina fraseriana, Banksia attenuata and B. menziesii over tall open shrubland of Xanthorrhoea preissii over low open heath of Hibbertia hypericoides and Acacia humilis over very open grassland/sedgeland of Mesomelaena pseudosty		
5072	1014773	11336	Adenanthos cygnorum subsp. chamaephyton	3	Prostrate mat like shrub.	Lateritic sandy loam. Roadside.		common, ca 10 plants.	
8365	3416119	34161	Baeckea sp. Limestone (N. Gibson & M.N. Lyons 1425)	1	Shrub 1.8-2 m high, flowers white.	Limestone.			
8370	7404808	34161	Baeckea sp. Limestone (N. Gibson & M.N. Lyons 1425)	1		Limestone ridges SCP26a.			FCT26a Hadrell road. Transect road myhad 02, 10 m transect ID JP05, preburn plot.
8374	9139532	34161	Baeckea sp. Limestone (N. Gibson & M.N. Lyons 1425)	1	Upright shrub to 2.5 m. White flowers.	Moderate east-facing slope. Yellow grey sand.		120+ plants.	
16366	8755388	1425	Conostylis bracteata	3	Tufted herb to 20 cm tall. Flowers yellow. Plants flowering at the time of collection. Leaves arranged into flattened, broadly fan-like clusters. The leaf margins glabrescent.	Grey sand, on mid-slope.	Acacia rostellifera and Melaleuca systema mid shrubland. Lomandra maritima low open herbs.	1 mature plant.	Project: 3536.
16534	9208054	11388	Conostylis pauciflora subsp. euryrhipis	4	Stoloniferous herb, 20 cm high.	Interdunal flat or swale. White calcareous sand. > 7 years since fire.	Allocasuarina lehmanniana subsp. lehmanniana high open shrubland over Spyridium globulosum, Olearia axillaris, Acacia cyclops high shrubland over Melaleuca systema, Rhagodia baccata low open shrubland over Desmodium asper, Lepidosperma pubisquamum ver		
16537	5982138	11388	Conostylis pauciflora subsp. euryrhipis	4		S slope, on sand dunes; dry white sand; long unburnt.	Low heath 0.3 m tall, 30-70% cover.	c. 20 mature plants in a 5 x 20 m area.	
16539	7836457	11388	Conostylis pauciflora subsp. euryrhipis	4		Yellow-brown sand over limestone, slope, private lease. NW aspect.	Acacia rostellifera and Spyridium globulosum Tall Open Scrub over Melaleuca systema Low Open Shrubland over mixed Herbland-Grassland.		Healthy population with flowers. Potential threat from clearing.
16540	7858833	11388	Conostylis pauciflora subsp. euryrhipis	4	Tufted perennial.	Sand, secondary dunes.	Scaevola crassifolia, Lomandra maritima, Rhagodia baccata, Hardenbergia comptoniana, Threlkeldia diffusa, Hemiandra pungens, Acanthocarpus preissii.		
16545	9039023	11388	Conostylis pauciflora subsp. euryrhipis	4	Herb.	Dunes.	Acacia cochlearis and Melaleuca systema low open shrubland.		
16550	4059034	11388	Conostylis pauciflora subsp. euryrhipis	4	Tufted perennial herb, flowers yellow.	On grey calcareous sand.			
16567	7836449	11657	Conostylis pauciflora subsp. pauciflora	4		Grey sand over limestone, slope private lease, W aspect.	Melaleuca systema and Scaevola globulifera Open Low Heath over Austrostipa flavescens, Lolium perenne and Bromus diandrus Grassland.		Healthy population with flowers. Potential threat from clearing.

FID	Sheet	NameID	Taxon	Cons _Cod e	Plant_Desc	Site	Vegetation	Frequency	Notes
22919	1123661	13091	<i>Eucalyptus argutifolia</i>	T		ESE aspect. Lower ridgetop slope. Sheet sand/brown boulder. Completely open to treeless site.	Melaleuca huegelii, Xanthorrhoea preissii, Dryandra sessilis/nivea, Hakea trifurcata, Hibbertia hypericoides, Native wisteria.		
22934	9139524	13091	<i>Eucalyptus argutifolia</i>	T	Mallee to 2 m high.	At the base of a limestone ridge. Grey sand.	Completely open and treeless with dense scrubland.	ca. 6 plants.	
22936	2160765	13091	<i>Eucalyptus argutifolia</i>	T		Slight gully situation nestled between two limestone ridges. Sand/boulder/brown/ yellow/dry/limestone.	Dryandra's nivea/ sessilis, Hakea trifurcata, Melaleuca huegelii, Blackboys (Xanthorrhoea preissii), Templetonia retusa.	32 clumps.	
22937	2117223	13091	<i>Eucalyptus argutifolia</i>	T		Slight gully situation nestled between two limestone ridges. Limestone/boulder/ sand/brown/yellow/dry.	Completely open & treeless with dense scrubland. Dryandra's nivea/ sessilis, Hakea trifurcata, Melaleuca huegelii, Blackboys (Xanthorrhoea preissii), Templetonia retusa.	32 clumps, undisturbed.	
22946	8153302	13091	<i>Eucalyptus argutifolia</i>	T	Mallee to 2.5 m. Flowers white.	Slight slope/ridge. Grey/white sand over limestone.	With Acacia cyclops, Hakea prostrata, Lomandra maritima, rhagodia baccata, Spyridium globulosum.		
22947	8153310	13091	<i>Eucalyptus argutifolia</i>	T	Mallee to 2.5 m. Flowers white.	Slight slope/ridge. Grey/white sand over limestone.	With Acacia cyclops, Hakea prostrata, Lomandra maritima, rhagodia baccata, Spyridium globulosum.		
22953	9482083	13091	<i>Eucalyptus argutifolia</i>	T	Mallee, 1 - 2.5 m high by 1 - 3.5 m wide.	Hill top, with exposed limestone outcropping, moist brown sand. Site was burnt approx. 2002-2003.			Population 7B. Access is through the quarry. Plants are in two clumps. The southern clump is close to a limestone quarry.
22954	9487921	13091	<i>Eucalyptus argutifolia</i>	T	Mallee to 3 m high. Buds, white flowers and fruit present.	Mid-slope, brown sand over limestone.	Associated species: Banksia sessilis, Xanthorrhoea preissii, Melaleuca huegelii, Hibbertia hypericoides.	25 mature and 2 juvenile plants.	
24451	1176412	50737	<i>Eucalyptus foecunda</i> subsp. foecunda	4	Mallee to 5 m tall, bark rough, flowers white.	Slopes of hill high in the landscape.	Limestone heath with <i>Eucalyptus falcata</i> and <i>E. decipiens</i> at foot of N side of hill.		
24457	1153900	50737	<i>Eucalyptus foecunda</i> subsp. foecunda	4	Mallee to < 3 m, grey bark rough at base, smooth above. Buds and branchlets yellow-orange.	On limestone/sand,	<i>Dryandra sessilis</i> , <i>Grevillea thelemanniana</i> , <i>Hakea trifurcata</i> .		
24458	1153919	50737	<i>Eucalyptus foecunda</i> subsp. foecunda	4	Mallee to < 3 m, grey bark rough at base, smooth above. Buds and branchlets yellow-orange.	On limestone/sand,	<i>Dryandra sessilis</i> , <i>Grevillea thelemanniana</i> , <i>Hakea trifurcata</i> .		
24466	1192558	50737	<i>Eucalyptus foecunda</i> subsp. foecunda	4	Smooth barked mallee to 2 m x 2 m.	Grey sand over limestone, hilltop.	Low limestone heath.	rare.	
24472	1144987	50737	<i>Eucalyptus foecunda</i> subsp. foecunda	4		Limestone soil.			
24476	1155458	50737	<i>Eucalyptus foecunda</i> subsp. foecunda	4		In limestone soil.			
24503	1144235	50737	<i>Eucalyptus foecunda</i> subsp. foecunda	4		Sand over limestone.	In shrubland with <i>E. petrensis</i> .		
24511	6985165	50737	<i>Eucalyptus foecunda</i> subsp. foecunda	4	Mallee. 2 m high x 2 m wide. Flowers white; in flower and bud.	Limestone hill. White sand.	<i>Eucalyptus foecunda</i> mallee heath.	>100 plants over 0.25 ha.	
27340	8076626	20162	<i>Fabronia hampeana</i>	2		Private property in depression between limestone outcrops with yellow sand. Potential threat by urban development. Last burnt summer 2001.	<i>Banksia</i> low open woodland with occasional <i>Eucalyptus decipiens</i> , <i>Macrozamia riedlei</i> , <i>Acacia rostellifera</i> and <i>Hypocalymma angustifolium</i> .		Condition of population: Healthy.
27341	9248811	20162	<i>Fabronia hampeana</i>	2	Moss on <i>Macrozamia riedlei</i> trunks.	Lower dune. Dry pale grey sand.	Woodland of <i>Banksia attenuata</i> with <i>Xanthorrhoea preissii</i> , <i>Mesomelaena pseudostygia</i> , <i>Hakea trifurcata</i> and occasional <i>Macrozamia</i> .		The stems of <i>Macrozamia</i> needed to be well developed and the fronds large to provide shade.
34558	2625598	49637	<i>Hibbertia leptotheca</i>	3		Limestone.	Heath.		

FID	Sheet	NameID	Taxon	Cons _Cod e	Plant_Desc	Site	Vegetation	Frequency	Notes
34572	7520859	49637	Hibbertia leptotheca	3		Outcrop, slope. Dry, red-brown-white, limestone.	Mixed low scrub. Melaleuca cardiophylla, Mel. huegelii, Diplopeltis huegelii, Grevillea preissii, Trymalium ledifolium.	> 100 plants.	
34582	9208046	49637	Hibbertia leptotheca	3	Low shrub, 30 cm high.	WSW-facing upper to mid slope of dune. White calcareous sand. 1.5 to 2.5 years since fire.	Allocasuarina lehmanniana subsp. lehmanniana, high open shrubland over Acacia rostellifera shrubland over Melaleuca systema, Phyllanthus calycinus, Olearia axillaris, Gastrolobium linearifolium low shrubland over Lepidosperma pubisquameum scattered sedge		
34583	9039058	49637	Hibbertia leptotheca	3	Low shrub.	Dunes.	Xanthorrhoea preissii mid open shrubland over Melaleuca systema low open shrubland.	5 plants.	
36574	8755396	20462	Jacksonia gracillima	3	Perennial tufted herb with narrow leaves 10-40 cm long, with rose pink flowers.	Grey sand, on mid-slope with exposed limestone. Fire > 5 years.	Low open forest of Eucalyptus rudis and Melaleuca preissiana. Banksia attenuata shrubs. Tall shrubland of Gastrolobium ebracteolatum and Kunzea glabrescens. Sedgeland of Baumea preisii subsp. laxa.	1 mature plant.	Project: 3516.
36729	6410731	4027	Jacksonia sericea	4		Slope/flat. Dry grey sand over limestone.	Eucalyptus marginata, Banksia attenuata, B. menziesii Woodland. Associated species: Banksia attenuata, B. grandis, Allocasuarina fraseriana, Dryandra sessilis, Calothamnus sp.		Condition of population: healthy.
36734	7400160	4027	Jacksonia sericea	4	Low shrub.				
36751	8982643	4027	Jacksonia sericea	4	Shrub, 0.5 m high.	Gentle slope, slight ridge. Yellow brown loamy sand.	Tall open shrubland of Acacia rostellifera to 3 m over closed tall scrub of Banksia sessilis to 2.4 m over open shrubland of Xanthorrhoea preissii, Melaleuca systema and Hakea trifurcata to 2 m over low shrubland of Jacksonia sericea and Hibbertia hyperi	> 700 plants.	
38359	1421468	3042	Lepidium pseudotasmanicum	4					
39370	5456169	40801	Leucopogon maritimus	1		On stable dune.	Coastal heath.		
39371	7835213	40801	Leucopogon maritimus	1		White sand, sand dune, slope, private property.	Melaleuca systema, Lomandria maritima Low Open Heath Melaleuca systema, Scaevola thesioides, Acacia rostellifera and Herbland of Lomandra martima.		Healthy population with potential threat from clearing.
39378	5536359	40801	Leucopogon maritimus	1	Low spreading shrub, 20 cm high x 20 cm wide. Flowers white, single stemmed at ground level. Ovary 3 celled glabrous.	Near coastal dunes ca 600 m from beach. Bare yellow sand over limestone.	Low Heath D (Muir 1977) with Acacia truncata, Melaleuca systema and Acanthocarpus preissii.	locally common.	
39383	5127742	40801	Leucopogon maritimus	1	Erect to spreading shrub to 30 cm tall. Corolla white, flowers just beginning.	In sand among limestone rocks on small hill.	In low kwongan, Scaevola, Pimelea, Acacia.		
39384	9208038	40801	Leucopogon maritimus	1	Low shrub, 35 cm high.	Gentle, NW-facing lower slope of lower ridge. Grey calcareous sands. > 5 - 7 years since fire.	Melaleuca huegelii, M. cardiophylla, Acacia truncata closed low heath over Thomasia triphylla, Leucopogon insularis, Melaleuca systema, Lysinema ciliatum low shrubland over Desmodium asper, Lepidosperma pubisquameum very open sedgeland with Lomandra ma		
39599	8262926	19460	Leucopogon sp. Yanchep (M. Hislop 1986)	3					
39600	8262934	19460	Leucopogon sp. Yanchep (M. Hislop 1986)	3					

FID	Sheet	NameID	Taxon	Cons _Cod e	Plant_Desc	Site	Vegetation	Frequency	Notes
39603	3509311	19460	Leucopogon sp. Yanchepe (M. Hislop 1986)	3	Dwarf shrub 40 cm high, flowers white, mucronate leaves.	Undulating, grey sand over limestone.	Woodland, Banksia.	frequent.	
39604	1147773	19460	Leucopogon sp. Yanchepe (M. Hislop 1986)	3	Low twiggly woody shrub, 15-20 cm, flowers white, sweet honey scent.	Low hill, grey sand over limestone.	Limestone heath.	scattered in area.	
39617	7293178	19460	Leucopogon sp. Yanchepe (M. Hislop 1986)	3	Erect shrub to 60 cm high x 60 cm wide. Flowers white, strictly pendulous.	Coastal plain. Dry, yellow sand over limestone.	Heath (mostly 1-2 m). Dryandra sessilis, Jacksonia calcicola, Conostephium stoechadis.	locally common.	
41047	9196951	33022	Melaleuca sp. Wanneroo (G.J. Keighery 16705)	T	Slender erect open shrub, 2-3 m high x 1 m wide. In fruit, not in flower.	Limestone hill. Skeletal white loam over limestone.	Banksia sessilis / Melaleuca tall shrubland.	locally common.	Co-occurring with Melaleuca systema which is in full flower.
41048	8815224	33022	Melaleuca sp. Wanneroo (G.J. Keighery 16705)	T	Erect to spreading shrub to 1.5 m with yellow flowers.	Limestone ridge remnant within a mine pit.	Remnant.	occasional.	
41049	8816476	33022	Melaleuca sp. Wanneroo (G.J. Keighery 16705)	T	Erect shrub 1 - 2.5 m x 2 m.	On fine sand to sandy loam soils with 30-70% outcropping limestone.	Closed tall scrub of Melaleuca systema, M. sp. Wanneroo, M. sp. Wanneroo x systema and M. huegelii, over low shrubland of Calothamnus quadrifidus, Banksia sessilis var. cygnorum, Leucopogon parviflorus and Templetonia retusa.	locally common.	Co-occurs with Melaleuca systema and M. systema x M. sp. Wanneroo. Population 1.
41050	8816522	33022	Melaleuca sp. Wanneroo (G.J. Keighery 16705)	T	Erect shrub 1-2.5 m x 2 m. Flowers yellow.	On well drained grey sand with 30-70% outcropping limestone.	Tall open scrub of Melaleuca huegelii, M. sp. Wanneroo with occasional Eucalyptus petrensis and Melaleuca systema, over open low heath of Acacia alata var. tetrantha, Thomasia triphylla over open sedgeland/herbland.	locally common.	
41051	9137459	33022	Melaleuca sp. Wanneroo (G.J. Keighery 16705)	T	Tall shrub to 2 m tall. Yellow flowers.	Hilltop and upper slopes. Soil: shallow brown sand.	Shrubland. Associated species: Thomasia sp., sedges, Hakea trifurcata, Grevillea preissii, Melaleuca systema, Banksia sessilis.	>1000.	
41052	8997675	33022	Melaleuca sp. Wanneroo (G.J. Keighery 16705)	T		Hill slope. Yellow/brown sand.	Melaleuca shrubland. Associated species: Acacia alata var. tetrantha, Banksia sessilis, Melaleuca huegelii and M. systema.	1000+.	
41053	9041443	33022	Melaleuca sp. Wanneroo (G.J. Keighery 16705)	T	Shrub to 2 m tall. Yellow flowers.	NE face of limestone hill. Soil: shallow yellow/brown sand.	Dense shrubland to 2 m. Associated species: Calothamnus sp., Hakea trifurcata, Grevillea preissii and Banksia sessilis.	>1000.	
41054	6972942	33022	Melaleuca sp. Wanneroo (G.J. Keighery 16705)	T	Slender erect single 2-3 m high and 1-2 m wide. Flowers pale yellow; in full flower.	Rugged limestone ridge. Mossy black sand.	Melaleuca cardiophylla, M. sp., M. systema tall closed shrubland.	dominant locally.	
41057	8982635	33022	Melaleuca sp. Wanneroo (G.J. Keighery 16705)	T	Shrub, 2.5 m high. Flowers yellow.	Limestone ridge. Brown loamy sand.	Tall open scrub of Melaleuca huegelii and M. sp. Wanneroo (G.J. Keighery 16705) over open shrubland to 1.5 m of Melaleuca systema, Xanthorrhoea preissii and Acacia lasiocarpa over low open shrubland to 0.4 m of Grevillea preissii and Banksia nivea over v	40 plants.	

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41058	9446958	33022	Melaleuca sp. Wanneroo (G.J. Keighery 16705)	T	Many branched shrub to 1.3 m tall x 0.8 m wide. Leaves are linear to 20 mm long x 3-5 mm wide, hairy and bright green on young plants. Early fruits present towards stem ends, with new growth of shorter recurved leaves continuing.	Grey fine sand on limestone outcropping up to 70%. Upper slopes to ridge.	Very Open Shrub Mallee of Eucalyptus argutifolia over Closed to Open Heath of Melaleuca sp. Wanneroo (G.J. Keighery 16705), Grevillea preissii, Templetonia retusa, Melaleuca huegelii, Acacia lasiocarpa, A. alata subsp. tetranthera, Opercularia vaginata,	6250 plants extrapolated within a mapped population boundary.	The majority of plants had recruited after a wildfire 6 years previously. The habitat is between a water corporation facility and a mine-pit.
41059	9446966	33022	Melaleuca sp. Wanneroo (G.J. Keighery 16705)	T	Many branched shrub to 1.3 m tall x 0.8 m wide. Leaves are linear to 20 mm long x 3-5 mm wide, hairy and bright green on young plants. Early fruits present towards stem ends, with new growth of shorter recurved leaves continuing.	Grey fine sand on limestone outcropping up to 70%. Upper slopes to ridge.	Very Open Shrub Mallee of Eucalyptus argutifolia over Closed to Open Heath of Melaleuca sp. Wanneroo (G.J. Keighery 16705), Grevillea preissii, Templetonia retusa, Melaleuca huegelii, Acacia lasiocarpa, A. alata subsp. tetranthera, Opercularia vaginata,	6250 plants extrapolated within a mapped population boundary.	The majority of plants had recruited after a wildfire 6 years previously. The habitat is between a water corporation facility and a mine-pit.
42409	8755442	50567	Netrostylis sp. Chandala (G.J. Keighery 17055)	2	Sedge c. 50 cm tall with very narrow leaves and culms. Inflorescence loose and branched, with dark brown florets.	Grey brown peaty soil in a swamp.	Low open forest of Eucalyptus rudis and Melaleuca preissiana. Tall open shrubland of Astartea fascicularis and Kunzea glabrescens. Pteridium esculentum mid ferns. Sedgeland of Lepidosperma.	100 mature plants.	Project: 3516.
44256	9136924	5237	Pimelea calcicola	3		Brown sandy loam soil on plain over limestone.	Isolated low Banksia attenuata trees over tall closed Banksia sessilis, Hakea trifurcata and Leptospermum laevigatum shrubland over low open Hibbertia hypericoides and Xanthorrhoea preissii shrubland.	1 mature plant.	
44267	3409368	5237	Pimelea calcicola	3	Shrub, erect 3 ft. Reddish pink flowers.				
44269	4948874	5237	Pimelea calcicola	3	Erect single stemmed shrub 1 m high x 1 m wide. Flowers grading from white through to pink.	Dry brown clayey sand over limestone.	Dense Low Forest A, Open Scrub, Heath A, Heath B, Low Heath C, Low Heath D, Very Open Herbs, Open Hummock Grass. Eucalyptus gomphocephala, Dryandra sessilis, Scaevola sp, purple Hemidra and yellow flowered Melaleuca, Xanthorrhoea preissii.	frequent.	
44274	9220828	5237	Pimelea calcicola	3	1.5 m high.	Undulating plain. Brown sandy loam over limestone.	Isolated low Banksia attenuata trees over tall closed Banksia sessilis, Hakea trifurcata and Leptospermum laevigatum shrubland over low open Hibbertia hypericoides and Xanthorrhoea preissii shrubland.		
44419	6209874	8163	Pithocarpa corymbulosa	3					Field No. Y 64.
46763	8039364	17543	Sarcozona bicarinata	3		Private property; limestone outcrops with dry white sand. Potential threat by urban development. Last burnt summer 2001.	Open Banksia sessilis heathland. Banksia sessilis, Opercularia vaginata, Scaevola crassifolia and Desmodcladus flexuosus.	5 mature plants over 5 m squared.	Condition of population: Healthy.
48266	6233090	20348	Sphaerolobium calcicola	3	Standard yellow, red around yellow eye. Red wings. Keel yellow with few red spots near apex. Ca 1 m tall.	Grey brown sand over limestone. Seasonally wet, fairly low lying area.	Shrubland with understorey of sedgeland. Associated species: Nuytsia and Acacia with Viminaria, Xanthorrhoea, Comesperma and Lepidospermum.	occasional.	
49717	6511546	7756	Stylidium longitubum	4	Flowers pink.	Seasonal Wetland, flat ground. Dark brown clay loam some peat, over ?clay. Poor drainage, wet during winter/spring.	Open Low Scrub A. Associated species: Astartea fascicularis.		

FID	Sheet	NameID	Taxon	Cons _Cod e	Plant_Desc	Site	Vegetation	Frequency	Notes
49775	4430921	13127	Stylidium maritimum	3	Flowers pink-mauve, throat white, outer petal surface white to pale pink, upper winged throat appendages pink, lower throat appendages white-red tipped, leaves 3 per papery sheath.	On limestone outcrops in crater-like depressions filled with black sandy soil.	Area surrounded by low coastal heath and open Banksia menziesii woodland.		
49786	9139559	13127	Stylidium maritimum	3	Sedge-like herb to 0.4 m high. In fruit.	Limestone ridge with outcropping. Sandy soil.	Melaleuca huegelii and Melaleuca systema TEC.	ca. 35 plants.	
49790	7520840	13127	Stylidium maritimum	3		Side of dune. Dry, white-grey sand.	Low heath. Lomandra maritima, Leptorhynchos scabrus, Melaleuca huegelii.	> 200 plants.	
49791	5982103	13127	Stylidium maritimum	3		Slope; on stable sand dunes; dry white sand; long unburnt.	Low heath 0.5 m tall, 70-100 % cover.	c. 10 mature plants in a 5 x 5 m area.	
49796	7836384	13127	Stylidium maritimum	3		Grey sand-loam, slope, ridge, limestone, private property.	Closed Tall Scrub of Melaleuca huegelii, Dryandra sessilis with occasional Spyridium globulosum.		Healthy population, in flower. Potential threat from clearing and weeds.
49798	7836430	13127	Stylidium maritimum	3		Brown sand-loam over limestone, slope, private property.	Acacia rostellifera Open Low Heath with Melaleuca huegelii, Acacia truncata and Melaleuca systema.		Healthy population with flowers. Potential threat from clearing and weeds.
49800	8755361	13127	Stylidium maritimum	3	Perennial tufted herb with narrow leaves 10-40 cm long, with rose pink flowers.	Grey sand, on mid-slope with exposed limestone.		1 mature plant.	Project: 3536.
49806	9039066	13127	Stylidium maritimum	3	Herb.	Dune swale.	Banksia sessilis low open shrubland.	10 plants.	
49808	8982600	13127	Stylidium maritimum	3	Herb, 0.8 m high.	Limestone ridge. Brown loamy sand over limestone.	Tall shrubland of Melaleuca systema over open shrubland of Melaleuca huegelii and Acacia lasiocarpa over very open herbland of Desmodium flexuosus. Associated species: Grevillea preissii.	15 plants.	
49809	9207996	13127	Stylidium maritimum	3	Caespitose, perennial herb, 40 cm high. Flowers white/purple.	S-facing, midslope of low dune (ridge). Brown sand.	Olearia axillaris, Stylidium globulosum scattered shrubs over Melaleuca systema, Leucopogon parviflorus, Trymalium ledifolium var. ledifolium low shrubland over Austrostipa flavescens, Poa poiformis, Lomandra maritima herbland/grassland/sedgeland.		
49816	9556192	13127	Stylidium maritimum	3	Perennial herb. Leaves smooth, 3 leaves sometimes 2 per scale leaf sheath. Flowers pink, calyx lobes bent at an angle away from the ovary centre line.	Grows in small pockets, filled with soil in very weathered and eroded limestone (cap-rock) outcrops.			
49818	9565078	13127	Stylidium maritimum	3	Flowers pink-mauve, throat white, outer petal surface white to pale pink, upper winged throat appendages pink, lower throat appendages white-red tipped, leaves 3 per papery-sheath.	On limestone outcrops in crater-like depressions filled with black sandy soil.	Area surrounded by low coastal heath and open Banksia menziesii woodland.		
49819	9565116	13127	Stylidium maritimum	3	Flowers pink-mauve, throat white, outer petal surface white to pale pink, upper winged throat appendages pink, lower throat appendages white-red tipped, leaves 3 per papery sheath.	On limestone outcrops in crater-like depressions filled with black sandy soil.	Area surrounded by low coastal heath and open Banksia menziesii woodland.		
50489	9573445	7803	Stylidium striatum	4	Corolla pink.	Grows in sand over limestone in Banksia woodlands.			
55374	6427405	44444	Tripterococcus sp. Brachylobus (A.S. George 14234)	4	Flowers yellow.	Seasonal Wetland, flat ground, black fine peaty clay loam sand, poor drainage, wet during winter/spring.	Open Herbs. Associated species: Lepyrodia muirii, Baumea articulata, Baumea vaginalis.		

FID	Popld	Nameid	Taxon	Con sSta tus	WA Ran k	Pop Nu mbe r	Sub Pop Cod e	District	Vesting	Purpose1	Purp ose2	CountDate	Method	HabNotes	SoilCondit	Landform	RockType	Gravel	SoilType	SoilColor	Drainage
352	86278	3237	Acacia benthamii	2		4		SWAN COASTAL	MRD	VER		5/06/2000	ESTMT	VegClas: Open B.menziessii woodland over shrubland	MOIST	FLAT	LIMESTN		SAND	YELLOW	
1684	89656	11336	Adenanthos cygnorum subsp. chamaephyton	3		16		SWAN COASTAL	LGA	VER	FOR	13/11/1981	UNKNOWN				LATERITE		LOAM_SND		
2856	118771	34161	Baeckea sp. Limestone (N. Gibson & M.N. Lyons 1425)	1		3		SWAN COASTAL	MRD	VER		9/11/2017	ESTMT	No sign of fire	DRY	SLOPE		GRVL_30	SAND	GREY	WLL_DRND
2857	118772	34161	Baeckea sp. Limestone (N. Gibson & M.N. Lyons 1425)	1		4		SWAN COASTAL	CC	FOR		14/09/2020	ACT_IND	Heath of Melaleuca huegelii, Banksia sessilis var. cygnorum, Xanthorrhoea preissii, Calothamnus quadrifidus, Baeckea sp. Limestone over Open Low Shrubland of Melaleuca systema, Hibbertia hypericoides, Banksia dallanneyi subsp. dallanneyi, Leucopogon parv	MOIST	SL_UP_ST	LIMESTN	GRVL_30	SAND	YEL_ORNG	WLL_DRND
6555	89775	11657	Conostylis pauciflora subsp. pauciflora	4		7		SWAN COASTAL	PRI			19/10/2007		Dom sp: Bromus diandrus. Open low heath over grassland.		SLOPE	LIMESTN		SAND	GREY	
8894	101587	13091	Eucalyptus argutifolia	T	VU	7	A	SWAN COASTAL	CC	FOR		6/12/2013	ACT_CLMP	QUARRY Despite being surrounded by a limestone mine this elevated and isolated remnant of vegetation on the top of the ridge is in very good to excellent condition.	DRY	OUTCROP	LIMESTN	GRVL_30	SAND	BROWN	
8895	101588	13091	Eucalyptus argutifolia	T	VU	7	B	SWAN COASTAL	CC	FOR	MIN	6/12/2013	ACT_CLMP	Heath of Banksia sessilis var. cygnorum, Acacia lasiocarpa, Melaleuca huegelii, Melaleuca systema, Xanthorrhoea preissii, Acacia ?stenoptera, Hemiandra pungens, Trymalium ledifolium var. ledifolium with occasional Hakea prostrata, Cassytha ?racemosa, Tem	MOIST	SLOPE	LIMESTN		SAND	BROWN	
8898	90756	13091	Eucalyptus argutifolia	T	VU	10		SWAN COASTAL	WAT	WAT		15/05/2018	ACT_CLMP	Regenerating community: Very Open Shrub Mallee of Eucalyptus argutifolia over Tall Open Scrub of Banksia sessilis var. cygnorum, Xanthorrhoea preissii, Melaleuca systema, M. sp. Wanneroo (T), M. huegelii, Hakea prostrata, Acacia saligna over Open Low Hea	MOIST	SLOPE	LIMESTN		SAND	BROWN	WLL_DRND
8901	90759	13091	Eucalyptus argutifolia	T	VU	13		SWAN COASTAL	LGA	REC		5/12/2017	ACT_CLMP	HABITAT CONDITION: Good-degraded. Two bushland remnants still exist, but the degraded areas are reducing. 1. Low Open Woodland of Eucalyptus argutifolia over Tall Shrubland of Acacia rostellifera and Spyridium globulosum. 2. The second remnant is domina	MOIST	SL_MI_GE	LIMESTN		SAND	GREY	WLL_DRND
8902	101581	13091	Eucalyptus argutifolia	T	VU	14	A	SWAN COASTAL	NON	UCL		13/12/2013	ACT_IND		MOIST	SL_UP_ST	LIMESTN	GRVL_10	SAND	BROWN	
8903	101582	13091	Eucalyptus argutifolia	T	VU	14	B	SWAN COASTAL	NON	UCL		13/12/2013	ACT_IND		MOIST	RIDGE	LIMESTN		SAND	BROWN	
8904	90760	13091	Eucalyptus argutifolia	T	VU	15		SWAN COASTAL	LGA	REC		6/04/2021		A small amount of rubbish within population. Shrub Malle of Eucalyptus argutifolia over Shrubland Melaleuca huegelii, Melaleuca systema, Acacia rostellifera, Spyridium globulosum, Hakea trifurcata, over Hardenbergia comptoniana, Opercularia vaginata, Le	DRY	SL_UP_GE	LIMESTN		SAND	WHITE	
8906	101584	13091	Eucalyptus argutifolia	T	VU	17		SWAN COASTAL	PRI			3/08/2006	ACT_IND		MOIST	RIDGE	LIMESTN		SAND	BROWN	
8911	120029	13091	Eucalyptus argutifolia	T	VU	20		SWAN COASTAL	WAT	OTH		7/11/2017	ESTMT		DRY	SLOPE	LIMESTN	GRVL_10	SAND	GREY	WLL_DRND
10043	104267	20162	Fabronia hampeana	2		4	B	SWAN COASTAL	PRI			12/01/2009		Dom sp: Macrozamia sp. & Banksia sp. Woodland.					SAND	YELLOW	
10044	104268	20162	Fabronia hampeana	2		4	C	SWAN COASTAL	PRI			12/01/2009		Banksia low open woodland. Dom sp: Acacia cyclops, Hibbertia hypericoides, Desmodcladus flexuosus			LIMESTN		SAND	YELLOW	
12418	100798	49637	Hibbertia leptotheca	3		9	A	SWAN COASTAL	PRI			14/10/2004	ESTMT		DRY	OUTCROP	LIMESTN		SAND	GREY	
12419	100799	49637	Hibbertia leptotheca	3		9	B	SWAN COASTAL	PRI			14/10/2005	UNKNOWN		DRY	OUTCROP	LIMESTN			WHITE	

FID	Popld	Nameid	Taxon	Con sSta tus	WA Ran k	Pop Nu mbe r	Sub Pop Cod e	District	Vesting	Purpose1	Purp ose2	CountDate	Method	HabNotes	SoilCondit	Landform	RockType	Gravel	SoilType	SoilColor	Drainage
13226	87329	5038	Lasiopetalum membranaceum	3		11		SWAN COASTAL	CC	NPK		4/11/1987		Growing under a jarrah tree in open woodland. On a flat - gently undulating slope. Occasional in area.		FLAT	LIMESTN		SAND	GREY	
14062	107424	25819	Marianthus paralius	T	EN	3		SWAN COASTAL	LGA	REC		18/09/2013	ACT_IND	1) Acacia xanthina, Templetonia retusa Open Heath over Spyridium globulosum, Grevillea preissii, Allocasuarina lehmanniana, Melaleuca cardiophylla, Phyllanthus calycinus, Hibbertia hypericoides, Scaevola crassifolia, Lomandra maritima Low Shrubland. *Ehr	MOIST	SL_UP_GE	LIMESTN	GRVL_10	SAND	GREY	WLL_DRND
14197	110769	33022	Melaleuca sp. Wanneroo (G.J. Keighery 16705)	T	EN	1		SWAN COASTAL	LGA	GVT		8/07/2014	PART_CNT	Almost on the top of the ridge, slightly SW - W aspect.	MOIST	RIDGE	LIMESTN		FSA_LOAM		WLL_DRND
14198	110770	33022	Melaleuca sp. Wanneroo (G.J. Keighery 16705)	T	EN	2		SWAN COASTAL	PRI	UNKNOW N		7/04/2008	ESTMT			OU_SLOPE	LIMESTN		SAND	BLACK	
14199	110789	33022	Melaleuca sp. Wanneroo (G.J. Keighery 16705)	T	EN	3	A	SWAN COASTAL	PRI			10/05/2017	ESTMT	Hilltop and upper slopes. Soil: shallow brown sand.		CR_HILL	LIMESTN		SAND	BROWN	
14200	111492	33022	Melaleuca sp. Wanneroo (G.J. Keighery 16705)	T	EN	3	B	SWAN COASTAL	RDL	MIN		27/11/2013	ACT_IND	NOTE - Fire information was taken from Corporate Mapping Data. Not confirmed in the field			LIMESTN				
14201	111509	33022	Melaleuca sp. Wanneroo (G.J. Keighery 16705)	T	EN	3	C	SWAN COASTAL	RDL	MIN		30/09/2009	PART_CNT				LIMESTN				
14202	120789	33022	Melaleuca sp. Wanneroo (G.J. Keighery 16705)	T	EN	3	D	SWAN COASTAL	WAT	GVT		15/05/2018	EXT_GRQD	Occasional Eucalyptus argutifolia and Eucalyptus petrensis to 1.5m over Closed Heath of Melaleuca sp. Wanneroo, Melaleuca huegelii, Grevillea preissii, Templetonia retusa, Scaevola crassifolia, Acacia lasiocarpa, Acacia alata var. tetrantha, Opercularia	MOIST	RIDGE	LIMESTN		SAND	GREY	WLL_DRND
14203	110790	33022	Melaleuca sp. Wanneroo (G.J. Keighery 16705)	T	EN	4	A	SWAN COASTAL	CC	FOR		26/11/2013	PART_CNT	NOTE - Fire information was taken from Corporate Mapping Data. Not confirmed in the field			LIMESTN				
14204	111490	33022	Melaleuca sp. Wanneroo (G.J. Keighery 16705)	T	EN	4	B	SWAN COASTAL	CC	FOR		6/12/2013	ESTMT		DRY	RIDGE	LIMESTN		SAND		WLL_DRND
14205	120790	33022	Melaleuca sp. Wanneroo (G.J. Keighery 16705)	T	EN	4	C	SWAN COASTAL	CC	FOR		17/01/2019	PART_CNT	Tall Open Scrub of Melaleuca systema, M. sp. Wanneroo, Banksia sessilis ssp. cygnorum, M. huegelii over Open Heath of Grevillea preissii, Hibbertia hypericoides, Conostylis candicans, Cryptandra mutilla, Acacia pulchella, Desmodcladus flexuosa.	DRY	SL_MI_ST	LIMESTN		SAND	GREY	WLL_DRND
16741	89298	7756	Stylidium longitubum	4		16		SWAN COASTAL	SPC			10/11/1994				FL_PALU		CLA_LOAM	BROWN	SEASINUN	
16766	90804	13127	Stylidium maritimum	3		13		SWAN COASTAL	PRI			9/10/2004	ESTMT	more illegible DomSp on RFRF	DRY	CREST	LIMESTN		SAND	GREY	
16767	90805	13127	Stylidium maritimum	3		14		SWAN COASTAL	PRI			12/10/2005	UNKNOWN		DRY	RI_DUNE		SAND	WHITE		
18032	93721	44444	Tripterococcus sp. Brachylobus (A.S. George 14234)	4		17		SWAN COASTAL	PRI			10/11/1994		VegClass:Open Herbs		FL_PALU		CLA_LOAM	BLACK	SEASINUN	

Appendix 5. State Categories of Threatened and Priority list flora.

Conservation code	Category
(T) Threatened species pursuant to Sect 19 of the BC Act 2016.	
T	<p>(T) CR – Critically endangered</p> <p>Threatened species considered to be <i>“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”</i>.</p>
	<p>(T) EN - Endangered</p> <p>Threatened species considered to be <i>“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”</i>.</p>
	<p>(T) VU - Vulnerable</p> <p>Threatened species considered to be <i>“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”</i>.</p>
(P) Priority species – possible Threatened species.	
P1	<p>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.</p>
P2	<p>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.</p>

Conservation code	Category
P3	<p>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.</p>
P4	<p>(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.</p> <p>(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.</p> <p>(c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.</p>

Appendix 6. Categories of Threatened flora species under the EPBC Act.

Category	Definition
Extinct (Ex)	A native species is eligible to be included in the extinct category at a particular time if, at that time, there is no reasonable doubt that the last member of the species has died.
Extinct in the Wild (ExW)	A native species is eligible to be included in the extinct in the wild category at a particular time if, at that time (a) it is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; or (b) it 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 (CE)	A native species is eligible to be included in the critically endangered category at a particular time if, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.
Endangered (EN)	A native species is eligible to be included in the endangered category at a particular time if, at that time (a) it is not critically endangered; and (b) it is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria.
Vulnerable (VU)	A native species is eligible to be included in the vulnerable category at a particular time if, at that time (a) it is not critically endangered or endangered; and (b) it is facing a high risk of extinction in the wild in the medium term future, as determined in accordance with the prescribed criteria.
Conservation Dependent (CD)	A native species is eligible to be included in the conservation dependent category at a particular time if, at that time, the species is the focus of a specific conservation program, the cessation of which would result in the species becoming vulnerable, endangered or critically endangered within a period of 5 years.

Appendix 7. 2023 quadrat data – Lot 107 (C16-C19).

QUADRAT C16

50 380449 E 6500279 N

Vegetation: *Eucalyptus gomphocephala*/*E. marginata* Woodland over **Ehrharta calycina* Closed Grassland
Condition: Completely Degraded
Soil Type: Brown sand
Landform: Top of slope
Date: 25.9.23
Recorder: Paul van der Moezel



QUADRAT (10 x 10m)

SPECIES	HEIGHT (m)	COVER (%)
<i>Eucalyptus gomphocephala</i>	12	15
<i>Eucalyptus marginata</i>	6	10
<i>Acacia pulchella</i>	1.1	1
<i>Xanthorrhoea preissii</i>	1	<1
<i>*Ehrharta calycina</i>	0.8	80
<i>*Euphorbia terracina</i>	0.4	4
<i>*Lolium perenne</i>	0.3	10
<i>*Romulea rosea</i>	0.2	1
<i>Hardenbergia comptoniana</i>	Climber	1

* introduced species

QUADRAT C17

50 380197 E 6500345 N

Vegetation: *Eucalyptus gomphocephala* Woodland over *Xanthorrhoea preissii*
Shrubland
Condition: Degraded
Soil Type: Orange-brown sand, some surface limestone
Landform: Upper slopes of low rise
Date: 25.9.23
Recorder: Paul van der Moezel



QUADRAT (10 x 10m)

SPECIES	HEIGHT (m)	COVER (%)
<i>Eucalyptus gomphocephala</i>	10	20
<i>Xanthorrhoea preissii</i>	1.5	10
* <i>Ehrharta calycina</i>	1	50
<i>Acacia pulchella</i>	1	2
* <i>Gladiolus caryophyllaceus</i>	0.6	1
<i>Mesomelaena pseudostygia</i>	0.5	<1
<i>Hakea lissocarpha</i>	0.4	1
* <i>Ursinia anthemoides</i>	0.3	2
<i>Acanthocarpus preissii</i>	0.3	1
<i>Jacksonia calcicola</i>	0.3	1
<i>Bossiaea eriocarpa</i>	0.3	<1
<i>Conostylis aculeata</i>	0.3	<1
<i>Banksia dallaneyi</i>	0.2	1
<i>Hakea prostrata</i>	0.2	<1
* <i>Briza maxima</i>	0.2	<1
* <i>Romulea rosea</i>	0.2	<1
<i>Ptilotus polystachyus</i>	0.2	<1

SPECIES	HEIGHT (m)	COVER (%)
<i>*Trifolium campestre</i>	0.1	<1
<i>*Erodium botrys</i>	0.1	<1
<i>*Urospermum picroides</i>	0.1	<1
<i>Schoenus latitans</i>	<0.1	<1
<i>*Hypochaeris glabra</i>	Flat	<1
<i>Hardenbergia comptoniana</i>	Climber	<1

* introduced species

QUADRAT C18

50 380247 E 6500026 N

Vegetation: **Vegetation:** *Corymbia calophylla/Eucalyptus marginata* Low Woodland over

Xanthorrhoea preissii Shrubland

Condition: Degraded

Soil Type: Dark brown sand

Landform: Mid-slope

Date: 25.9.23

Recorder: Paul van der Moezel



Quadrat (10 x 10m)

SPECIES	HEIGHT (m)	COVER (%)
<i>Corymbia calophylla</i>	8	10
<i>Eucalyptus marginata</i>	6	10
<i>Xanthorrhoea preissii</i>	1.2	10
* <i>Ehrharta calycina</i>	1	80
<i>Acacia pulchella</i>	1.1	1
* <i>Gladiolus caryophyllaceus</i>	0.5	<1
<i>Burchardia congesta</i>	0.4	<1
<i>Dianella revoluta</i> var. <i>divaricata</i>	0.4	<1
* <i>Lolium perenne</i>	0.4	1
<i>Hakea lissocarpha</i>	0.4	<1
<i>Morelotia octandra</i>	0.3	<1
* <i>Lupinus cosentinii</i>	0.3	<1
* <i>Romulea rosea</i>	0.2	<1
* <i>Disa bracteata</i>	0.2	<1
* <i>Asparagus asparagoides</i>	Climber	<1

* introduced species

QUADRAT C19

50 380432 E 6499948 N

Vegetation: *Eucalyptus marginata* Low Woodland over *Xanthorrhoea preissii*
Shrubland
Condition: Degraded
Soil Type: Dark brown sand
Landform: Mid slope
Date: 25.9.23
Recorder: Paul van der Moezel



QUADRAT (10 x 10m)

SPECIES	HEIGHT (m)	COVER (%)
<i>Eucalyptus marginata</i>	9	10
<i>Xanthorrhoea preissii</i>	1.5	10
<i>Macrozamia fraseri</i>	1	5
* <i>Ehrharta calycina</i>	0.7	70
<i>Acacia pulchella</i>	0.6	4
<i>Hakea lissocarpha</i>	0.5	<1
* <i>Gladiolus caryophyllaceus</i>	0.5	<1
* <i>Avena fatua</i>	0.3	1
* <i>Lupinus cosentinii</i>	0.3	<1
* <i>Romulea rosea</i>	0.2	5
* <i>Silene gallica</i>	0.2	<1
* <i>Euphorbia terracina</i>	0.1	<1
<i>Hardenbergia comptoniana</i>	Climber	1
* <i>Asparagus asparagoides</i>	Climber	<1

* introduced species

<i>Lomandra maritima</i>	0.3	1
<i>Conostylis aculeata</i>	0.3	1
<i>Acanthocarpus preissii</i>	0.3	<1
<i>Mesomelaena pseudostygia</i>	0.3	<1
* <i>Lysimachia arvensis</i>	0.3	<1
* <i>Lolium perenne</i>	0.3	<1
<i>Desmocladus flexuosus</i>	0.2	1
* <i>Lactuca serriola</i>	0.2	<1
* <i>Petrorhagia dubia</i>	0.2	<1
<i>Tricoryne elatior</i>	0.2	<1
* <i>Ursinia anthemoides</i>	0.1	<1
* <i>Sonchus oleraceus</i>	0.1	<1
<i>Trachymene pilosa</i>	0.1	<1
* <i>Arctotheca calendula</i>	Flat	<1
<i>Comesperma volubile</i>	Climber	<1
<i>Billardiera fraseri</i>	Climber	<1
<i>Drosera menziesii</i> subsp. <i>penicillaris</i>	Climber	<1

* introduced species



Appendix 2 Basic Vertebrate Fauna Survey and Targeted Black Cockatoo Assessment

Basic Vertebrate Fauna Survey and Targeted Black Cockatoo Assessment

Lot 107 Godel Road, Nowergup

Prepared for: Coterra Environment

Version 2. August, 2024



RECORD OF DISTRIBUTION

No. of copies	Report File Name	Report Status	Date	Prepared for:	Initials
Electronic	2024-0042-002-GT V1	DRAFT	15 May 2024	Coterra Environment	GT
Electronic	2024-0042-002-GT V2	DRAFT	3 June 2024	Coterra Environment	GT
Electronic	2024-0042-002-GT V2	FINAL	10 August 2024	Coterra Environment	GT

Suggested Citation: Terrestrial Ecosystems (2024) *Basic Vertebrate Fauna Survey and Targeted Black Cockatoo Assessment for Lot 107 Godel Road, Nowergup*, Unpublished report for Coterra Environment, Perth.

Prepared For: Coterra Environment
Level 1
98 Colin Street
West Perth WA 6005

Prepared By: Terrestrial Ecosystems
10 Houston Place
Mt Claremont WA 6010
Phone: 08 9385 2398, 0407 385 289
Website: www.terrestrialecosystems.com
ABN: 40921131346

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EXECUTIVE SUMMARY

Coterra Environment on behalf of its client, requested a Black-Cockatoo habitat survey and Basic vertebrate fauna assessment of Lot 107 Godel Road, Nowergup (18.8ha; i.e. project area). The project area is situated ~6.5km from the coast and 13km north of the Joondalup CBD area in an area primarily used for agriculture.

The project area supports two fauna habitats: Eucalypts over grass; and low Eucalypt woodland over grasstree shrubland. In addition, there are disturbed areas that are mostly sand tracks through the project area.

Carnaby's Black-Cockatoo was seen foraging in the project area, and it is probable that Forest Red-tailed Black-Cockatoos would also forage in the area. There are 118 significant Black-Cockatoo habitat trees in the project area. Five of these significant trees have a hollow(s) that when assessed from ground level could potentially support a Black-Cockatoo nest. There are no known Black-Cockatoo nests in the project area. The project area provides reasonable Black-Cockatoo foraging habitat.

It is possible that Quenda (priority 4 species with DBCA) is present in the project area and surrounding areas, and cats, foxes and rabbits are also present. It is possible that the Black-Striped Snake (priority 3 species with DBCA) is present in low abundance in the project area.

It is recommended that:

- if the significant Black-Cockatoo habitat trees and foraging habitat are to be cleared, then the proposed action should be referred to the Commonwealth Government under the *EPBC Act*; and
- active management before and during the vegetation clearing program is implemented to mitigate the potential impact on the vertebrate fauna.

1. INTRODUCTION

1.1 BACKGROUND

Terrestrial Ecosystems was commissioned by Coterra Environment to undertake a Black-Cockatoo habitat survey and Basic vertebrate fauna assessment of Lot 107 Godel Road, Nowergup (total 18.8ha; i.e. project area). The project area is situated ~6.5km from the coast and 13km north of the Joondalup CBD area in an area primarily used for agriculture.

1.2 PROJECT OBJECTIVES AND SCOPE OF WORKS

A Basic vertebrate fauna risk assessment and targeted Black-Cockatoo habitat survey was undertaken for the project area. The methodology adopted broadly follows that described in the Environmental Protection Authority's (EPA; 2020) *Technical Guidance – Terrestrial vertebrate fauna surveys for environmental impact assessment*. A Basic fauna assessment involves undertaking a desktop review and reconnaissance site visit, and sometimes it is supported by a targeted survey for conservation significant fauna or in this case a Black-Cockatoo habitat assessment. The objectives of this fauna survey were to:

- provide an indication of the vertebrate fauna assemblage (reptiles, amphibians, mammals and birds) in and near the project area, so that potential impacts on the fauna and fauna assemblage might be adequately assessed;
- undertake a Black-Cockatoo habitat assessment; and
- describe the major vertebrate fauna habitats present.

To achieve these objectives, Terrestrial Ecosystems:

- reviewed Terrestrial Ecosystems' database [includes Atlas of Living Australia and the Western Australian Museum records] to identify potential vertebrate fauna within the area;
- searched the Commonwealth Governments database of fauna of national environmental significance to identify species potentially occurring within the area that are protected under the *Environment Protection and Biodiversity Conservation (EPBC) Act 1999* or international migratory bird agreements (JAMBA/CAMBA);
- undertook a site reconnaissance survey;
- assessed the trees in the project against the Commonwealth Government's (Department of Agriculture Water and the Environment 2022) Black-Cockatoo referral criteria;
- reviewed previous fauna surveys conducted near the project area in similar habitat types; and
- discussed the likelihood of *EPBC Act 1999* and *Biodiversity Conservation (BC) Act 2016* listed species being present in the project area.

2. EXISTING ENVIRONMENT

2.1 LOCATION OF PROJECT AREA

The project area in the Swan Coastal Plain 2 (SWA2) Interim Biogeographic Regionalisation of Australia (IBRA) subregion. This subregion is a low lying coastal plain, once vegetated by Banksia and Tuart on sandy soils, with *Casuarina obesa* on outwash plains and paperbark in swampy areas (Mitchell et al. 2002).

The project area is in an area used for market gardens and agriculture and is east of a string of shallow lakes that run in a north-south direction east of Wanneroo Road.

2.2 LAND USE HISTORY

The dominant land uses in the IBRA subregion are urban, rural residential, industrial, cultivation, forestry plantations, grazing and conservation areas. The greater Perth metropolitan area now extends almost from Mandurah to Alkimos, with towns further north at Yanchep and Two Rocks and east over the Darling Scarp towards Muchea.

In the northern portion of the greater Perth metropolitan region, land clearing is progressively moving in a northerly and easterly direction from the coastal development strip in Jindalee, Bulter, Shorehaven and Alkimos.

The project area is a remnant patch of bushland supporting Banksia, Tuart and Jarrah trees on sandy soils. Review of historical aerial photography indicates that the site was partially cleared prior to 1965 with numerous tracks also historically created within the site (Landgate 2024).

2.3 CLIMATE

The project area is characterised as having a warm Mediterranean climate (Mitchell et al. 2002). Perth Airport, which is ~40km south of the project area, and a similar distance from the coast, has an annual rainfall of ~759mm, although this varies considerably from year-to-year. The highest mean maximum and minimum temperatures in Perth Airport are in January to March (Bureau of Meteorology 2024). The lowest mean daily maximum and minimum temperatures occur in July (Chart 1). Rainfall predominantly occurs between May and August and winter rains result from low pressure cells moving in an easterly direction.

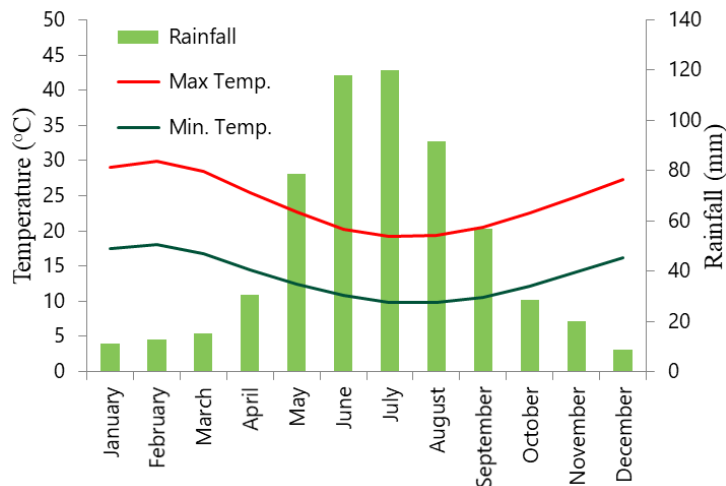


Chart 1. Climatic averages for Perth Airport

2.4 VEGETATION

Botanical surveys undertaken for the project area (PGV Environmental 2014, 2023, EcoEdge Consulting 2024) identify the following vegetation characteristics of the site:

- Vegetation comprises the following:
 - *Eucalyptus gomphocephala* Woodland over *Xanthorrhoea preissii* Shrubland over *Mesomelaena pseudostygia/Phyllanthus calycinus* Open Low Heath (9.77ha)
 - *Eucalyptus marginata* Low Woodland over *Xanthorrhoea preissii* Tall Shrubland (3.83ha)
 - *Corymbia calophylla/Eucalyptus marginata* Low Woodland over *Xanthorrhoea preissii* Shrubland (4.79ha)
- Vegetation condition ranged from Degraded to Completely Degraded (0.53ha).

2.5 REGIONAL BIOLOGICAL FAUNA CONTEXT OF PROJECT AREA

The frogs, reptiles, mammals and birds in the vicinity of the project area have been surveyed for other environmental assessments and research purposes and are therefore known. Fauna surveys and assessments undertaken in the vicinity of the project area that have been reviewed for this assessment include:

- ATA Environmental (2007) *Flora, Vegetation and Vertebrate Fauna Assessment Neerabup Industrial Area (NIA), Neerabup*. Unpublished report for City of Wanneroo, Perth.
- Biota Environmental Sciences (2000) *Lot 52 Burns Beach Road Fauna Survey*. Unpublished report for ATA Environmental, Perth.
- Coffey Environments (2008) *Vertebrate Fauna Assessment, Lot 3 Romeo Road, Alkimos*. Unpublished report for Northern Corridor Developments Limited, Perth.
- Department of Conservation and Land Management (1993) *Fauna Studies in Water Supply Reserve 34537, adjacent to Neerabup National Park*. Unpublished report of Department of Environment and Conservation, Perth.
- Ecoscape (1991) *Biological Survey - Carramar Park*, Unpublished report for City of Wanneroo, Perth.
- GHD (2014) *Neerabup Road Extension Level 2 Fauna Survey*. Unpublished report for Main Roads, Perth.
- GHD (2019) *Mitchell Freeway Extension Hester Avenue to Romeo Road Biological Survey*. Unpublished report for Main Roads WA, Perth.
- Gole, C.A. (2003) *Bird Survey in selected Perth Metropolitan Reserves. A Joint Biodiversity Conservation Project between Birds Australia WA and Perth Biodiversity Project*. Unpublished report Birds Australia and Perth Biodiversity Project, Perth.
- Terrestrial Ecosystems (2012) *Vertebrate fauna relocation outcomes for Trinity*. Unpublished report for Coterra Environment and LWP, Perth.
- Valentine, L.E., Wilson, B.A., Reaveley, A., Huang, N., Johnson, B. and Brown, P. (2009) *Patterns of Ground-dwelling Vertebrate Biodiversity in the Gnanagara Sustainability Strategy Study Area*. Department of Environment and Conservation, Perth.
- Western Australian Museum (1978) *Faunal Studies of the Northern Swan Coastal Plain: A Consideration of Past and Future Changes*. Report for the Department of Conservation and Environment, Perth.

Data in the Atlas of Living Australia database and the Department of Biodiversity, Conservation and Attractions' threatened species database have also been added to the information contained in Appendix E, and the compilation of the species lists for the project area.

2.5.1 Fauna species at risk

Mitchell *et al.* (2002) reported multiple vertebrate fauna species at risk in the subregion. However, some of these species have not been recorded near the project area for many years (e.g. *Myrmecobius fasciatus*, *Pseudocheirus occidentalis*, *Setonix brachyurus*), although, species such as *Zanda latirostris*, *Calyptorhynchus banksii naso*, *Isoodon fusciventer* and *Neelaps calonotos* are still present, and regularly recorded.

3. METHODOLOGY

3.1 DATABASE SEARCHES

A review of the *EPBC* list of protected species was undertaken to identify species of conservation interest to the Commonwealth Government by searching the Commonwealth Government's *EPBC Act* matters of national environmental significance (MNES) online database. In addition, a desktop search of Terrestrial Ecosystems' fauna survey database was used to develop an appreciation of the vertebrate fauna assemblages in relevant sections of the bioregion near the project area.

Other more general texts were also used to provide supplementary information on vertebrate fauna in the bioregion, including Tyler et al. (2000) for frogs; Storr et al. (1983, 1990, 1999, 2002) for reptiles; Johnstone and Storr (1998, 2004) for birds; and Van Dyck and Strahan (2008) for mammals.

Collectively these sources of information were used to create lists of species expected to utilise the project area and broader subregion. It should be noted that these lists will include species that have been recorded in the general region but are possibly vagrants and they will not generally be found in the project area due to a lack of suitable habitat (e.g. shore birds). Vagrants can be recorded almost anywhere. Many of the records are historical and the species is no longer present in the area. Many of the bird, mammal, reptile and amphibian species have specific habitat requirements that may be present in the general area but not in the project area. Also, the ecology of many of these species is often not well understood and it can sometimes be difficult to indicate those species whose specific habitat requirements are not present in the project area. Therefore, many species will be included in the lists produced from database searches but will not be present in the actual project area.

There are errors in most databases, including Atlas of Living Australia and the Western Australian Museum collection. These errors occur because of a misidentification of individuals, taxonomic name changes and incorrect coordinates being entered into the database. Terrestrial Ecosystems was unable to verify the primary records, so it has used the information provided. Obvious errors have been removed but readers should appreciate that species lists and fauna surveys reported in the appendices may include these errors.

3.2 SITE INSPECTION AND FAUNA HABITAT ASSESSMENT

A site visit was undertaken on 11, 12, 15, 17-19 April 2024 to assess fauna habitat types and condition in the project area and to record significant Black-Cockatoo habitat trees. The fauna habitat assessment had two foci:

- assessing fauna habitat types and their condition; and
- assessing the possible presence of and recording evidence of conservation significant fauna.

Simon Pitt, who undertook the fauna habitat assessment, stopped at multiple locations within the project area and recorded a suite of data about the fauna habitat and its condition. This information included a description of the habitat structure, habitat condition, landform, soils and vegetation and time since last fire and is shown in Table 1.

Table 1. Field habitat assessment variables

Observer's Name:	
Coordinates of the location as UTM (GDA94):	
Fire history – options	
<input type="checkbox"/> > 5 years	
<input type="checkbox"/> 1-5 years	
<input type="checkbox"/> < 1 year	
Landform – options	
<input type="checkbox"/> Beach	<input type="checkbox"/> Lower slope
<input type="checkbox"/> Clay plain	<input type="checkbox"/> Mid slope
<input type="checkbox"/> Cliff	<input type="checkbox"/> Ridge
<input type="checkbox"/> Creek line	<input type="checkbox"/> River
<input type="checkbox"/> Dam	<input type="checkbox"/> Rocky outcrop / breakaway
<input type="checkbox"/> Drainage line	<input type="checkbox"/> Salt lake
<input type="checkbox"/> Dune crest	<input type="checkbox"/> Sand dune
<input type="checkbox"/> Dune slope	<input type="checkbox"/> Sand plain
<input type="checkbox"/> Dune swale	<input type="checkbox"/> Stony plain
<input type="checkbox"/> Escarpment	<input type="checkbox"/> Swamp
<input type="checkbox"/> Flat	<input type="checkbox"/> Undulating
<input type="checkbox"/> Gorge	<input type="checkbox"/> Upper slope
<input type="checkbox"/> Gully	<input type="checkbox"/> Wetland
<input type="checkbox"/> Intertidal / mangrove	<input type="checkbox"/> Water hole
<input type="checkbox"/> Lake / lake edge	
Habitat quality – options	
<input type="checkbox"/> <i>High quality fauna habitat</i> – These areas closely approximate the vegetation mix and quality that would have been in the area prior to any disturbance. The habitat has connectivity with other habitats and is likely to contain the most natural vertebrate fauna assemblage.	
<input type="checkbox"/> <i>Very good fauna habitat</i> - These areas show minimal signs of disturbance (e.g. grazing, clearing, fragmentation, weeds) and generally retain many of the characteristics of the habitat if it had not been disturbed. The habitat has connectivity with other habitats and fauna assemblages in these areas are likely to be minimally effected by disturbance.	
<input type="checkbox"/> <i>Good fauna habitat</i> – These areas showed signs of disturbance (e.g. grazing, clearing, fragmentation, weeds) but generally retain many of the characteristics of the habitat if it had not been disturbed. The habitat has connectivity with other habitats and fauna assemblages in these areas are likely to be affected by disturbance.	
<input type="checkbox"/> <i>Disturbed fauna habitat</i> – These areas showed signs of significant disturbance. Many of the trees, shrubs and undergrowth are cleared. These areas may be in the early succession and regeneration stages. Areas may show signs of significant grazing, containing weeds or have been damaged by vehicle or machinery. Habitats are fragmented or have limited connectivity with other fauna habitats. Fauna assemblages in these areas are likely to differ significantly from what might be expected in the area had the disturbance not occurred.	
<input type="checkbox"/> <i>Highly degraded fauna habitat</i> – These areas often have a significant loss of vegetation, an abundance of weeds, and a large number of vehicle tracks or are completely cleared. Limited or no fauna habitat connectivity. Fauna assemblages in these areas are likely to be significantly different to what might have been in the area pre-disturbance.	

Soil Type – options	
<input type="checkbox"/> Sand	<input type="checkbox"/> Silty loam
<input type="checkbox"/> Loamy sand	<input type="checkbox"/> Sand clay loam
<input type="checkbox"/> Clayey sand	<input type="checkbox"/> Clay
<input type="checkbox"/> Clay loam	<input type="checkbox"/> Peat / organic
<input type="checkbox"/> Silty clay loam	<input type="checkbox"/> Stony
<input type="checkbox"/> Sandy loam	
Soil colour - options	
<input type="checkbox"/> Black	<input type="checkbox"/> Red
<input type="checkbox"/> Brown	<input type="checkbox"/> White
<input type="checkbox"/> Grey	<input type="checkbox"/> Yellow
<input type="checkbox"/> Orange	
Surface stones – options	
<input type="checkbox"/> None	<input type="checkbox"/> Boulders (>250mm)
<input type="checkbox"/> Pebbles (0-50mm)	<input type="checkbox"/> Rocks
<input type="checkbox"/> Cobbles (51-250)	

3.3 BLACK-COCKATOO HABITAT ANALYSIS

3.3.1 Habitat tree assessment

The Commonwealth Government’s (Department of Agriculture Water and the Environment 2022) referral guidelines for Black-Cockatoos in the south-west of Australia indicate that significant habitat trees are those trees that have a potential to develop hollow suitable for breeding purposes or already have a hollow(s). Trees considered as significant black-cockatoo habitat trees are therefore Eucalypts that typically have a diameter at breast height (DBH) of at least 50cm. In addition, the guidelines indicate the vegetation that is typically foraged by the three species. Both breeding and foraging opportunities should be considered when determining whether an action should be referred to the Commonwealth Government under the *EPBC Act*.

The following data for all trees with a diameter at breast height (DBH) ≥ 50 cm were recorded:

- the GPS location;
- the diameter at breast height (DBH);
- the tree’s approximate height;
- health of the tree;
- any hollows, the hollow’s entrance estimated from ground level, the hollow’s height above ground and the orientation of the hollow;
- other notable observable features (historical use for breeding/feeding, presence of bees, etc);
- each recorded tree was numbered with a metal tag;
- recorded current use of tree for breeding from ground level;
- recorded evidence of Black-Cockatoos in the project area; and
- investigated evidence of the trees supporting a roosting site.

Appendix A provides additional information on how habitat trees were assessed.

3.3.2 Foraging habitat assessment

The foraging value of the project area was assessed by calculating the Bamford Consulting Ecologists (BCE; 2020) Black-Cockatoo a foraging score for areas that provide a food resource for Black-Cockatoos. This score provides a numerical value to reflect the significance of vegetation as foraging habitat for Black-Cockatoos and was designed to provide the sort of information requested by the federal Department of Climate Change, Energy, the Environment and Water (DCCEEW), the Department of Water and Environmental Regulation (DWER) and WA Environmental Protection Authority (EPA) to assess impact significance and offset requirements.

The BCE scoring system for value of foraging habitat has three components. Calculating the total score (out of 10) requires the following steps:

- Site condition - Determining a score out of six for the vegetation composition, condition and structure; plus
- Site context - Determining a score out of three for the context of the site; plus
- Species stocking rate - Determining a score out of one for species density.

Determining the total score out of 10, which may require moderation for context and species density with respect to the site condition (vegetation) score. Moderation also includes consideration of pine plantations as a special case for foraging value.

3.4 SURVEY AND REPORTING STAFF

Simon Pitt and Stelleena Mackay undertook the site investigation, fauna habitat assessment, significant tree assessment and habitat mapping. Dr Graham Thompson prepared this report and Dr Scott Thompson reviewed the report before it was sent to the client. Both senior scientists have appropriate relevant post-graduate qualifications, extensive experience in conducting fauna assessments on the Swan Coastal Plain, have published research articles on biodiversity, fauna assemblages, conservation significant species, trapping techniques and temporal variations in trapped fauna assemblages and are therefore appropriately trained and experienced for the task of preparing this assessment.

3.5 TAXONOMY AND NOMENCLATURE

Taxonomy and nomenclature for fauna species used in this report are generally based on the WA Museum species list. Terrestrial Ecosystems has presumed that the identifications referred to in the appendices or in reports used to provide local and regional comparative data are correct and we have only corrected obvious records where the nomenclature was known to be incorrect.

3.6 LIMITATIONS

This Basic fauna risk assessment is based on information contained in the Commonwealth Government MNES database and other published and unpublished fauna survey data for the bioregion and a site visit. It is acknowledged that multiple surveys conducted in different seasons, repeated over several years are necessary to fully appreciate the fauna assemblage in the project area.

The EPA's (2020) *Technical Guidance – Terrestrial vertebrate fauna surveys for environmental impact assessment* suggested that fauna surveys may be limited by many variables. Limitations associated with each of these variables are assessed in Table 2.

Table 2. Fauna survey limitations and constraints

Possible limitations	Constraint (yes/no); significant, moderate or negligible	Comment
Availability of data and information	Negligible	There are quantitative vertebrate fauna survey data available for similar habitats near the project area.
Competency/experience of the survey team, including experience in the bioregion surveyed	No	The field zoologists and authors of this report have appropriate qualifications and are suitably experienced to undertake this assessment.
Scope of the survey, e.g. where faunal groups were excluded from the survey	N/A	
Timing, weather and season	No	Weather was suitable for a site survey and assessment.
Disturbance that may have affected results, e.g. fire, flood	No	Disturbances in the project area have been factored into this assessment.
The proportion of fauna identified, recorded or collected	N/A	
Adequacy of the survey intensity and proportion of survey achieved, e.g. the extent to which the area was surveyed	No	Basic and Targeted survey requirements were met.
Access problems	No	The site was accessible.
Problems with data and analysis, including sampling biases	N/A	

N/A = not applicable, Significant = major impact on outcome of the assessment, Moderate = impacted parts of the assessment, Negligible = almost no impact on the assessment.

4. RESULTS

4.1 FAUNA HABITAT

Twenty-six habitat assessments were completed in the project area (Figure 2: Appendix G). There are the following two broad fauna habitats in the project area:

- Eucalypts over grass; and
- Low Eucalypt woodland over grasstree shrubland.

In addition, there are disturbed areas that are mostly sand tracks through the project area.

Most of the project area is in reasonable to good condition, but the fauna are likely to have been impacted over many years by feral cats and foxes. Plates 1-6 provide representative images of the fauna habitat types and the extent of the disturbance.



Plate 1. Eucalypts over grass



Plate 2. Eucalypts over grass



Plate 3. Low Eucalypt woodland over grasstree shrubland



Plate 4. Low Eucalypt woodland over grasstree shrubland



Plate 5. Disturbed area



Plate 6. Disturbed area

4.2 BLACK-COCKATOO HABITAT TREE ASSESSMENT

One hundred and eighteen Black-Cockatoo habitat trees (i.e. Eucalypts with a diameter at breast height at least 50cm) were recorded in the project area. Five of these trees, when assessed from ground level, had a hollow(s) that could potentially support a Black-Cockatoo nest. Details of these trees are provided in Appendix C and their locations mapped in Figure 2. Carnaby’s Black-Cockatoo were seen foraging in the project area (Plates 7 and 8).



Plate 7. Carnaby’s Black-Cockatoo foraging in the project area



Plate 8. Carnaby’s Black-Cockatoo foraging in the project area

4.3 BLACK-COCKATOO FORAGING HABITAT ASSESSMENT

The two broad fauna habitats present within the project area have been assessed for foraging habitat value. There is a significant overlap in the vegetation foraged by Carnaby’s and Forest Red-tailed Black-Cockatoos, so the foraging scoring system has been applied to Black-Cockatoo rather than individual species.

Table 3. Black Cockatoo foraging scores

Fauna Habitat	Site Condition (out of 6)	Site Context (out of 3)	Species Stocking Rate (0 or 1)	Total (out of 10)
Combined sites	4	0	1	5

Comments on the scoring systems Table 3.

Table 4. Comment on the scoring for Table 3

Site Condition (out of 6)	Site Context (out of 3)	Species Stocking Rate (0 or 1)	Moderation
The project area has a large amount of intact foraging vegetation. However, there are no banksias and the understory vegetation has largely been cleared which has allowed grass to grow.	There is at least one known breeding colony within 15km of the site. The amount of intact foraging vegetation within 15km of the project area is approximately 215km ² . The project area is ~19ha, and this represents <0.1% of foraging habitat availability so it scores 0.	Black-Cockatoos were sighted feeding in the project area during fieldwork and there was evidence of regular foraging in the project area.	The project area scored highly for condition, so there is no need to moderate site context or site density.

Based on the above, the project area contains approximately 17ha of Black-Cockatoo foraging habitat with a score of 5.

4.4 OBVIOUS FAUNA IN THE PROJECT AREA

Tracks of foxes (Plate 9) and cats (Plate 10) were observed in the project, along with kangaroo (Plate 11) and rabbit scats (Plate 12) and rabbit burrows (Plates 13-14).



Plate 9. Fox tracks



Plate 10. Cat tracks



Plate 11. Kangaroo scats



Plate 12. Rabbit scats

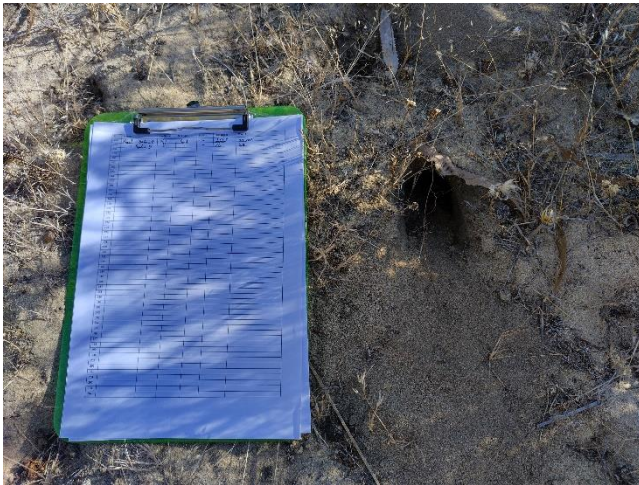


Plate 13. Rabbit burrow



Plate 14. Rabbit burrow entrance

4.5 BIOREGIONAL VERTEBRATE FAUNA ASSEMBLAGE

Appendix E provides a summary of the fauna survey data that are available near the project area. There are appreciable differences in the recorded fauna assemblages within and among fauna surveys shown in Appendix E. These differences are partially due to the low survey effort deployed by some of the surveys and they also reflect variations in soils and vegetation as well as temporal variations in the fauna assemblages.

Tables 6-9 provide a list of vertebrate species potentially found near the project area that have been compiled based on the fauna survey report results shown in Appendix E.

Table 5. Birds potentially found near the project area

Family	Species	Common Name
Casuariidae	<i>Dromaius novaehollandiae</i>	Emu
Anatidae	<i>Cygnus atratus</i>	Black Swan
	<i>Tadorna tadornoides</i>	Australian Shelduck
	<i>Anas superciliosa</i>	Pacific Black Duck
	<i>Biziura lobata</i>	Musk Duck
Phasianidae	<i>Synoicus ypsilophorus</i>	Brown Quail
Columbidae	<i>Columba livia</i>	Rock Pigeon
	<i>Streptopelia chinensis</i>	Spotted Dove
	<i>Streptopelia senegalensis</i>	Laughing Dove
	<i>Phaps chalcoptera</i>	Common Bronzewing
	<i>Phaps elegans</i>	Brush Bronzewing
	<i>Ocyphaps lophotes</i>	Crested Pigeon
Cuculidae	<i>Chrysococcyx basalis</i>	Horsfield's Bronze-Cuckoo
	<i>Chrysococcyx lucidus</i>	Shining Bronze-Cuckoo
	<i>Cacomantis pallidus</i>	Pallid Cuckoo
	<i>Cacomantis flabelliformis</i>	Fan-tailed Cuckoo
Aegothelidae	<i>Aegotheles cristatus</i>	Australian Owlet-nightjar
Podargidae	<i>Podargus strigoides</i>	Tawny Frogmouth
Rallidae	<i>Fulica atra</i>	Eurasian Coot
	<i>Porphyrio melanotus</i>	Australasian Swamphen
Scolopacidae	<i>Calidris acuminata</i>	Sharp-tailed Sandpiper
	<i>Calidris subminuta</i>	Long-toed Stint
Turnicidae	<i>Turnix varius</i>	Painted Buttonquail
Laridae	<i>Chroicocephalus novaehollandiae</i>	Silver Gull
Ardeidae	<i>Egretta novaehollandiae</i>	White-faced Heron
Pelecanidae	<i>Pelecanus conspicillatus</i>	Australian Pelican
Threskiornithidae	<i>Threskiornis molucca</i>	Australian White Ibis
	<i>Threskiornis spinicollis</i>	Straw-necked Ibis
Accipitridae	<i>Elanus axillaris</i>	Black-shouldered Kite
	<i>Hieraetus morphnoides</i>	Little Eagle
	<i>Accipiter fasciatus</i>	Brown Goshawk
	<i>Accipiter cirrocephalus</i>	Collared Sparrowhawk
	<i>Haliastur sphenurus</i>	Whistling Kite
Tytonidae	<i>Tyto alba</i>	Barn Owl
Cuculidae	<i>Heteroscenes pallidus</i>	Pallid Cuckoo
Strigidae	<i>Ninox boobook</i>	Southern Boobook
Strigidae	<i>Ninox novaeseelandiae</i>	Morepork
Alcedinidae	<i>Dacelo novaeguineae</i>	Laughing Kookaburra
Alcedinidae	<i>Todiramphus sanctus</i>	Sacred Kingfisher
Meropidae	<i>Merops ornatus</i>	Rainbow Bee-eater

Family	Species	Common Name
Falconidae	<i>Falco cenchroides</i>	Nankeen Kestrel
	<i>Falco longipennis</i>	Australian Hobby
	<i>Falco berigora</i>	Brown Falcon
	<i>Falco peregrinus</i>	Peregrine Falcon
Cacatuidae	<i>Calyptorhynchus banksii naso</i>	Red-tailed Black-Cockatoo
	<i>Zanda latirostris</i>	Carnaby's Black-Cockatoo
	<i>Eolophus roseicapilla</i>	Galah
	<i>Cacatua pastinator</i>	Western Corella
	<i>Cacatua sanguinea</i>	Little Corella
	<i>Nymphicus hollandicus</i>	Cockatiel
Psittaculidae	<i>Neophema elegans</i>	Elegant Parrot
	<i>Barnardius zonarius</i>	Australian Ringneck
	<i>Purpureicephalus spurius</i>	Red-capped Parrot
	<i>Glossopsitta porphyrocephala</i>	Purple-crowned Lorikeet
	<i>Trichoglossus haematodus</i>	Coconut Lorikeet
Maluridae	<i>Malurus assimilis</i>	Purple-backed Fairywren
	<i>Malurus lamberti</i>	Variegated Fairywren
	<i>Malurus splendens</i>	Splendid Fairywren
	<i>Malurus leucopterus</i>	White-winged Fairywren
Meliphagidae	<i>Acanthorhynchus superciliosus</i>	Western Spinebill
	<i>Manorina flavigula</i>	Yellow-throated Miner
	<i>Anthochaera chrysoptera</i>	Little Wattlebird
	<i>Anthochaera lunulata</i>	Western Wattlebird
	<i>Anthochaera carunculata</i>	Red Wattlebird
	<i>Gavicalis virescens</i>	Singing Honeyeater
	<i>Ptilotula ornata</i>	Yellow-plumed Honeyeater
	<i>Epthianura albifrons</i>	White-fronted Chat
	<i>Gliciphila melanops</i>	Tawny-crowned Honeyeater
	<i>Lichmera indistincta</i>	Brown Honeyeater
	<i>Phylidonyris novaehollandiae</i>	New Holland Honeyeater
	<i>Phylidonyris niger</i>	White-cheeked Honeyeater
	<i>Nesoptilotis leucotis</i>	White-eared Honeyeater
	<i>Melithreptus chloropsis</i>	Gilbert's Honeyeater
	<i>Melithreptus brevirostris</i>	Brown-headed Honeyeater
Pardalotidae	<i>Pardalotus punctatus</i>	Spotted Pardalote
	<i>Pardalotus striatus</i>	Striated Pardalote
Acanthizidae	<i>Sericornis frontalis</i>	White-browed Scrubwren
	<i>Acanthiza inornata</i>	Western Thornbill

Family	Species	Common Name
	<i>Acanthiza apicalis</i>	Inland Thornbill
	<i>Acanthiza chrysorrhoa</i>	Yellow-rumped Thornbill
	<i>Smicrornis brevirostris</i>	Weebill
	<i>Gerygone fusca</i>	Western Gerygone
Campephagidae	<i>Coracina novaehollandiae</i>	Black-faced Cuckooshrike
	<i>Lalage tricolor</i>	White-winged Triller
Neosittidae	<i>Daphoenositta chrysoptera</i>	Varied Sittella
Pachycephalidae	<i>Colluricincla harmonica</i>	Grey Shrikethrush
	<i>Pachycephala pectoralis</i>	Golden Whistler
	<i>Pachycephala occidentalis</i>	Western Whistler
	<i>Pachycephala rufiventris</i>	Rufous Whistler
Artamidae	<i>Artamus cinereus</i>	Black-faced Woodswallow
	<i>Artamus cyanopterus</i>	Dusky Woodswallow
	<i>Cracticus torquatus</i>	Grey Butcherbird
	<i>Cracticus nigrogularis</i>	Pied Butcherbird
	<i>Gymnorhina tibicen</i>	Australian Magpie
	<i>Strepera versicolor</i>	Grey Currawong
Rhipiduridae	<i>Rhipidura leucophrys</i>	Willie Wagtail

Family	Species	Common Name
	<i>Rhipidura albiscapa</i>	Grey Fantail
	<i>Rhipidura fuliginosa</i>	New Zealand Fantail
Monarchidae	<i>Grallina cyanoleuca</i>	Magpie-lark
	<i>Myiagra inquieta</i>	Restless Flycatcher
Corvidae	<i>Corvus coronoides</i>	Australian Raven
Petroicidae	<i>Microeca fascians</i>	Jacky Winter
	<i>Petroica boodang</i>	Scarlet Robin
	<i>Petroica multicolor</i>	Norfolk Robin
	<i>Eopsaltria griseogularis</i>	Western Yellow Robin
	<i>Eopsaltria georgiana</i>	White-breasted Robin
Acrocephalidae	<i>Acrocephalus australis</i>	Australian Reed Warbler
Locustellidae	<i>Poodytes gramineus</i>	Little Grassbird
	<i>Cincloramphus mathewsi</i>	Rufous Songlark
Hirundinidae	<i>Hirundo neoxena</i>	Welcome Swallow
	<i>Petrochelidon nigricans</i>	Tree Martin
	<i>Cheramoeca leucosterna</i>	White-backed Swallow
Zosteropidae	<i>Zosterops lateralis</i>	Silvereye
Dicaeidae	<i>Dicaeum hirundinaceum</i>	Mistletoebird
Motacillidae	<i>Anthus novaeseelandiae</i>	Australasian Pipit

Table 6. Amphibians potentially found near the project area

Family	Species	Common Name
Limnodynastidae	<i>Heleioporus eyrei</i>	Moaning Frog
	<i>Limnodynastes dorsalis</i>	Western Banjo Frog
Myobatrachidae	<i>Crinia georgiana</i>	Quacking Frog
	<i>Crinia insignifera</i>	Sin-bearing Froglet

Family	Species	Common Name
	<i>Myobatrachus gouldii</i>	Turtle Frog
	<i>Pseudophryne guentheri</i>	Gunther's Toadlet
Pelodyridae	<i>Litoria adelaidensis</i>	Slender Tree Frog
	<i>Litoria moorei</i>	Motorbike Frog

Table 7. Mammals potentially found near the project area

Family	Species	Common Name
Tachyglossidae	<i>Tachyglossus aculeatus</i>	Short-beaked Echidna
	<i>Vulpes vulpes</i>	Red Fox
Felidae	<i>Felis catus</i>	Cat
Molossidae	<i>Austronomus australis</i>	White-striped Freetail Bat
Vespertilionidae	<i>Chalinolobus gouldii</i>	Gould's Wattled Bat
	<i>Nyctophilus geoffroyi</i>	Lesser Long-eared Bat
	<i>Vespadelus regulus</i>	Southern Forest Bat
Dasyuridae	<i>Dasyurus geoffroyi</i>	Chuditch
Macropodidae	<i>Macropus fuliginosus</i>	Western Grey Kangaroo

Family	Species	Common Name
	<i>Notamacropus irma</i>	Western Brush Wallaby
Phalangeridae	<i>Trichosurus vulpecula</i>	Common Brushtail Possum
Tarsipedidae	<i>Tarsipes rostratus</i>	Honey Possum
Leporidae	<i>Oryctolagus cuniculus</i>	Rabbit
Peramelidae	<i>Isodon fusciventer</i>	Quenda
Muridae	<i>Mus musculus</i>	House Mouse
	<i>Pseudomys albocinereus</i>	Ash-grey Mouse
	<i>Rattus fuscipes</i>	Bush Rat
	<i>Rattus rattus</i>	Black Rat

Table 8. Reptiles potentially found near the project area

Family	Species	Common Name	
Agamidae	<i>Ctenophorus adelaidensis</i>	Western Heath Dragon	
	<i>Pogona minor</i>	Western Bearded Dragon	
Diplodactylidae	<i>Crenadactylus ocellatus</i>	Clawless Gecko	
	<i>Diplodactylus polyophthalmus</i>	Spotted Sand Plain Gecko	
	<i>Oedura marmorata</i>	Marbled Velvet Gecko	
	<i>Strophurus elderi</i>	Jewelled Gecko	
	<i>Strophurus spinigerus</i>	South-western Spiny-tailed Gecko	
Elapidae	<i>Brachyuropsis semifasciata</i>	Half-girdled Snake	
	<i>Demansia psammophis</i>	Yellow-faced Whipsnake	
	<i>Echiopsis curta</i>	Bardick	
	<i>Naropsis bimaculatus</i>	Black-naped Burrowing Snake	
	<i>Neelaps calonotos</i>	Black-striped Snake	
	<i>Notechis scutatus</i>	Tiger Snake	
	<i>Suta gouldii</i>	Gould's Snake	
	<i>Pseudechis australis</i>	Mulga Snake	
	<i>Pseudonaja affinis</i>	Dugite	
	<i>Pseudonaja mengdeni</i>	Gwardar	
	<i>Simoselaps bertholdi</i>	Jan's Banded Snake	
	Gekkonidae	<i>Christinus marmoratus</i>	Marbled Gecko
	Pygopodidae	<i>Aprasia repens</i>	Southwest Sandplain Worm Lizard
<i>Delma concinna</i>		Javelin Lizard	
<i>Delma fraseri</i>		Fraser's Delma	
<i>Delma grayii</i>		Side-barred Delma	
<i>Lialis burtonis</i>		Burton's Legless Lizard	
<i>Pletholax gracilis</i>		West Coast Keeled Legless Lizard	
	<i>Pygopus lepidopodus</i>	Common Scaly-foot	

Family	Species	Common Name
Pythonidae	<i>Morelia spilota</i>	Carpet Python
Scincidae	<i>Acritoscincus trilineatus</i>	Western Three-lined Skink
	<i>Cryptoblepharus buchananii</i>	Buchanan's Snake-eyed Skink
	<i>Ctenotus australis</i>	Western Limestone Ctenotus
	<i>Ctenotus fallens</i>	West-coast Laterite Ctenotus
	<i>Cyclodomorphus celatus</i>	Western Slender Bluetongue
	<i>Egernia kingii</i>	King's Skink
	<i>Egernia napoleonis</i>	Southwestern Crevice Skink
	<i>Hemiergis initialis</i>	South-western Earless Skink
	<i>Hemiergis quadrilineata</i>	Two-toed Earless Skink
	<i>Lerista distinguenda</i>	South-western Orange-tailed Slider
	<i>Lerista elegans</i>	West Coast Four-toed Lerista
<i>Lerista elongata</i>	Wide-striped Mulch Slider	
<i>Lerista lineopunctulata</i>	Dotted-line Robust Slider	
<i>Lerista praepedita</i>	Blunt-tailed West-coast Slider	
<i>Menetia greyii</i>	Common Dwarf Skink	
<i>Morethia lineoocellata</i>	Pale-flecked Morethia	
<i>Morethia obscura</i>	Shrubland Pale-flecked Morethia	
<i>Tiliqua occipitalis</i>	Western Blue-tongued Lizard	
<i>Tiliqua rugosa</i>	Bobtail	
Typhlopidae	<i>Anilius australis</i>	Austral Blind Snake
	<i>Anilius pinguis</i>	Rotund Blind Snake
Varanidae	<i>Varanus gouldii</i>	Gould's Goanna
	<i>Varanus tristis</i>	Black-headed Monitor
Chelidae	<i>Chelodina oblonga</i>	South-western Snake-necked Turtle

4.6 CONSERVATION SIGNIFICANT FAUNA

Conservation significant fauna are protected by the Commonwealth *EPBC Act 1999*, and this list includes species covered by international treaties such as the Japan-Australia Migratory Bird Agreement (JAMBA) and China-Australia Migratory Bird Agreement (CAMBA) and the Western Australia (WA) *BC Act 2016*. The *BC Act 2016* provides for the publishing of the *Wildlife Conservation (Specially Protected Fauna) Notice* that lists species under multiple categories. In addition, DBCA maintains a list of fauna that require monitoring under four priorities based on the current knowledge of their distribution, abundance and threatening processes. The *EPBC Act 1999* and *BC Act 2016* imply legislative requirements for the management of anthropogenic impacts to minimise the effects of disturbances on species and their habitats. Priority species have no statutory

protection, other than the DBCA's interest in monitoring potential impacts on these species. Avoidance and minimisation of impacts on these species is encouraged. Definitions of the significant fauna under the *BC Act 2016* are provided in Appendix F.

The fauna species that have special status in either State or Commonwealth government legislation or are on the DBCA Priority species list and are potentially present in the vicinity of the project area are listed in Table 9. Although they were recorded in the search of the MNES online database, wetland and shorebirds that typically would be found around the edge of salt lakes, clay pans, estuaries, coastal shores and marshes have been excluded from Table 9 as there is no suitable habitat nearby.

Four threatened species of fauna and one migratory species of birds were identified under the *EPBC Act 1999* and *Biodiversity Conservation Act 2016* as potentially occurring in the project area or surrounds. The following is an assessment of the likelihood of each of the species listed in Table 9 being found in the project area.

Table 9. Assessment of the potential presence of a conservation significant fauna species in the project

Species	DBCA Schedule / Priority	Status under Commonwealth EPBC Act	Comment on the potential presence of a species
Western Ringtail Possum <i>Pseudocheirus occidentalis</i>	Critically Endangered	Critically Endangered	Not previously recorded in the project area and there is no suitable habitat.
Woylie <i>Bettongia penicillata ogilbyi</i>	Critically Endangered	Endangered	Not previously recorded in the project area and there is no suitable habitat.
Black-striped Dwarf Galaxias <i>Galaxiella nigrostriata</i>	Endangered	Endangered	Not previously recorded in the project area and there is no suitable habitat.
Australasian Bittern <i>Botaurus poiciloptilus</i>	Endangered	Endangered	Not previously recorded in the project area and there is no suitable habitat.
Carnaby's Black-Cockatoo <i>Zanda latirostris</i>	Endangered	Endangered	This cockatoo was recorded foraging in the project area.
Baudin's Black-Cockatoo <i>Zanda baudinii</i>	Endangered	Endangered	May infrequently fly over the project area but would be considered a vagrant.
Forest Red-tailed Black-Cockatoo <i>Calyptorhynchus banksii naso</i>	Vulnerable	Vulnerable	This cockatoo potentially forages in the project area.
Malleefowl <i>Leipoa ocellata</i>	Vulnerable	Vulnerable	Locally extinct from the area.
Chuditch <i>Dasyurus geoffroii</i>	Vulnerable	Vulnerable	Not recently recorded in the project area and there is no suitable habitat.
Fork-tailed Swift <i>Apus pacificus</i>	Migratory	Migratory	May infrequently be seen flying in the region.
Grey Wagtail <i>Motacilla cinerea</i>	Migratory	Migratory	Highly unlikely to be seen in the project area.
Quenda <i>Isodon fusciventer</i>	P3		Potentially in the project area.
Black-striped Snake <i>Neelaps calonotos</i>	P4		Potentially in the project area.
Peregrine Falcon <i>Falco peregrinus</i>	OS*		May very infrequently be seen in the project area.

*OS - Other specially protected fauna

Results of the Commonwealth *EPBC Act 1999* protected matters database search are provided in Appendix B.

Western Ringtail Possum (*Pseudocheirus occidentalis*) - Critically endangered under the *BC Act 2016* and endangered under the *EPBC Act 1999*

The Western Ringtail Possum is found on the southern Swan Coastal Plain dominated by Peppermint woodlands from Dawesville to Albany, with some patchy inland populations in the Upper Warren and Manjimup area, around Walpole, Denmark and in other State Forests (Department of Parks and Wildlife 2017).

Its diurnal retreats including dreys, platforms, tree hollows, hollow logs, balga (*Xanthorrhoea* spp.) skirts, under sedges, forest debris and disused rabbit warrens (Department of Parks and Wildlife 2017). Dreys range from rough platforms to more elaborate roughly spherical arboreal nests constructed from vegetation and are generally built where hollows are absent.

Western Ringtail Possum has not been recorded north of the Swan River for many decades and is not likely to be present in the project area.

Woylie (*Bettongia penicillata*) – Critically endangered under the *BC Act 2016* and endangered under the *EPBC Act 1999*

The Brush-tailed Bettong or Woylie is a small (1-1.6kg) mammal that has a preference for open forests and woodlands, with clumped low understorey of tussock grasses or clumped low woody scrub (Christensen 2000). Woinarski et al. (2014) reported a population reduction of greater than 90% in the last 10 years.

The Woylie has not been recorded near the project area for many years, so it is not considered likely to be present in the project area.

Black-striped Dwarf Galaxias (*Galaxiella nigrostriata*) - Endangered under the *BC Act 2016* and endangered under the *EPBC Act 1999*

The Black-striped Dwarf Galaxia is a small (maximum 48mm TL), scaleless freshwater fish. It is characterised by two black longitudinal bands separated with a yellow/orange to red stripe. This species is restricted to ephemeral peat wetlands of the south-west of WA, with two localities nearer the project area – Melaleuca Park and Lake Chandala (Threatened Species Scientific Committee 2018).

As there is no permanent freshwater in the project area, so the Black-striped Dwarf Galaxia is not present.

Australasian Bittern (*Botaurus poiciloptilus*) – Endangered under the *BC Act 2016* and *EPBC Act 1999*

The Australasian Bittern has a distribution from Moora through much of the south-west and east to Mt Arid; however, it is rarely recorded. It is almost always found in dense *Typha*, *Baumea* and sedges in freshwater or brackish swamps (Johnstone and Storr 1998). Garnett *et al.* (2011) reported its population across Australia as less than 2,000 and in decline. Most of the Western Australian records come from Lake Muir.

There is no suitable habitat for the Australasian Bittern in the project area.

Carnaby's Black-Cockatoo (*Zanda latirostris*) - Endangered under the *BC Act 2016* and *EPBC Act 1999*

Carnaby's Black-Cockatoo (*Zanda latirostris*) is a large, pied, cockatoo. Garnett *et al.* (2011) and the DSEWPac (2011) reported that Carnaby's Black-Cockatoo inhabits the south-west of Western Australia, from Kalbarri to as east on the south coast as Esperance. It breeds inland and moves to the coastal areas when chicks have fledged (Saunders et al. 1985). Carnaby's Black-Cockatoos are highly gregarious, usually seen in trios, small parties or large flocks (up to 5000 birds)(Perry 1948). These flocks usually contain males, females and immature birds.

Carnaby's Black-Cockatoos are partly migratory and partly sedentary (Higgins 1999). In the drier regions of their geographic range where most of the native vegetation has been cleared (e.g. wheatbelt), Carnaby's Black-Cockatoos are postnuptial migrants (Saunders 1980, Saunders and Ingram 1995). After breeding, individuals in these areas migrate to feed in higher rainfall areas including the Swan Coastal Plain, and to a lesser extent,

forests dominated by *E. marginata* (Jarrah), *C. calophylla* (Marri) and *E. diversicolor* (Karri; Saunders 1980). On the Swan Coastal Plain, Carnaby's Black-Cockatoos have been recorded foraging in most suburbs and in pine plantations within the greater Perth metropolitan area (Perry 1948). Vagrants have been recorded on Rottnest Island (Winnett 1989) and Garden Island (Wykes et al. 1999). These later two sightings clearly indicate that Carnaby's Black-Cockatoo will fly considerable distances over non-vegetated areas to forage.

Garnett *et al.* (2011) estimated there were between 10,000 and 60,000 birds in the population. Data presented by Saunders (1980) suggest that Carnaby's Black-Cockatoo move from areas where there is little food to southern and western coastal areas where food is presumably more plentiful during summer and autumn (Davies 1966, Saunders 1980).

Carnaby's Black-Cockatoo breed between July and November mostly in eucalypt woodland (Saunders 1980, 1986). Carnaby's Black-Cockatoo nest in tree hollows that are created by fire, fungi, termites or old age, with hollows between 2.5 and 12m above the ground (Saunders 1979, Higgins 1999). Hollows are large, ranging from 10 to over 250cm in depth (Higgins 1999). These hollows are usually in live or dead smooth-barked *Eucalyptus salmonophloia* (Salmon Gum) or *Eucalyptus wandoo* (Wandoo). However, Carnaby's Black-Cockatoo will also nest in *E. longicornis* (Red Morrell), *E. loxophleba* (York Gum), *E. gomphocephala* (Tuart), *E. rudis* (Flooded Gum), *E. salubris* (Gimlet), *E. occidentalis* (Swamp Yate) and *C. calophylla* (Higgins 1999, Cale 2003). When breeding, they most often forage in the surrounding shrubland and kwongan heath (Higgins 1999). On the Swan Coastal Plain, breeding could occur in *E. gomphocephala*, *E. rudis*, *E. occidentalis* and *C. calophylla*. Adults return to the same breeding area each year (Saunders 1977) and some use the same tree hollow for many years in succession to raise their chicks, others shift their nests among a number of trees in the same area (Saunders and Ingram 1998).

Foraging habitat of Carnaby's Black-Cockatoo has been reported to include woodlands dominated by *Eucalyptus*, particularly *E. wandoo* and *E. salmonophloia* and often in shrubland or kwongan heathland dominated by *Hakea*, *Dryandra*, *Banksia* and *Grevillea* and seasonally in *Pinus* plantations and less often in *C. calophylla*, *E. diversicolor* or *E. marginata* (Saunders 1980, Higgins 1999).

The project area has an abundance of Black-Cockatoo foraging plants, and Carnaby's Black-Cockatoo was observed foraging in the project area during the site visit. The extent of foraging habitat onsite is estimated to be approximately 17ha.

There are 118 significant habitat trees in the project area. Five of these trees had one or more hollows, when assessed from the ground level, which could potentially support a Black-Cockatoo nest, although there were no active nests recorded during the site assessment. DBCA mapping indicates that the closest known breeding site to the project area is ~26km to the east.

Peck et al.'s (2019) Great Cocky Count records indicate that there is one white-tailed Black-Cockatoo roost site within 5km of the project area. The closest confirmed Carnaby's Black Cockatoo nesting site is ~15km south of the project area in the Edith Cowan Joondalup Campus.

Baudin's Black-Cockatoo (*Zanda baudinii*) - Endangered under the *BC Act 2016* and *EPBC Act 1999*

Baudin's Black-Cockatoo occurs in the humid and sub-humid forests of Western Australia, an area within the 750mm isohyet (Chapman 2007). Its range extends from Gidgegannup and Clackline in the north to about 50km east of Albany and all the forest to the south-west coast (Chapman 2007).

Baudin's Black-Cockatoo is typically found in vagrant flocks and utilises the taller, more open *E. marginata*, *C. calophylla* and *E. diversicolor* forests, where it feeds mainly on *C. calophylla* seeds and various Proteaceous species. Johnstone and Kirkby (2008) reported Baudin's Black-Cockatoo feeding on the seeds of *C. calophylla*, *E. marginata*, *A. fraseriana*, *Banksia grandis*, *B. quercifolia*, *B. littoralis*, *B. ilicifolia*, *Hakea erinacea*, *H. prostrata*, *H. stenocarpa*, *H. trifurcata*, *H. lasianthoides*, *H. ruscifolia*, *H. lissocarpa*, *H. varia*, *H. cristata*, *H. marginata*, *Dryandra sessilis*, *D. squarrosa*, *D. praemorsa*, *Grevillea wilsonii*, *Xanthorrhoea preissii*, *Kingia australis*, *Reedia spathacea*, *Pinus radiata*, *Erodium* spp., *Jacaranda* spp., *Macadamia* spp., *Carya illinoensis*, *Malus* spp., *Pyrus* spp., *Diospyros* spp. and *Quercus* spp.; and the nectar, buds and flowers of *C. calophylla*, *C. citridora*, *E.*

marginata, *E. wandoo*, *B. grandis*, *D. sessilis*, *D. lindleyana*, *D. squarrosa*, *Darwinia citriodora* and *Callistemon* spp. They also eat insect larvae and insects from under the bark.

Johnstone and Kirkby (2008) suggested that once chicks had fledged, birds leave the nesting area and family groups amalgamate to form larger flocks. These large flocks arrive in the non-breeding central and northern parts of the Darling Scarp in early February and March. This postnuptial nomad is seen in Collie, Bannister, North Dandalup, Serpentine, Jarrahdale, Wungong, Mundaring and Chidlow, and sometimes venture on to the adjacent coastal plain at Maida Vale, Kelmscott, Armadale, Byford, Mundijong, Lake Clifton, Bunbury, Capel, Busselton and Dunsborough (Johnstone and Kirkby 2008, Johnstone et al. 2011). During the non-breeding period, Baudin's Black-Cockatoo utilises a number of roosts on a regular basis. Johnstone and Kirkby (2008) have recorded some of the larger roosts at Gidgegannup, Piesse Brook, Nganguring and Mundaring,. Other roosts are at Chidlow, Parkerville, Kalamunda, Kelmscott, Roleystone, Bedfordale, Gleneagle, Mundijong, Jarrahdale, Bannister and Crossman. Most of these roost sites are tall emergent eucalypts or Blackbutt and they are often near watercourses and in sheltered gullies. They seldom venture as far west as the project area.

The species is known to breed in the southern forests north to Collie and east to near Kojonup in large vertical hollows of *E. diversicolor*, *C. calophylla* and *E. wandoo* (Johnstone and Kirkby 2008). Johnstone and Storr (1998) reported eggs are laid in August to December, with a clutch of 1-2, but normally only a single chick is fledged. Only the female incubates and broods.

Garnett et al. (2011) estimated the population to be around 10,00-15,000, with only 10% breeding in any year.

Garnett et al. (2011) reported the primary threat to this species is a lack of suitable hollows. Competition for hollows comes from other cockatoos, Galahs, Australian Shelducks, Wood Ducks and feral Honey Bees (Johnstone and Kirkby 2008, Garnett et al. 2011). Inadequate feeding resources in the vicinity of nesting hollows to enable adults to feed chicks are also a threat.

It is unlikely that Baudin's Black-Cockatoo will forage this far west of the Darling Range, although they are occasionally mixed in with a flock of Carnaby's Black-Cockatoos, so any individuals recorded in the project area are likely to be vagrants. There are 118 significant habitat trees in the project area. Five of these trees had one or more hollows, when assessed from the ground level, which could potentially support a Black-Cockatoo nest, although breeding by this species is not known to occur in this location.

Forest Red-tailed Black-Cockatoo (*Calyptorhynchus banksii naso*) - Vulnerable under the *BC Act 2016* and *EPBC Act 1999*

The Forest Red-tailed Black-Cockatoo is one of three large black-cockatoos found in Western Australia. *Calyptorhynchus banksii naso* frequents the humid to sub-humid south-west of Western Australia from Gingin in the north, to Albany in the south and west to Cape Leeuwin and Bunbury (Department of Sustainability Environment Water Population and Communities 2011). It was mostly seen in the hills, but small numbers of birds were seen at Mundijong, Baldivis, Karnup, Stakehill, Pinjarra, Coolup and in the Lake Clifton area (Johnstone et al. 2011). In 2011, there was an increase in the number of Forest Red-tailed Black-Cockatoo on the coastal strip north from Rockingham to the northern metropolitan suburbs. The reason for the recent increase in abundance is unknown.

Forest Red-tailed Black-Cockatoo nest hollows have been recorded between 6.5 and 33m above the ground, with entrance sizes ranging from 10 x 12cm to 44 x 150cm and a depth of 0.3-8.2m (Johnstone et al. 2013a, b). Breeding occurs in all months, but peaks in April-June and August-October with an incubation period of 29-31 days. A female broods her hatchling for the first 3-10 days after hatching and then leaves the nest each day at dawn and returns to feed the chick at dusk. Hatchlings are fully feathered at about 48 days. The majority of nests are in Marri, but they have also been recorded in Jarrah, Blackbutt, Bullich and Wandoo. Nest sites are often clustered in an area.

Johnstone et al., (2011) reported the Forest Red-tailed Black-Cockatoo to feed mostly on seeds from *C. calophylla*, *E. marginata*, but also on *Allocasuarina fraseriana* (Sheoak), *Persoonia longifolia* (Snottygobble),

Eucalyptus patens (Blackbutt) and introduced species such as *M. azedarach* (Cape Lilac) and *Corymbia citriodora* (Lemon-scented Gum).

The Forest Red-tailed Black-Cockatoo is likely to be recorded in the project area, given that potential foraging plant species that are present.

There are 118 significant habitat trees in the project area. Five of these trees have had one or more hollows, when assessed from the ground level, which could potentially support a Black-Cockatoo nest. However, there were no active nests recorded during the site survey. The closest confirmed Forest Red-tailed Black Cockatoo nesting site is ~50km south of the project area in the Murdoch University Campus.

Peck et al.'s (2019) Great Cockey Count did not record Red-tailed Black-Cockatoos roosting sites near the project area. The closest Forest Red-tailed Black Cockatoo confirmed roosting site is ~10km south of the project area in Wanneroo.

Malleefowl (*Leipoa ocellata*) – Vulnerable under the *BC Act 2016* and *EPBC Act 1999*

Malleefowl are large, ground-dwelling birds that rarely fly unless alarmed or are perching for the night. Historically, Malleefowl have been found in mallee regions of southern Australia from approximately the 26th parallel of latitude southwards. Prior to vegetation clearing for agriculture, Malleefowl were abundant in the WA Wheatbelt. Vegetation clearing for agriculture also opened adjacent bushland to predators, and in the south-west of WA, Malleefowl often only persist in isolated remnant patches of native vegetation. Sheep and other herbivores (e.g. goats, kangaroos) grazing in remnant vegetation removes or thins the undergrowth, and they also compete with Malleefowl for herbaceous foods and can cause changes to the structure and floristic diversity of foraging habitats (Benshemesh 2007).

Malleefowl and their eggs are vulnerable to predation by foxes, and newly hatched chicks are vulnerable to foxes, cats and raptors (Priddel and Wheeler 1990, 1997, Benshemesh and Burton 1999, Benshemesh 2007, Lewis and Hines 2014). Malleefowl are no longer present on the Swan Coastal Plain. Their remaining abundance in the Midwest and Goldfields is low and they are sparsely distributed, favouring those areas that are more densely vegetated. Malleefowl build distinctive nests that comprise a large mound of soil/rock covering a central core of leaf litter. These nest mounds range in diameter but can span more than five metres and may be up to one metre high. Malleefowl are generally monogamous and once breeding commences, they pair for life. The presence of nest mounds provides an indication of the presence of Malleefowl in the area.

Malleefowl has not been observed in the bioregion for many decades and the species is not expected to be present in or near the project area.

Chuditch (*Dasyurus geoffroii*) – Vulnerable under the *BC Act 2016* and *EPBC Act 1999*

The Chuditch is the largest extant carnivorous marsupial in WA. It is usually active from dusk to dawn. Formally known from over 70% of Australia, the Chuditch now has a patchy distribution throughout the Jarrah forest and mixed Karri/Marri/Jarrah forest of south-west WA and other isolated areas. Chuditch are solitary animals for most of their life and den in hollow logs, burrows, culverts, etc. and have also been recorded in tree hollows and rock cavities. Chuditch are opportunistic feeders, and forage primarily on the ground at night. Their diet can include other mammals, birds, lizards, bird and reptile eggs but the majority is a mixture of large invertebrates (e.g. spiders, scorpions and crickets).

Chuditch have not been recorded in or near the project area for many years, so it is highly unlikely to be present.

Fork-tailed Swift (*Apus pacificus*) - Migratory species under the *EPBC Act 1999* and *BC Act 2016*

This species breeds in the northeast and mid-east Asia and winters in Australia and southern New Guinea. It is a visitor to most parts of Western Australia, beginning to arrive in the Kimberley in late September, in the Pilbara in November and in the southwest land division in mid-December, and leaving by late April. The Fork-

tailed Swift is an almost exclusively aerial species, foraging and sleeping on the wing. It rarely comes to ground, usually only for breeding. It is common in the Kimberley, uncommon to moderately common near northwest, west and southeast coasts and rare to scarce elsewhere.

Terrestrial Ecosystems' assessment is that the Fork-tailed Swift may very infrequently be seen flying over the project area, however, the Fork-tailed Swift is essentially an aerial species and would be highly unlikely to land in the project area.

Grey Wagtail (*Motacilla cinerea*) - Migratory species under the *EPBC Act 1999* and *BC Act 2016*

The Grey Wagtail is a small yellow breasted bird with a grey back and head. Johnstone and Storr (2004) reported this migratory species as breeding in Palearctic from western Europe and north-west Africa to eastern Asia and wintering in Africa, south-east Asia, Indonesia, the Philippines, New Guinea and Australia. Its preferred habitat in Australia is banks and rocks in fast-running fresh water including rivers, streams and creeks where it feeds on insects. The Atlas of Living Australia records two sightings on the south-coast of Western Australia and none around the project area.

It is highly unlikely to be seen in the project area due to a lack of records and suitable habitat.

Quenda (*Isodon fusciventer*) – Priority 4 species with the DBCA

Quenda prefer dense scrub (up to one metre high), often in swampy vegetation but they are found in a variety of other habitats. They will often feed in adjacent forest and woodland that is open grassland, pasture and crop land lying close to dense cover. This ground dwelling medium-sized mammal is found throughout the greater Perth metropolitan area, and in the south-west of WA.

There is suitable habitat in the project area and surrounds to support Quenda, so it is potentially present.

Black-striped Snake (*Neelaps calonotos*) – Priority 3 with DBCA

The Black-striped Snake occurs on dunes and sand-plains vegetated with heaths and eucalypt/banksia woodlands. It feeds largely on skinks and its distribution is restricted and threatened by urban development. In its natural undisturbed state. The Atlas of Living Australia has records of this snake around the project area, so it is feasible that they were in the project area and suitable habitat is present.

Peregrine Falcon (*Falco peregrinus*) – Other specially protected fauna under the *BC Act 2016*

The Peregrine Falcon is uncommon, although widespread throughout much of Australia excluding the extremely dry areas and has a wide and patchy distribution. It favours hilly or mountainous country and open woodlands and may be an occasional visitor to the project area. Nesting sites include ledges along cliffs, granite outcrops and quarries, hollow trees near wetlands and old nests of other large bird species. There is no evidence to suggest any change in status in the last 50 years.

The Atlas of Living Australia contains records of this species around the project area, so it is possible that they are infrequently seen in the project area. The Peregrine Falcon will not rely on this site for continued survival in the region.

5. DISCUSSION

5.1 ADEQUACY OF THE FAUNA SURVEY DATA FOR FAUNA HABITATS REPRESENTED IN THE PROJECT AREA

Detailed vertebrate fauna surveys are rarely undertaken on the Swan Coastal Plain as the vertebrate fauna in this IBRA subregion is relatively well known. Even if such a survey was undertaken, it is unlikely to provide new species, in particular a conservation significant species that has not previously been identified for this area that would alter the assessment of potential impacts.

5.2 AMPHIBIANS

Amphibians typically found on the Swan Coastal Plain are listed in Table 6. The lack of permanent freshwater in the project area means that only those species able to survive away from permanent water on very porous sandy soil (e.g. potentially *Heleioporus eyrei*, *Limnodynastes dorsalis* and *Myobatrachus gouldii*) are potentially present in the project area.

Given the project area has a substantial amount of relatively undisturbed native vegetation a small number of amphibians could be present in the project area and would only come to the surface after heavy rain. None of these species are of conservation significance.

5.3 REPTILES

Reptile species found in the vicinity of the project area are shown in Table 8. Reptile species richness in the project area will have been reduced by the presence of foxes and feral cats over many decades, however, there still could be 10-15 species present. Many of the commonly recorded reptiles on the Swan Coastal Plain are potentially present in the project area [e.g. Bobtails (*Tiliqua rugosa*), Dugites (*Pseudonaja affinis*), Western Spiny-tailed Gecko (*Strophurus spinigerus*), Fence Skinks (*Cryptoblepharus buchanani*), Western Limestone Ctenotus (*Ctenotus australis*), Common Dwarf Skink (*Menetia greyii*)].

The project area provides suitable habitat for the Black-striped Snake (*Neelaps calonotos*; Priority 3), so it is potentially present albeit in low numbers.

5.4 BIRDS

Avian species richness on the Swan Coastal Plain are influenced by rainfall, urban disturbance and vegetation clearing. The list provided in Table 5 represents species likely to be found over a large area of diverse habitat types. Jarrah, Tuart and Banksia woodlands were once widespread on the northern Swan Coastal Plain, so there are many species that could be present.

Carnaby's Black-Cockatoo was recorded foraging in the project area and the Forest Red-tailed Black-Cockatoo could also forage in the project area. There are five trees with hollows that were assessed from ground level, that potentially have one or more hollows that could provide a nesting site for Black-Cockatoos. The Peregrine Falcon is very occasionally recorded in the region, but it has a large home range, and would not be significantly impacted by vegetation clearing.

5.5 MAMMALS

It is possible that Quenda are present in the sections of dense vegetation in the project area. The project area is part of a larger area of similar vegetation, which almost certainly supports Quenda. The abundance of Quenda in the project area is likely to be largely determined by the abundance of foxes and the extent to which

the denser ground vegetation disappear at the end of summer, as this reduces the available protection for this species.

Evidence of foxes, feral cats and rabbits were recorded in the project area.

5.6 BIODIVERSITY VALUE

From a fauna perspective, the project area is Jarrah, Tuart and Banksia woodland, and therefore would support a vertebrate fauna assemblage that occurs on large section of the Swan Coastal Plain. However, the project area has been subject to the presence of foxes and cats over decades, with the consequence that the vertebrate fauna assemblage has been depleted, however, it will still contain a reasonable fauna assemblage.

In addition, fauna habitat on the northern Swan Coastal Plain has been cleared over many years for agriculture, housing and industrial developments, and pristine, relatively large remnant sites are now rare in the urban and peri-urban area, so loss of this type of habitat should be considered in the context of cumulative impacts.

5.6.1 Ecological functional value at the ecosystem level

Although the project area does not support a near-natural functional ecosystem, it will contain the remnants of the vertebrate fauna assemblage found in Jarrah, Tuart and Banksia woodlands on the northern Swan Coastal Plain.

5.6.2 Maintenance of threatened ecological communities

No threatened ecological fauna communities were identified in the project area.

5.6.3 Condition of fauna habitat

Fauna habitats present in the project area have been disturbed. There are multiple cleared tracks, and it is likely that parts of the vegetation have been removed, and foxes and cats will have been in the area for decades. The available habitat will support a depleted fauna assemblage, compared with what once existed.

5.6.4 Ecological linkages

The project area does not provide an important ecological linkage or fauna movement corridor.

5.6.5 Size and scale of the proposed disturbance

The assessed project area is ~18.8ha in an IBRA region where much of the similar fauna habitat has already been cleared for agriculture or other forms of land development, so as clearing of the vegetation continues, the remaining remnants becomes more important.

6. POTENTIAL ENVIRONMENTAL IMPACTS

Vegetation clearing in the project area, will remove the vertebrate fauna assemblage from the project area. All small terrestrial vertebrate fauna, without an active management/relocation program, will be lost. Birds, and larger vertebrates (large snakes and kangaroos) will move to adjacent areas. Cumulative impacts require consideration in an environmental impact assessment context.

6.1 CONSERVATION SIGNIFICANT SPECIES

There is a low possibility that some Quenda (Priority 4 species) are in the project area. Many of these mammals will move to adjacent areas once vegetation clearing commences, but some will be lost without active management/fauna relocation.

Although it is improbable that Carnaby's or Forest Red-tailed Black-Cockatoos would be injured or killed in the vegetation clearing program, there will be a loss of foraging habitat, and significant trees, that may in the distant future provide nesting sites for these birds should appropriately sized hollows form.

The Black-Striped Snake (Priority 3 species) is potentially in the project area in low abundance. If it is present, then it is likely to be present in similar habitat in adjacent areas. It would almost certainly be lost during vegetation clearing without active management.

7. VERTEBRATE FAUNA RISK ASSESSMENT

7.1 RISK ASSESSMENT

Fauna surveys to support Environmental Impact Assessments (EIA) are part of the environmental risk assessment undertaken to consider what potential impacts a development might have on the biodiversity on a particular area and region. Potential impacts on fauna from the proposed development are identified and briefly described above. Tables 10, 11 and 12 provide a summary of the risk assessment associated with this project.

Any risk assessment is a product of the likelihood of an impact occurring and the consequences of that impact. Likelihood and consequences are categorised and described below. The assessed risk level (likelihood x consequences) is then calculated as the overall risk for the development. This is followed by an assessment of the acceptability of the risk associated with each of the impacts. Disturbances and vegetation clearing have an impact on the fauna at multiple scales – site, local, landscape and regional. Each of these is considered in the risk assessment. This assessment should be considered in the context of the summary in Table 12.

Table 10. Fauna impact risk assessment descriptors

Likelihood		
Level	Description	Criteria
A	Rare	The environmental event may occur, or one or more conservation significant species may be present in exceptional circumstances.
B	Unlikely	The environmental event could occur, or one or more conservation significant species could be present at some time.
C	Moderate	The environmental event should occur, or one or more conservation significant species should be present at some time.
D	Likely	The environmental event will probably occur, or one or more conservation significant species will be present in most circumstances.
E	Almost certain	The environmental event is expected to occur, or one or more conservation significant species is expected to be present in most circumstances.
Consequences		
Level	Description	Criteria
1	Insignificant	Insignificant impact on fauna of conservation significance or regional biodiversity, and the loss of individuals will be insignificant in the context of the availability of similar fauna or fauna assemblages in the area.
2	Minor	Impact on fauna localised and no significant impact on species of conservation significance in the project area. Loss of species at the local scale.
3	Moderate	An appreciable loss of fauna in a regional context or a limited impact on species of conservation significance in the project area.
4	Major	Significant impact on conservation significant fauna or their habitat in the project area and/or regional biodiversity and/or a significant loss in the biodiversity at the landscape scale.
5	Catastrophic	Loss of species at the regional scale and/or a significant loss of species categorised as 'vulnerable' or 'endangered' under the <i>EPBC Act (1999)</i> at a regional scale.
Acceptability of risk		
Level of risk	Management Action Required	
Low	No action required.	
Moderate	Avoid if possible, routine management with internal audit and review of monitoring results annually.	
High	Externally approved management plan to reduce risks, monitor major risks annually with external audit and review of management plan outcomes annually. May a referral to the Commonwealth under the <i>EPBC Act 1999</i> .	
Extreme	Unacceptable, project should be redesigned or not proceed.	

Table 11. Risk assessment matrix

		Likelihood				
		Rare or very low (A)	Unlikely or low (B)	Moderate (C)	Likely (D)	Almost certain (E)
Consequences	Insignificant (1)	Low	Low	Low	Low	Low
	Minor (2)	Low	Low	Low	Moderate	Moderate
	Moderate (3)	Low	Moderate	Moderate	High	High
	Major (4)	Moderate	Moderate	High	High	Extreme
	Catastrophic (5)	Moderate	High	High	Extreme	Extreme

Table 12. Assessed risk of potential impacts on the vertebrate fauna assemblage

			Before management			Management	With management		
			Inherent risk				Residual risk		
Factors	Potential impacts		Likelihood	Consequence	Significance		Likelihood	Consequence	Significance
Fauna survey data	Inadequate survey data to adequately assess the risks	Unknown loss of fauna, fauna of conservation significance, and fauna assemblages, and an incomplete fauna assessment.	B	2	Low				
	Inadequacy of comparative data	Limits on the availability of comparative data reduced the capacity to assess the uniqueness of the fauna assemblages in the project area.	B	2	Low				
Clearing vegetation	Loss of fauna habitat – local scale	Loss of terrestrial fauna in the project area.	E	1	Low				
	Loss of fauna habitat – landscape scale	Loss of some fauna during vegetation clearing.	A	1	Low				
	Loss of fauna habitat – regional scale	Small loss of some fauna from the region.	A	1	Low				
	Loss of a threatened ecological fauna community	Loss of an undetected threatened ecological fauna community.	A	3	Low				
	Habitat fragmentation	Fauna movement restricted resulting in the death of fauna and a loss of biodiversity.	A	2	Low				
	Loss of a unique terrestrial fauna ecosystem	Loss of an ecosystem containing fauna with high species richness, high abundance and numerous top of the food chain predators.	A	2	Low				

			Before management			Management	With management		
Death or loss of conservation significant fauna	Carnaby's Black-Cockatoo	Death or reduced viability of Carnaby's Black-Cockatoo.	B	3	Mod				
	Forest Red-tailed Black-Cockatoo	Death or reduced viability of Forest Red-tailed Black-Cockatoos.	B	3	Mod				
	Quenda	Death or the reduced viability of Quenda.	C	2	Low				
	Black-striped Snake	Death or the reduced viability of Black-striped Snake.	C	2	Low				
Human impacts	Spread of weeds	Changed vegetation and a resulting loss of fauna habitat.	B	2	Low				

7.2 NATIVE VEGETATION CLEARING PRINCIPLES AS THEY PERTAIN TO VERTEBRATE FAUNA

The *Environmental Protection Act (1986)* outlines 10 principles that are to be used in the assessment of native vegetation clearing permit applications which are also applicable for other assessments and approvals (Table 13). Where possible, native vegetation should not be cleared if any of the following principles are compromised.

Table 13. Assessment of impact using the native vegetation clearing principles

Principle	Response
It comprises a high level of biological diversity.	Clearing vegetation will not compromise a high level of biodiversity. Carnaby's Black-Cockatoo was recorded foraging in the project area, and it is likely that the Forest Red-tailed Black-Cockatoo also forages in the area. The project area could support a small population of Quenda, and a smaller population of the Black-striped Snake, both of which are likely to be found in similar habitat in adjacent areas.
It comprises the whole or a part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to Western Australia.	Clearing the vegetation will not result in the loss of significant habitat for indigenous fauna. The project area contains foraging habitat for Carnaby's and Forest Red-tailed Black-Cockatoos, however, similar habitat exists in the region. The loss of vegetation in the project area is unlikely to significantly impact the population of either species, however, it would trigger a referral under the <i>EPBC Act</i> and there will be a cumulative impact.
It includes, or is necessary for the continued existence or, rare flora.	N/A
It comprises the whole or a part of, or is necessary for the maintenance of, a threatened ecological community.	The area does not contain a threatened ecological fauna community.
It is significant as a remnant of native vegetation in an area that has been extensively cleared.	The area is not a remnant, although there is an on-going and progressive loss of Jarrah, Tuart and Banksia woodlands on the northern Swan Coastal Plain.
It is growing in, or in association with, an environment associated with a watercourses or wetland.	The area does not contain a wetland.
The clearing of the vegetation is likely to cause appreciable land degradation.	N/A
The clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area.	Some of the vertebrate fauna in the project area will have home ranges that extend into the adjacent properties (e.g. Quenda) and the clearing of the vegetation in the project area will alter home ranges and may expose some individuals to higher predation pressure.
The clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water.	N/A
The clearing of the vegetation is likely to cause, or exacerbate the incidence of flooding.	N/A

7.2.1 Is a referral required?

Table 14 details the threshold for referring a proposed action to the Commonwealth Government as a potential significant impact (Department of Agriculture Water and the Environment 2022) on Black-Cockatoos. In our assessment, we have assumed that the entire project area is planned for development (i.e. clear of vegetation and significant trees).

Table 14. Referral threshold for Carnaby's and Forest Red-tailed Black-Cockatoos

Attribute	Referral threshold	Carnaby's Black-Cockatoo	Forest Red-tailed Black-Cockatoo
Breeding	Any loss of / impact upon known, suitable or potential nesting trees, and the habitat around these trees, is highly likely to require a referral to the minister. Loss of any potential nesting habitat is likely to require a referral to the minister.	There are no known nesting trees in the project area, but five trees have a hollow(s) that could potentially be used as a nesting site in the future. Overall, there are 118 trees that exceed the 500mm DBH criterion that could potentially form hollows in the future and if this occurred could possibly be used as nesting trees.	There are no known nesting trees in the project area, but five trees have a hollow(s) that could potentially be used as a nesting site in the future. There are 118 trees that exceed the 500mm DBH criterion that could potentially form hollows in the future and if this occurred could possibly be used as nesting trees.
High-quality native foraging habitat	Loss of greater than or equal to 1 ha of foraging habitat scoring 5-10 using the foraging quality scoring tool is likely to require referral to the minister. Foraging habitat quality is determined using the foraging quality scoring tool (see Appendix A) and takes into account context i.e. proximity of the impact site to important attributes.	Carnaby's Black-Cockatoo was recorded foraging in the project area. The site contains approximately 17ha of potential Black-Cockatoo foraging habitat with a foraging habitat score of 5.	It is likely that the Forest Red-tailed Black-Cockatoo will forage on Jarrah and Tuart trees in the project area. The site contains approximately 17ha of potential Black-Cockatoo foraging habitat with a foraging habitat score of 5.
Lower-quality native foraging habitat	Loss of greater than or equal to 10 ha of foraging habitat scoring 0-4 using the foraging quality scoring tool is likely to require referral to the minister. Foraging habitat quality is determined using the foraging quality scoring tool (see Appendix A) and takes into account context i.e. proximity of the impact site to important attributes.	The site contains approximately 17ha of potential Black-Cockatoo foraging habitat with a foraging habitat score of 5.	The site contains approximately 17ha of potential Black-Cockatoo foraging habitat with a foraging habitat score of 5.
Exotic foraging habitat	Loss of greater than or equal to 1 ha of predominantly exotic habitat (e.g. Cape Lilac trees and pine trees) known to be utilised by black cockatoos is likely to require a referral to the minister.	No exotic habitat is present onsite.	No exotic habitat is present onsite.
Night roosting Habitat	Removal of any part of a known night roosting site is likely to require referral to the minister.	There was no evidence to suggest that the project area is a Black-Cockatoo roosting site. Peck et al. (2019) indicated there is a white-tailed Black-Cockatoo roosting sites within 5km of the project area, however none within the project area.	There was no evidence to suggest that the project area is a Black-Cockatoo roosting site. Peck et al. (2019) did not indicate there were roosting sites nearby.

The Commonwealth Government's *Referral guideline for 3 WA threatened black cockatoo species Carnaby's Cockatoo (Zanda latirostris), Baudin's Cockatoo (Zanda baudinii) and the Forest Red-tailed Black-cockatoo (Calyptorhynchus banksii naso)* indicates that the criteria in the *Matters of National Environmental Significance Significant impact guidelines 1.1 Environment Protection and Biodiversity Conservation Act 1999* (Department of the Environment 2013) should be used to determine whether a referral under the *EPBC Act*.

Table 15. Referral guidelines for a significant impact guidelines 1.1

Criteria	Response
<ul style="list-style-type: none"> lead to a long-term decrease in the size of a population 	The removal of trees and foraging vegetation in the project area by itself is unlikely to lead to a significant long-term decline in the population. However, there is an on-going and progressive cumulative impact of vegetation clearing on foraging habitat for Black-Cockatoos on the Swan Coastal Plain.
<ul style="list-style-type: none"> reduce the area of occupancy of the species 	The removal of trees and foraging vegetation in the project area is unlikely to lead to a reduction in the area of occupancy, as there is similar habitat in the adjacent areas.
<ul style="list-style-type: none"> fragment an existing population into two or more populations 	The removal of trees and foraging vegetation in the project area is unlikely to lead to the fragmentation of the population.
<ul style="list-style-type: none"> adversely affect habitat critical to the survival of a species 	The removal of trees and foraging vegetation in the project area is unlikely to adversely affect habitat critical to the survival of the species, as there are other foraging trees in the general area and the trees do not currently support breeding hollows. However, there is an on-going and progressive cumulative impact of vegetation clearing on foraging habitat for Black-Cockatoos on the Swan Coastal Plain.
<ul style="list-style-type: none"> disrupt the breeding cycle of a population 	There are no identified active nesting trees in the project area. The removal of trees in the project area is unlikely to disrupt the breeding cycle of Black-Cockatoos.
<ul style="list-style-type: none"> modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline 	The removal of trees and foraging vegetation in the project area will remove foraging habitat, but not to the extent that there will likely result in a measurable decline of a Black-Cockatoo species.
<ul style="list-style-type: none"> result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat 	The removal of trees and foraging vegetation in the project area is unlikely to result in an invasive species impacting on Black-Cockatoos.
<ul style="list-style-type: none"> introduce disease that may cause the species to decline 	The removal of trees and foraging vegetation in the project area is unlikely to introduce disease that could cause a decline in the Black-Cockatoo population.
<ul style="list-style-type: none"> interfere with the recovery of the species 	The removal of trees and foraging vegetation in the project area may interfere with the recovery of Carnaby's and Forest Red-tailed Black-Cockatoo recovery plans through additional habitat loss.

8. SUMMARY

Terrestrial Ecosystems has undertaken a site assessment, recorded Black-Cockatoo significant habitat trees and foraging areas, and mapped fauna habitats for the project area.

The project area supports two fauna habitats:

- Eucalypts over grass; and
- Low Eucalypt woodland over grasstree shrubland.

In addition, there are disturbed areas that are mostly sand tracks through the project area.

Carnaby's Black-Cockatoo was seen foraging in the project area, and it is probable that Forest Red-tailed Black-Cockatoos would also forage in the area. There are 118 significant Black-Cockatoo habitat trees in the project area. Five of these significant trees have hollows that when assessed from ground level could support a Black-Cockatoo nest. There are no known Black-Cockatoo nests in the project area.

It is possible that Quenda are present in the project area and surrounding areas, and cats, foxes and rabbits are also present. It is possible that the Black-Striped Snake is present in low abundance in the project area.

8.1 RECOMMENDATIONS

If the project area is to be cleared of vegetation and developed, then the proposed action should be referred to the Commonwealth Government under the *EPBC Act* as the removal of significant habitat trees and foraging habitat could be deemed a significant impact on two Black-Cockatoo species.

Active management/fauna translocation before and during the vegetation clearing program should also be implemented to mitigate the potential impact on the vertebrate fauna.

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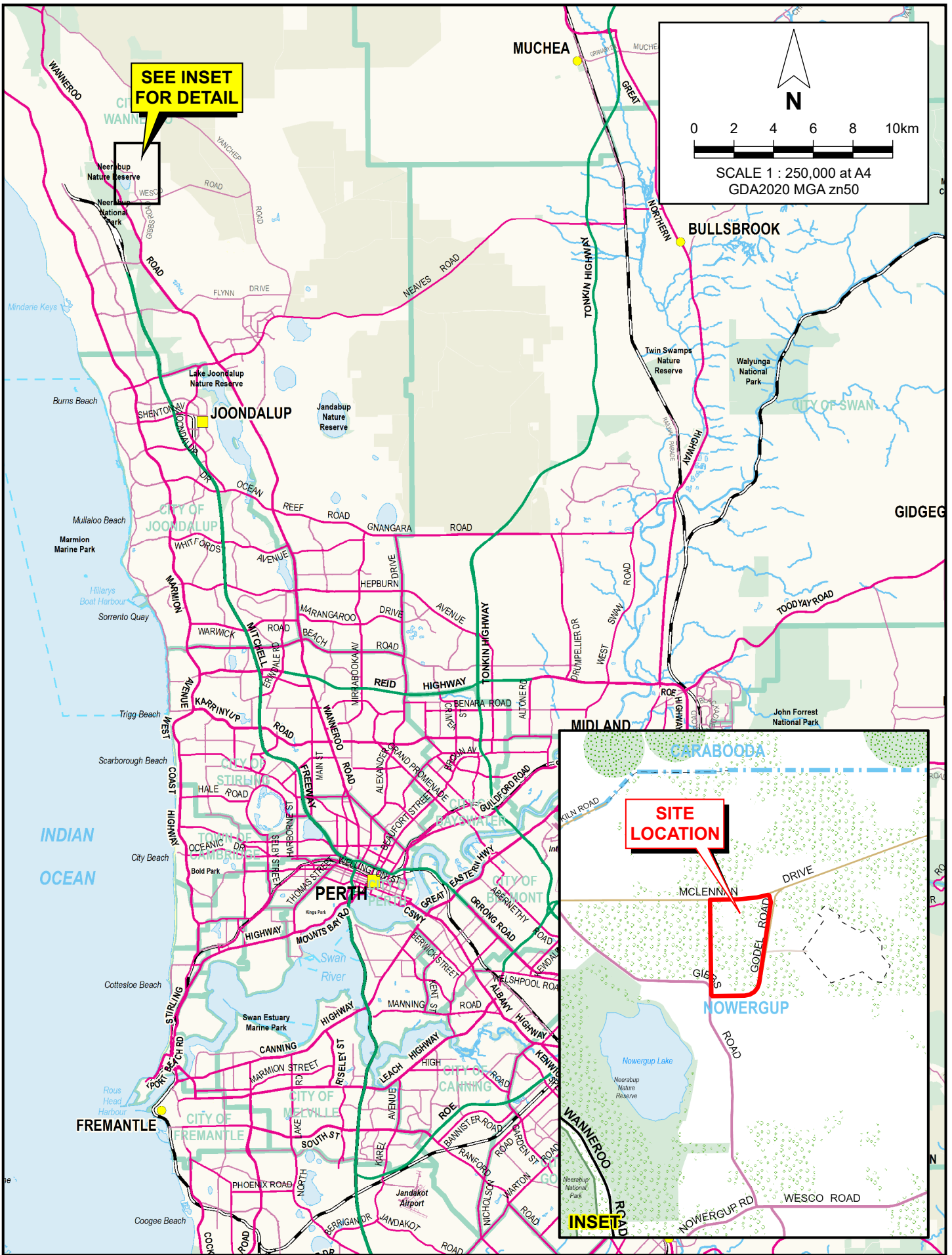
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Figures

**Basic Vertebrate Fauna Survey and Targeted Black Cockatoo Assessment
Lot 107 Godel Road, Nowergup**





PINPOINT CARTOGRAPHICS (08) 9562 7136 2024-0042-Lot107-f01.pagx

TERRESTRIAL ECOSYSTEMS

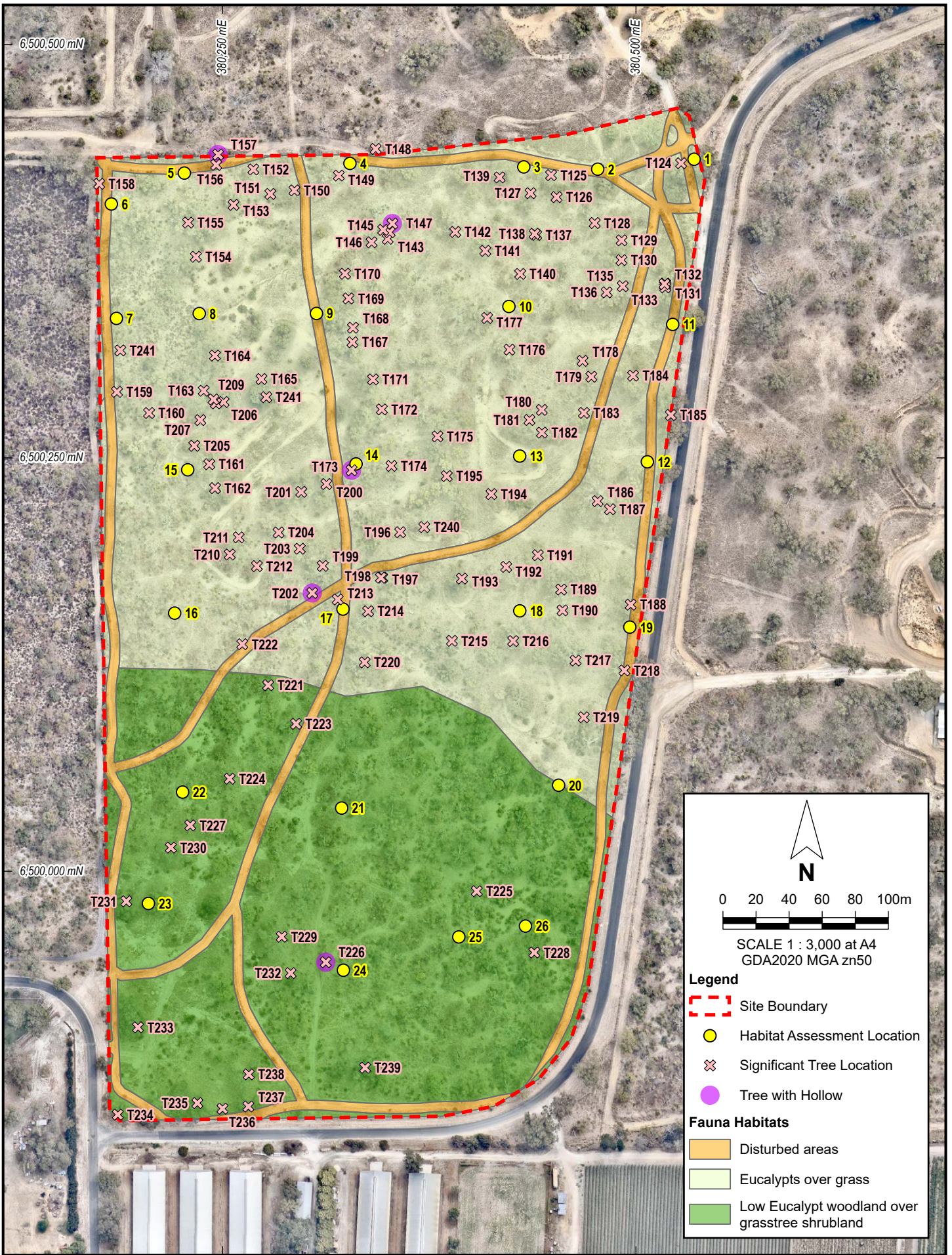
Drawn: G. Thompson Date: 28 May 2024

Coterra Environments
 BASIC VERTEBRATE FAUNA SURVEY AND TARGETED BLACK-COCKATOO
 ASSESSMENT FOR LOT 107 GODEL ROAD, NOWERGUP

REGIONAL CONTEXT

Figure 1

Job: 2024-0042



2024-0042-Lot107-f02.pagx

PINPOINT CARTOGRAPHICS (08) 9562 7136



TERRESTRIAL ECOSYSTEMS

Drawn: G. Thompson Date: 12 Aug 2024

Coterra Environments
 BASIC VERTEBRATE FAUNA SURVEY AND TARGETED BLACK-COCKATOO
 ASSESSMENT FOR LOT 107 GODEL ROAD, NOWERGUP

**PROJECT AREA SHOWING FAUNA HABITAT,
 FAUNA HABITAT ASSESSMENT LOCATIONS
 AND SIGNIFICANT TREES**

Figure 2

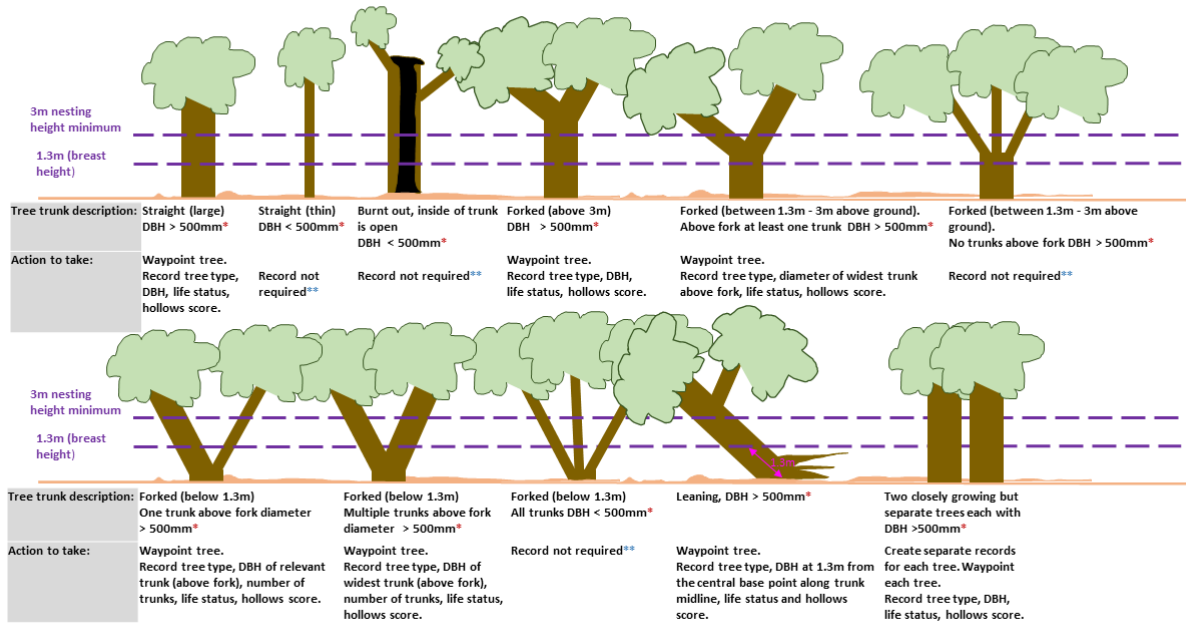
Job: 2024-0042

Appendix A. Black-Cockatoo habitat tree assessment protocol

Basic Vertebrate Fauna Survey and Targeted Black Cockatoo Assessment
Lot 107 Godel Road, Nowergup

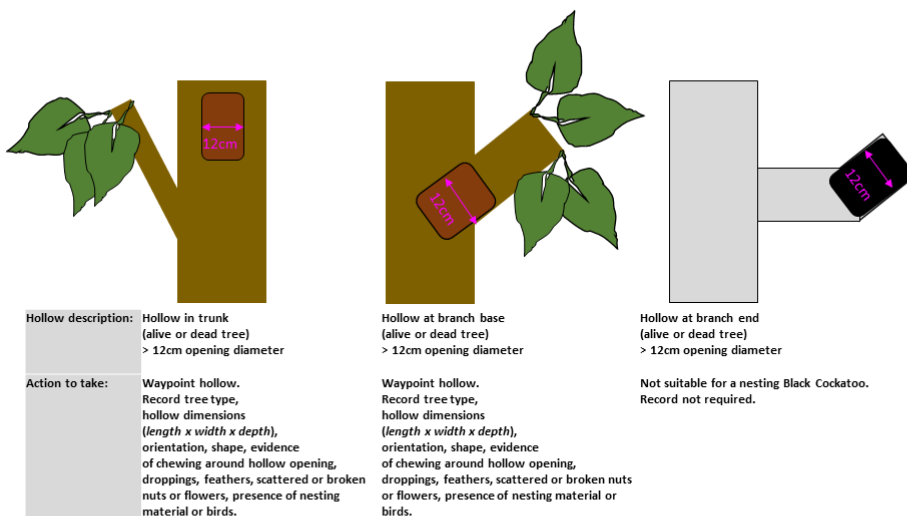


Black Cockatoo Field Assessment for Nesting Trees



*Lower DBH threshold for Salmon Gum or Wandoo trees (300mm)
 **Not suitable for nesting cockatoos

Black Cockatoo Hollows Field Assessment



Appendix B.

Results of the EPBC Act Protected Matters Search

Basic Vertebrate Fauna Survey and Targeted Black Cockatoo Assessment
Lot 107 Godel Road, Nowergup





Australian Government

Department of Climate Change, Energy,
the Environment and Water

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected. Please see the caveat for interpretation of information provided here.

Report created: 07-May-2024

[Summary](#)

[Details](#)

[Matters of NES](#)

[Other Matters Protected by the EPBC Act](#)

[Extra Information](#)

[Caveat](#)

[Acknowledgements](#)

Summary

Matters of National Environment Significance

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

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance (Ramsar)	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	7
Listed Threatened Species:	43
Listed Migratory Species:	18

Other Matters Protected by the EPBC Act

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

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

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

Commonwealth Lands:	92
Commonwealth Heritage Places:	None
Listed Marine Species:	26
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None
Habitat Critical to the Survival of Marine Turtles:	None

Extra Information

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

State and Territory Reserves:	15
Regional Forest Agreements:	None
Nationally Important Wetlands:	2
EPBC Act Referrals:	83
Key Ecological Features (Marine):	None
Biologically Important Areas:	1
Bioregional Assessments:	None
Geological and Bioregional Assessments:	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.

Status of Vulnerable, Disallowed and Ineligible are not MNES under the EPBC Act.

Community Name	Threatened Category	Presence Text
Aquatic Root Mat Community in Caves of the Swan Coastal Plain	Endangered	Community known to occur within area
Assemblages of plants and invertebrate animals of tumulus (organic mound) springs of the Swan Coastal Plain	Endangered	Community known to occur within area
Banksia Woodlands of the Swan Coastal Plain ecological community	Endangered	Community likely to occur within area
Empodisma peatlands of southwestern Australia	Endangered	Community may occur within area
Honeymyrtle shrubland on limestone ridges of the Swan Coastal Plain Bioregion	Critically Endangered	Community likely to occur within area
Sedgeland in Holocene dune swales of the southern Swan Coastal Plain	Endangered	Community known to occur within area
Tuart (<i>Eucalyptus gomphocephala</i>) Woodlands and Forests of the Swan Coastal Plain ecological community	Critically Endangered	Community likely to occur within area

Listed Threatened Species

[\[Resource Information \]](#)

Status of Conservation Dependent and Extinct are not MNES under the EPBC Act.

Number is the current name ID.

Scientific Name	Threatened Category	Presence Text
BIRD		
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat known to occur within area

Scientific Name	Threatened Category	Presence Text
Calidris acuminata Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat known to occur within area
Calidris canutus Red Knot, Knot [855]	Vulnerable	Species or species habitat likely to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calyptorhynchus banksii naso Forest Red-tailed Black-Cockatoo, Karrak [67034]	Vulnerable	Species or species habitat known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat likely to occur within area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat likely to occur within area
Limosa lapponica menzbieri Northern Siberian Bar-tailed Godwit, Russkoye Bar-tailed Godwit [86432]	Endangered	Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pachyptila turtur subantarctica Fairy Prion (southern) [64445]	Vulnerable	Species or species habitat known to occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Species or species habitat known to occur within area

Scientific Name	Threatened Category	Presence Text
Tringa nebularia Common Greenshank, Greenshank [832]	Endangered	Species or species habitat known to occur within area
Zanda latirostris listed as Calyptorhynchus latirostris Carnaby's Black Cockatoo, Short-billed Black-cockatoo [87737]	Endangered	Breeding known to occur within area
FISH		
Galaxiella nigrostriata Blackstriped Dwarf Galaxias, Black-stripe Minnow [88677]	Endangered	Species or species habitat likely to occur within area
INSECT		
Hesperocolletes douglasi Douglas' Broad-headed Bee, Rottnest Bee [66734]	Critically Endangered	Species or species habitat known to occur within area
MAMMAL		
Bettongia penicillata ogilbyi Woylie [66844]	Endangered	Species or species habitat may occur within area
Dasyurus geoffroii Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat known to occur within area
Macroderma gigas Ghost Bat [174]	Vulnerable	Species or species habitat may occur within area
Pseudocheirus occidentalis Western Ringtail Possum, Ngwayir, Womp, Woder, Ngoor, Ngoolangit [25911]	Critically Endangered	Species or species habitat likely to occur within area
OTHER		
Westralunio carteri Carter's Freshwater Mussel, Freshwater Mussel [86266]	Vulnerable	Species or species habitat likely to occur within area
PLANT		
Andersonia gracilis Slender Andersonia [14470]	Endangered	Species or species habitat likely to occur within area

Scientific Name	Threatened Category	Presence Text
Anigozanthos viridis subsp. terraspectans Dwarf Green Kangaroo Paw [3435]	Vulnerable	Species or species habitat likely to occur within area
Banksia mimica Summer Honeypot [82765]	Endangered	Species or species habitat may occur within area
Caladenia huegelii King Spider-orchid, Grand Spider-orchid, Rusty Spider-orchid [7309]	Endangered	Species or species habitat likely to occur within area
Caleana dixonii listed as Paracaleana dixonii Sandplain Duck Orchid [87944]	Endangered	Species or species habitat may occur within area
Chamelaucium lullfitzii listed as Chamelaucium sp. Gingin (N.G.Marchant 6) Gingin Wax [92777]	Endangered (listed as Chamelaucium sp. Gingin)	Species or species habitat may occur within area
Darwinia foetida Mucheas Bell [83190]	Critically Endangered	Species or species habitat likely to occur within area
Diuris micrantha Dwarf Bee-orchid [55082]	Vulnerable	Species or species habitat likely to occur within area
Diuris purdiei Purdie's Donkey-orchid [12950]	Endangered	Species or species habitat may occur within area
Drakaea elastica Glossy-leafed Hammer Orchid, Glossy-leafed Hammer Orchid, Warty Hammer Orchid [16753]	Endangered	Species or species habitat known to occur within area
Drakaea micrantha Dwarf Hammer-orchid [56755]	Vulnerable	Species or species habitat may occur within area
Eleocharis keigheryi Keighery's Eleocharis [64893]	Vulnerable	Species or species habitat likely to occur within area

Scientific Name	Threatened Category	Presence Text
Eucalyptus argutifolia Yanchep Mallee, Wabbling Hill Mallee [24263]	Vulnerable	Species or species habitat known to occur within area
Grevillea christineae Christine's Grevillea [64520]	Endangered	Species or species habitat likely to occur within area
Grevillea curviloba subsp. curviloba Curved-leaf Grevillea [64908]	Endangered	Species or species habitat known to occur within area
Grevillea curviloba subsp. incurva Narrow curved-leaf Grevillea [64909]	Endangered	Species or species habitat likely to occur within area
Macarthuria keigheryi Keighery's Macarthuria [64930]	Endangered	Species or species habitat may occur within area
Marianthus paralius [83925]	Endangered	Species or species habitat known to occur within area
Melaleuca sp. Wanneroo (G.J. Keighery 16705) [89456]	Endangered	Species or species habitat known to occur within area
Synaphea sp. Fairbridge Farm (D.Papenfus 696) Selena's Synaphea [82881]	Critically Endangered	Species or species habitat may occur within area
Thelymitra dedmaniarum Cinnamon Sun Orchid [65105]	Endangered	Species or species habitat may occur within area
SHARK		
Pristis pristis Freshwater Sawfish, Largetooth Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish [60756]	Vulnerable	Species or species habitat may occur within area
Listed Migratory Species [Resource Information]		
Scientific Name	Threatened Category	Presence Text
Migratory Marine Birds		

Scientific Name	Threatened Category	Presence Text
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardenna carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Species or species habitat likely to occur within area
Sterna dougallii Roseate Tern [817]		Foraging, feeding or related behaviour likely to occur within area
Migratory Marine Species		
Pristis pristis Freshwater Sawfish, Largetooth Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish [60756]	Vulnerable	Species or species habitat may 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 known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat known to occur within area
Calidris canutus Red Knot, Knot [855]	Vulnerable	Species or species habitat likely to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat likely to occur within area

Scientific Name	Threatened Category	Presence Text
Calidris ruficollis Red-necked Stint [860]		Species or species habitat known to occur within area
Calidris subminuta Long-toed Stint [861]		Species or species habitat known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat likely to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat known to occur within area
Tringa glareola Wood Sandpiper [829]		Species or species habitat known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]	Endangered	Species or species habitat known to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Lands [\[Resource Information \]](#)

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.

Commonwealth Land Name	State
Defence	
Defence - GIN GIN SATELLITE AIRFIELD [50112]	WA
Defence - MUCHEA ARMAMENT RANGE [50088]	WA
Defence - MUCHEA ARMAMENT RANGE [50089]	WA

Commonwealth Land Name	State
Defence - MUCHEA ARMAMENT RANGE [50083]	WA
Defence - MUCHEA ARMAMENT RANGE [50081]	WA
Defence - MUCHEA ARMAMENT RANGE [50094]	WA
Defence - MUCHEA ARMAMENT RANGE [50085]	WA
Defence - MUCHEA ARMAMENT RANGE [50087]	WA
Defence - MUCHEA ARMAMENT RANGE [50056]	WA
Defence - MUCHEA ARMAMENT RANGE [50070]	WA
Defence - MUCHEA ARMAMENT RANGE [50068]	WA
Defence - MUCHEA ARMAMENT RANGE [50062]	WA
Defence - MUCHEA ARMAMENT RANGE [50073]	WA
Defence - MUCHEA ARMAMENT RANGE [50063]	WA
Defence - MUCHEA ARMAMENT RANGE [50058]	WA
Defence - MUCHEA ARMAMENT RANGE [50061]	WA
Defence - MUCHEA ARMAMENT RANGE [50080]	WA
Defence - MUCHEA ARMAMENT RANGE [50092]	WA
Defence - MUCHEA ARMAMENT RANGE [50093]	WA
Defence - MUCHEA ARMAMENT RANGE [50090]	WA
Defence - MUCHEA ARMAMENT RANGE [50086]	WA
Defence - MUCHEA ARMAMENT RANGE [50084]	WA
Defence - MUCHEA ARMAMENT RANGE [50091]	WA
Defence - MUCHEA ARMAMENT RANGE [50069]	WA
Defence - MUCHEA ARMAMENT RANGE [50060]	WA
Defence - MUCHEA ARMAMENT RANGE [50067]	WA
Defence - MUCHEA ARMAMENT RANGE [50066]	WA
Defence - MUCHEA ARMAMENT RANGE [50064]	WA
Defence - MUCHEA ARMAMENT RANGE [50095]	WA
Defence - MUCHEA ARMAMENT RANGE [50074]	WA

Commonwealth Land Name	State
Defence - MUCHEA ARMAMENT RANGE [50075]	WA
Defence - MUCHEA ARMAMENT RANGE [50076]	WA
Defence - MUCHEA ARMAMENT RANGE [50077]	WA
Defence - MUCHEA ARMAMENT RANGE [50082]	WA
Defence - MUCHEA ARMAMENT RANGE [50078]	WA
Defence - MUCHEA ARMAMENT RANGE [50072]	WA
Defence - MUCHEA ARMAMENT RANGE [50071]	WA
Defence - MUCHEA ARMAMENT RANGE [50079]	WA
Defence - MUCHEA ARMAMENT RANGE [50057]	WA
Defence - MUCHEA ARMAMENT RANGE [50065]	WA
Defence - MUCHEA ARMAMENT RANGE [50059]	WA
Defence - PEARCE - AP19 HF RECEIVER STATION BULLSBROOK [50038]	WA
Defence - PEARCE - AP19 HF RECEIVER STATION BULLSBROOK [50020]	WA
Defence - PEARCE - AP19 HF RECEIVER STATION BULLSBROOK [50019]	WA
Defence - PEARCE - AP19 HF RECEIVER STATION BULLSBROOK [50043]	WA
Unknown	
Commonwealth Land - [50711]	WA
Commonwealth Land - [50583]	WA
Commonwealth Land - [50553]	WA
Commonwealth Land - [50312]	WA
Commonwealth Land - [50713]	WA
Commonwealth Land - [50575]	WA
Commonwealth Land - [50562]	WA
Commonwealth Land - [50680]	WA
Commonwealth Land - [50668]	WA
Commonwealth Land - [51120]	WA

Commonwealth Land Name	State
Commonwealth Land - [50705]	WA
Commonwealth Land - [50701]	WA
Commonwealth Land - [50586]	WA
Commonwealth Land - [50560]	WA
Commonwealth Land - [50747]	WA
Commonwealth Land - [50561]	WA
Commonwealth Land - [50271]	WA
Commonwealth Land - [51118]	WA
Commonwealth Land - [50682]	WA
Commonwealth Land - [50563]	WA
Commonwealth Land - [50703]	WA
Commonwealth Land - [50316]	WA
Commonwealth Land - [50702]	WA
Commonwealth Land - [50594]	WA
Commonwealth Land - [50402]	WA
Commonwealth Land - [50706]	WA
Commonwealth Land - [50704]	WA
Commonwealth Land - [50315]	WA
Commonwealth Land - [50489]	WA
Commonwealth Land - [50689]	WA
Commonwealth Land - [50559]	WA
Commonwealth Land - [50588]	WA
Commonwealth Land - [50355]	WA
Commonwealth Land - [50592]	WA
Commonwealth Land - [50593]	WA
Commonwealth Land - [50598]	WA
Commonwealth Land - [50700]	WA

Commonwealth Land Name	State
Commonwealth Land - [50667]	WA
Commonwealth Land - [51130]	WA
Commonwealth Land - [50606]	WA
Commonwealth Land - [50576]	WA
Commonwealth Land - [50574]	WA
Commonwealth Land - [50587]	WA
Commonwealth Land - [50585]	WA
Commonwealth Land - [50584]	WA
Commonwealth Land - [50582]	WA
Commonwealth Land - [50508]	WA

Listed Marine Species		[Resource Information]
Scientific Name	Threatened Category	Presence Text
Bird		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area overfly marine area
Ardenna carneipes as Puffinus carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Species or species habitat likely to occur within area
Bubulcus ibis as Ardea ibis Cattle Egret [66521]		Species or species habitat may occur within area overfly marine area
Calidris acuminata Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat known to occur within area

Scientific Name	Threatened Category	Presence Text
Calidris canutus Red Knot, Knot [855]	Vulnerable	Species or species habitat likely to occur within area overfly marine area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area overfly marine area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat likely to occur within area overfly marine area
Calidris ruficollis Red-necked Stint [860]		Species or species habitat known to occur within area overfly marine area
Calidris subminuta Long-toed Stint [861]		Species or species habitat known to occur within area overfly marine area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat likely to occur within area
Charadrius ruficapillus Red-capped Plover [881]		Species or species habitat known to occur within area overfly marine area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Himantopus himantopus Pied Stilt, Black-winged Stilt [870]		Species or species habitat known to occur within area overfly marine area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area overfly marine area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area overfly marine area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pachyptila turtur Fairy Prion [1066]		Species or species habitat known to occur within area
Pandion haliaetus Osprey [952]		Species or species habitat known to occur within area
Recurvirostra novaehollandiae Red-necked Avocet [871]		Species or species habitat known to occur within area overfly marine area
Rostratula australis as Rostratula benghalensis (sensu lato) Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area overfly marine area
Sterna dougallii Roseate Tern [817]		Foraging, feeding or related behaviour likely to occur within area
Thinornis cucullatus as Thinornis rubricollis Hooded Plover, Hooded Dotterel [87735]		Species or species habitat may occur within area overfly marine area
Tringa glareola Wood Sandpiper [829]		Species or species habitat known to occur within area overfly marine area

Scientific Name	Threatened Category	Presence Text
Tringa nebularia		
Common Greenshank, Greenshank [832]	Endangered	Species or species habitat known to occur within area overfly marine area

Extra Information

State and Territory Reserves [\[Resource Information \]](#)

Protected Area Name	Reserve Type	State
Jandabup	Nature Reserve	WA
Lake Joondalup	Nature Reserve	WA
Neaves Road	Nature Reserve	WA
Neerabup	Nature Reserve	WA
Neerabup	National Park	WA
Unnamed WA21176	5(1)(h) Reserve	WA
Unnamed WA43290	Conservation Park	WA
Unnamed WA46756	Conservation Park	WA
Unnamed WA46920	Nature Reserve	WA
Unnamed WA46926	5(1)(h) Reserve	WA
Unnamed WA49994	Conservation Park	WA
Unnamed WA50514	5(1)(h) Reserve	WA
Woodvale	5(1)(h) Reserve	WA
Yanchep	National Park	WA
Yeal	Nature Reserve	WA

Nationally Important Wetlands [\[Resource Information \]](#)

Wetland Name	State
Joondalup Lake	WA
Loch McNess System	WA

EPBC Act Referrals [\[Resource Information \]](#)

Title of referral	Reference	Referral Outcome	Assessment Status
Alkimos Seawater Desalination	2019/8453		Completed
Carabooda Quarry	2023/09554		Referral Decision
Expansion of Limestone Extraction	2022/09324		Assessment
Land clearing for timber storage	2022/09367		Assessment
Land Development, James Street and Well Street, East Wanneroo, Elberton Property	2021/9106		Assessment
Mariginiup Residential Development	2023/09675		Assessment
Muchea Silica Sand Project	2022/09370		Referral Decision
Rangedale Landholdings	2023/09612		Assessment
Residential Subdivision development	2011/6040		Post-Approval
Samphire Offshore Wind Farm	2022/09306		Assessment
Wanneroo Shooting Complex - Public shooting range	2023/09630		Referral Decision
Wattle Avenue East Quarry	2022/09326		Referral Decision
Yanchep Rail Extension, WA	2018/8262		Post-Approval
Controlled action			
Alkimos city centre and central development, WA	2015/7561	Controlled Action	Post-Approval
Alkimos Coastal Node	2020/8861	Controlled Action	Further Information Request
Butler North District Open Space playing fields development, Wanneroo, WA	2017/8053	Controlled Action	Post-Approval
Catalina Residential Development	2010/5785	Controlled Action	Post-Approval
East Wanneroo Cell 9 residential subdivision - Lots 50,51,52,154 & 404	2010/5772	Controlled Action	Completed

Title of referral	Reference	Referral Outcome	Assessment Status
Controlled action			
Eglinton/South Yanchep Residential Development	2011/6021	Controlled Action	Post-Approval
Eglinton Estates - Clearing of native vegetation from Lot 1007 & part Lot 1008	2010/5777	Controlled Action	Post-Approval
Ellenbrook Reliable Water Storage Project, WA	2015/7421	Controlled Action	Post-Approval
Excavate sand and limestone resources	2010/5621	Controlled Action	Completed
Jindee Residential Development	2012/6631	Controlled Action	Post-Approval
Limestone extraction on Lot 8 Wattle Avenue, Nowergup	2013/6767	Controlled Action	Post-Approval
Lot 1665 Wanneroo Road, Sinagra.	2017/7921	Controlled Action	Post-Approval
Lot 9000 Wanneroo Road Sinagra Mixed Use Development, Western Australia	2020/8798	Controlled Action	Proposed Decision
Meridian Business Park Industrial Development	2007/3479	Controlled Action	Post-Approval
Mitchell Freeway Extension and Wanneroo Road Upgrade, WA	2018/8367	Controlled Action	Post-Approval
Mitchell Freeway Extension between Burns Beach Rd and Hester Av, Neerabup, WA	2013/7091	Controlled Action	Post-Approval
Mitchell Freeway Principal Shared Path Gaps Project Ocean Reef Road to Hepburn Avenue	2020/8833	Controlled Action	Post-Approval
National Lifestyle Villages Development	2011/6020	Controlled Action	Post-Approval
Natural Gas Pipeline Expansion	2006/2813	Controlled Action	Post-Approval
Neerabup Industrial Area, WA	2021/8917	Controlled Action	Assessment Approach
Neerabup Industrial Estate, Lot 701 Flynn Drive Neerabup WA	2012/6424	Controlled Action	Post-Approval
Perth-Darwin National Highway alignment (Swan Valley Section), WA	2013/7042	Controlled Action	Post-Approval
Proposed Urban Development of Lots 1005 & 1006	2008/4638	Controlled Action	Post-Approval

Title of referral	Reference	Referral Outcome	Assessment Status
Controlled action			
Residential and commercial development on part 19 (Lot 6) Taronga Place, Eglinton, WA	2017/7872	Controlled Action	Post-Approval
Residential development, Lot 609, Yanchep Beach Road, Yanchep, WA	2014/7146	Controlled Action	Post-Approval
Residential development Lot 1004 Alkimos WA	2011/5902	Controlled Action	Post-Approval
Subdivision of Lot 902 Flynn Drive Neerabup for Industrial Development	2021/8977	Controlled Action	Assessment Approach
Urban development in accordance with the Local Structure Plan	2008/4601	Controlled Action	Post-Approval
Urban Residential Development at Lot 9049 Marmoin Avenue	2009/5155	Controlled Action	Post-Approval
Vegetation Clearing, Wannaroo Rd and Nowergup Rd	2011/5955	Controlled Action	Completed
Vegetation clearing for future agricultural use, Bullsbrook, WA	2014/7120	Controlled Action	Post-Approval
Not controlled action			
Amberton West urban development - Part lot 9005 Eglinton WA	2013/7068	Not Controlled Action	Completed
Butler Railway Extension Project - Nowergup Depot Eastern Alignment	2011/5989	Not Controlled Action	Completed
Commercial development of Lot 9004 Hodges Drive, Joondalup, WA	2016/7844	Not Controlled Action	Completed
Connect Joondalup - Lot 9000 McLarty Ave and Lot 999 Piccadilly Circus, Joondalup, WA	2016/7758	Not Controlled Action	Completed
Construction of an International Rifle Range	2011/6068	Not Controlled Action	Completed
Container Deposit Scheme Project	2019/8517	Not Controlled Action	Completed
Development of ECU Engineering Annex, Joondalup Campus, WA	2017/7995	Not Controlled Action	Completed
Development of new Alkimos Wastewater Treatment Plant	2007/3259	Not Controlled Action	Completed
Eradication of the European House Borer, Perth metropolitan area, WA	2009/5027	Not Controlled Action	Completed

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action			
Extension of 7.5km of the Joondalup Line electrified passenger railway from Cla	2010/5632	Not Controlled Action	Completed
Flynn Drive / Pinjar Road Intersection Works, Lot 9000 Flynn Drive, Neerabup, WA	2017/7983	Not Controlled Action	Completed
Groundwater Replenishment Scheme (GWRS) Stage 2	2016/7786	Not Controlled Action	Completed
Improving rabbit biocontrol: releasing another strain of RHDV, sthrn two thirds of Australia	2015/7522	Not Controlled Action	Completed
Lot 594 Wanneroo Road development, Hocking	2020/8621	Not Controlled Action	Completed
Nowergup Strawberry Farm McLennan Drive, Nowergup, WA	2017/8042	Not Controlled Action	Completed
Pearsall Primary School, Lots 62, 269, 1008, 1009 & Part Lot 23, Pearsall, WA	2012/6405	Not Controlled Action	Completed
Pinjar Motorcycle Park Raceway Development	2012/6419	Not Controlled Action	Completed
Quinns Main sewer extension, Clarkson - Neerabup, WA	2018/8215	Not Controlled Action	Completed
Realignment of Flynn Drive	2011/6170	Not Controlled Action	Completed
Residential and commercial development, Lot 1981 Alexander Drive & Lot 152 Gnangara Road, Landsdale,	2013/6982	Not Controlled Action	Completed
Residential Development, 50 Lot 2 Driver Road, Darch, Western Australia	2020/8677	Not Controlled Action	Completed
Residential Development, Lot 4 Coogee Road, Mariginiup, WA	2019/8452	Not Controlled Action	Completed
Residential development, Lot 55 Alexander Drive, Landsdale, WA	2013/6971	Not Controlled Action	Completed
Residential Development, Lots 10 Dundobar Road and 28 and 29 Belgrade Road, East Wanneroo, WA	2019/8521	Not Controlled Action	Completed
Residential development, Lots 9010 and 9031, Yanchep Beach Rd, Yanchep	2016/7642	Not Controlled Action	Completed

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action			
Residential Development Eglinton West, Lot 5000 & part Lot 5001, Pipidinny Road, Eglinton	2014/7137	Not Controlled Action	Completed
Residential development of 118 Coogee Road, Mariginiup, WA	2017/8011	Not Controlled Action	Completed
residential subdivision	2005/1965	Not Controlled Action	Completed
Residential Subdivision - Lots 12, 36 & 38 Capron St, Wanneroo	2012/6409	Not Controlled Action	Completed
Wangara Industrial Extension Area, WA	2012/6501	Not Controlled Action	Completed
Wanneroo Road/Ocean Reef Road Grade Separation, Pearsall, WA	2017/8110	Not Controlled Action	Completed
Wanneroo Road Duplication, WA	2015/7632	Not Controlled Action	Completed
Not controlled action (particular manner)			
Ocean Reef Road Extension Works in Wangara	2010/5388	Not Controlled Action (Particular Manner)	Post-Approval
Road realignment and widening	2009/4926	Not Controlled Action (Particular Manner)	Post-Approval
Subdivision Lot 4 Flynn Drive and earthworks for industrial development, 240 Fl	2009/5028	Not Controlled Action (Particular Manner)	Post-Approval
Transmission Line Rebuild and Extension	2009/5105	Not Controlled Action (Particular Manner)	Post-Approval
Referral decision			
Boundary Road Sand Quarry	2019/8560	Referral Decision	Completed
Residential Subdivision of 60ha, Swan Location 2424	2004/1928	Referral Decision	Completed
Transmission Line Rebuild and Extension	2009/4972	Referral Decision	Completed
Biologically Important Areas			[Resource Information]
Scientific Name		Behaviour	Presence

Scientific Name	Behaviour	Presence
Seabirds		
Sterna dougallii		
Roseate Tern [817]	Foraging	Known to occur

Caveat

1 PURPOSE

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

The report contains the mapped locations of:

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

2 DISCLAIMER

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

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

3 DATA SOURCES

Threatened ecological communities

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

Threatened, migratory and marine species

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

Where little information is available for a species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc.).

In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More detailed distribution mapping methods are used to update these distributions

4 LIMITATIONS

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

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

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

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

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

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

Acknowledgements

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

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

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

Please feel free to provide feedback via the [Contact us](#) page.

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Department of Climate Change, Energy, the Environment and Water

GPO Box 3090

Canberra ACT 2601 Australia

+61 2 6274 1111

Appendix C.

Significant tree data

Basic Vertebrate Fauna Survey and Targeted Black Cockatoo Assessment
Lot 107 Godel Road, Nowergup



Tree data							Hollow					
Tree #	UTM	UTM easting	UTM Northing	Tree Type	DBH (cm)	Height (m)	Ent size (cm)	Orientation	Height above ground (m)	Type	Health	Comment
T124	50	380527	6500428	Tuart	58	20					Healthy	
T125	50	380449	6500421	Jarrah	85	20					Healthy	
T126	50	380452	6500408	Jarrah	57	15					Healthy	
T127	50	380436	6500410	Jarrah	94	20					Healthy	
T128	50	380475	6500392	Jarrah	63	15					Dead	
T129	50	380491	6500382	Tuart	74	20					Healthy	
T130	50	380491	6500370	Tuart	67	20					Healthy	
T131	50	380518	6500354	Tuart	68	15					Healthy	Split at 4m
T132	50	380518	6500355	Tuart	53	20					Healthy	
T133	50	380518	6500353	Tuart	62	20					Healthy	Splits at 4 and 6m
T134	50	380517	6500355	Tuart	50	20					Healthy	splits in 3 at base, middle trunk measured
T135	50	380492	6500354	Jarrah	65	15					Healthy	Splits at 4m
T136	50	380482	6500350	Jarrah	56	15					Healthy with crown damage	Multi stems all split below 6m
T137	50	380440	6500385	Tuart	73	20					Healthy	Splits at 3m
T138	50	380439	6500385	Jarrah	62	10					Healthy	Splits at 4m

Tree data							Hollow					
T139	50	380418	6500420	Jarrah	86	20					Healthy with crown damage	One of three trunks that are regrowth from the base
T140	50	380430	6500361	Jarrah	51	20					Dead	Splits at 4m
T141	50	380409	6500375	Tuart	165	20					Healthy	Splits at 2m
T142	50	380391	6500387	Tuart	131	20					Healthy	Splits at 1.5m
T143	50	380350	6500382	Tuart	56	20					Severe Crown Damage	
T144	50	380351	6500386	Tuart	50	20					Healthy	
T145	50	380347	6500388	Tuart	52	20					Healthy	
T146	50	380340	6500380	Jarrah	97	15					Dead	
T147	50	380353	6500392	Jarrah	150	20	10	east	6	Trunk	Dead	
T148	50	380343	6500437	Tuart	62	20					Healthy	
T149	50	380320	6500421	Tuart	94	20					Healthy	
T150	50	380293	6500412	Tuart	162	20					Healthy	Splits at 2m
T151	50	380279	6500410	Tuart	54	15					Healthy	
T152	50	380269	6500424	Tuart	87	15					Healthy	
T153	50	380257	6500403	Tuart	55	20					Healthy	
T154	50	380234	6500372	Tuart	53	20					Healthy	
T155	50	380229	6500392	Tuart	139	25					Healthy	
T156	50	380246	6500427	Tuart	74	20					Healthy	
T157	50	380247	6500433	Tuart	158	20	15	East	8m	Trunk	Healthy with crown damage	

Tree data							Hollow					
T158	50	380175	6500416	Tuart	130	20					Healthy	
T159	50	380186	6500290	Tuart	119	20					Healthy with crown damage	
T160	50	380206	6500277	Jarrah	69	15					Healthy with crown damage	
T161	50	380242	6500246	Jarrah	54	15					Healthy	
T162	50	380245	6500232	Jarrah	54	15					Severe Crown Damage	
T163	50	380239	6500291	Tuart	99	20					Healthy with crown damage	
T164	50	380245	6500312	Tuart	60	20					Healthy	
T165	50	380274	6500298	Tuart	76	15					Healthy	
T166	50	380276	6500287	Jarrah	128	20					Healthy	
T167	50	380329	6500320	Jarrah	54	15					Healthy	
T168	50	380329	6500329	Tuart	113	20					Healthy with crown damage	
T169	50	380326	6500346	Jarrah	80	15					Healthy	
T170	50	380324	6500361	Jarrah	60	15					Dead	
T171	50	380341	6500297	Tuart	132	20					Healthy	
T172	50	380346	6500279	Jarrah	69	15					Severe crown damage	
T173	50	380328	6500243	Jarrah	78	10	10	North	10m	Branch/trunk junction	Dead	
T174	50	380352	6500245	Jarrah	79	15					Healthy with crown damage	
T175	50	380380	6500263	Jarrah	127	10					Healthy with crown damage	

Tree data							Hollow					
T176	50	380424	6500315	Tuart	77	20					Healthy	Split at 2m
T177	50	380410	6500335	Tuart	114	20					Healthy	
T178	50	380468	6500309	Tuart	101	20					Healthy	
T179	50	380473	6500299	Tuart	74	20					Healthy	
T180	50	380443	6500279	Tuart	70	20					Healthy	
T181	50	380436	6500273	Tuart	105	20					Healthy	
T182	50	380443	6500265	Tuart	66	20					Healthy	
T183	50	380469	6500277	Tuart	53	25					Healthy	
T184	50	380498	6500300	Tuart	102	25					Healthy	
T185	50	380521	6500276	Tuart	159	25					Healthy	
T186	50	380477	6500224	Tuart	136	25					Healthy with crown damage	
T187	50	380484	6500219	Tuart	58	20					Healthy	
T188	50	380497	6500161	Tuart	143	25					Healthy	
T189	50	380455	6500170	Tuart	146	20					Healthy with crown damage	
T190	50	380456	6500158	Tuart	73	20					Healthy	
T191	50	380441	6500191	Tuart	107	25					Healthy	
T192	50	380422	6500184	Tuart	120	20					Healthy	
T193	50	380395	6500177	Tuart	96	25					Healthy	
T194	50	380413	6500228	Tuart	66	20					Healthy	
T195	50	380386	6500239	Jarra	70	15					Healthy with crown damage	

Tree data							Hollow						
T196	50	380357	6500205	Jarrah	60	15						Severe Crown Damage	
T197	50	380347	6500178	Jarrah	71	15						Healthy	
T198	50	380346	6500178	Tuart	69	20						Healthy	
T199	50	380311	6500185	Tuart	124	25						Healthy	
T200	50	380313	6500234	Jarrah	67	15						Healthy	
T201	50	380298	6500229	Jarrah	60	20						Healthy	
T202	50	380304	6500168	Tuart	92	12	10	South	4.5	Trunk		Severe Crown Damage	
T203	50	380297	6500195	Tuart	65	15						Healthy	
T204	50	380284	6500205	Jarrah	97	15						Severe Crown Damage	
T205	50	380233	6500257	Jarrah	99	12						Healthy	
T206	50	380251	6500284	Tuart	101	20						Healthy	
T207	50	380237	6500273	Jarrah	64	10						Healthy with crown damage	
T208	50	380246	6500283	Jarrah	101	10						Healthy with crown damage	
T209	50	380245	6500285	Tuart	75	15						Healthy	
T210	50	380254	6500192	Tuart	75	20						Healthy	
T211	50	380260	6500202	Jarrah	76	12						Severe Crown Damage	
T212	50	380271	6500185	Tuart	69	15						Healthy	
T213	50	380320	6500164	Tuart	86	20						Healthy with crown damage	
T214	50	380338	6500157	Tuart	128	20						Severe Crown Damage	

Tree data							Hollow					
T215	50	380389	6500139	Tuart	90	20					Healthy with crown damage	
T216	50	380426	6500139	Tuart	132	20					Healthy	
T217	50	380464	6500127	Tuart	97	20					Healthy	
T218	50	380493	6500121	Tuart	126	25					Healthy	
T219	50	380468	6500093	Tuart	76	20					Healthy	
T220	50	380336	6500126	Tuart	108	20					Healthy	
T221	50	380278	6500113	Jarra	83	20					Dead	
T222	50	380262	6500137	Jarra	99	15					Severe Crown Damage	
T223	50	380294	6500089	Jarra	78	15					Severe Crown Damage	
T224	50	380254	6500056	Tuart	104	15					Severe Crown Damage	
T225	50	380404	6499988	Jarra	78	20					Healthy with crown damage	
T226	50	380312	6499945	Jarra	112	15	15	North	5.25	End of Branch	Severe Crown Damage	
T227	50	380230	6500028	Jarra	114	15					Severe Crown Damage	
T228	50	380439	6499951	Jarra	58	15					Healthy	
T229	50	380286	6499960	Jarra	85	20					Dead	
T230	50	380219	6500014	Tuart	57	15					Healthy	
T231	50	380192	6499982	Jarra	124	15					Healthy	
T232	50	380291	6499938	Tuart	74	15					Dead	
T233	50	380199	6499906	Tuart	125	20					Healthy	
T234	50	380187	6499853	Tuart	90	20					Dead	

Tree data							Hollow					
T235	50	380235	6499860	Tuart	95	15					Healthy	
T236	50	380250	6499856	Tuart	92	15					Healthy	
T237	50	380266	6499858	Tuart	83	15					Healthy with crown damage	
T238	50	380266	6499877	Tuart	71	15					Healthy	
T239	50	380336	6499881	Marri	92	15					Healthy	
T240	50	380188	6500315	Jarrah	75	15					Healthy with crown damage	
T241	50	380372	6500208	Tuart	125	20					Healthy with crown damage	

Appendix D.

Significant tree images

Basic Vertebrate Fauna Survey and Targeted Black Cockatoo Assessment
Lot 107 Godel Road, Nowergup

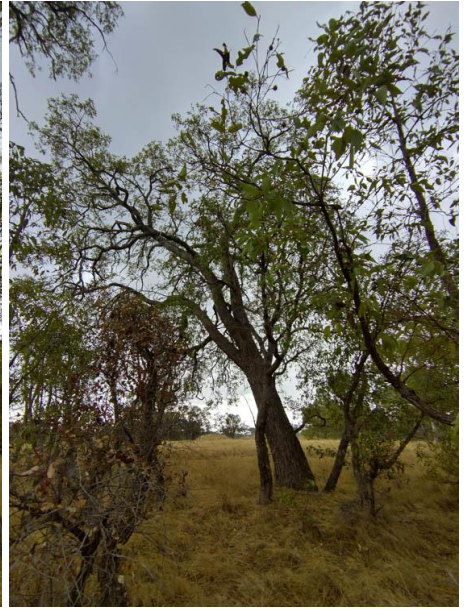




Tree 124



Tree 125



Tree 126



Tree 127



Tree 128



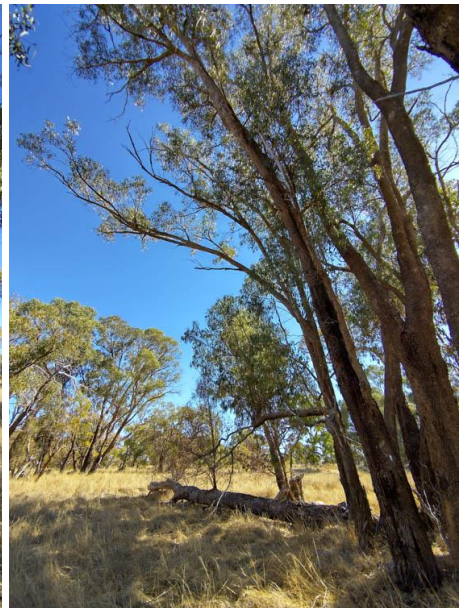
Tree 129



Tree 130



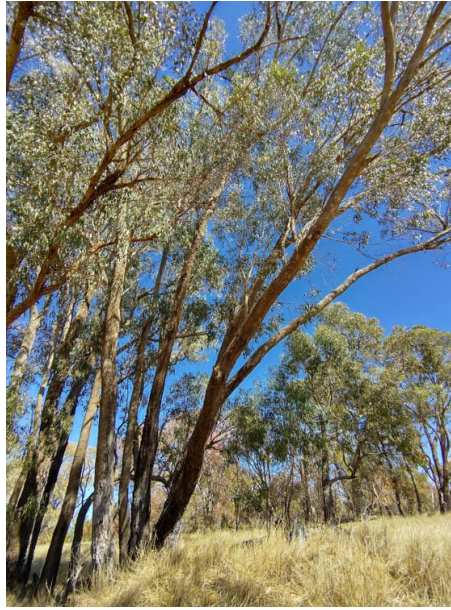
Tree 131



Tree 132



Tree 133



Tree 134



Tree 135



Tree 136



Tree 137



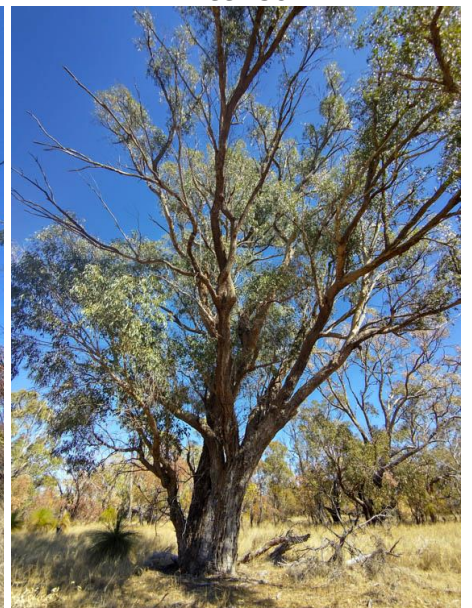
Tree 138



Tree 139



Tree 140



Tree 141



Tree 142



Tree 143



Tree 144



Tree 145



Tree 146



Tree 147



Tree 147



Tree 148



Tree 149



Tree 150



Tree 151



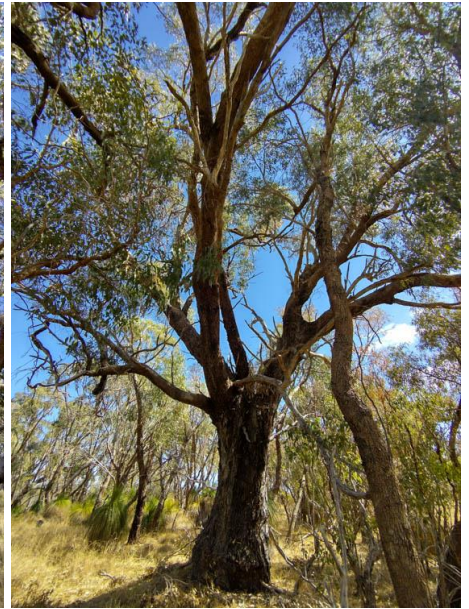
Tree 152



Tree 153



Tree 154



Tree 155



Tree 157



Tree 157



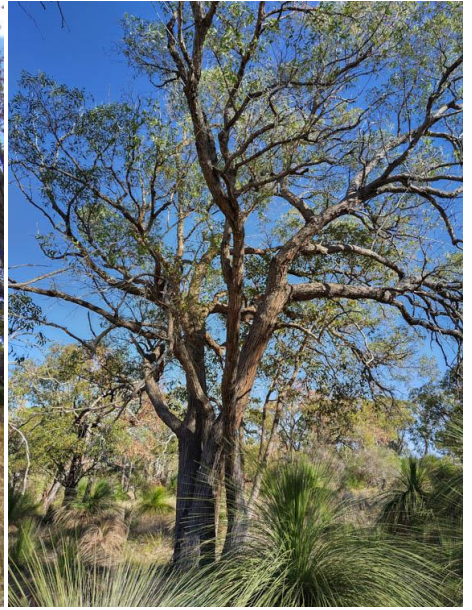
Tree 158



Tree 159



Tree 160



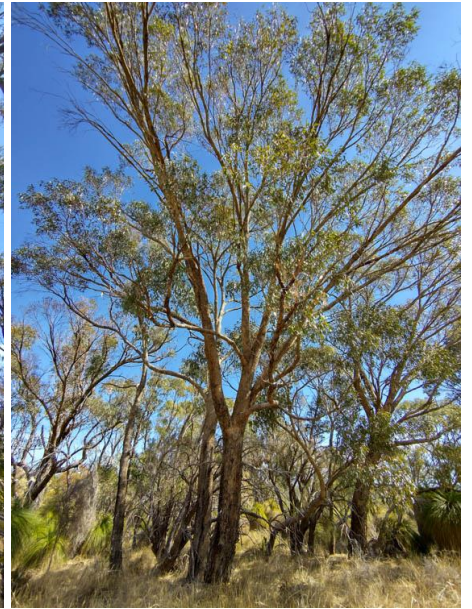
Tree 161



Tree 162



Tree 163



Tree 164



Tree 165



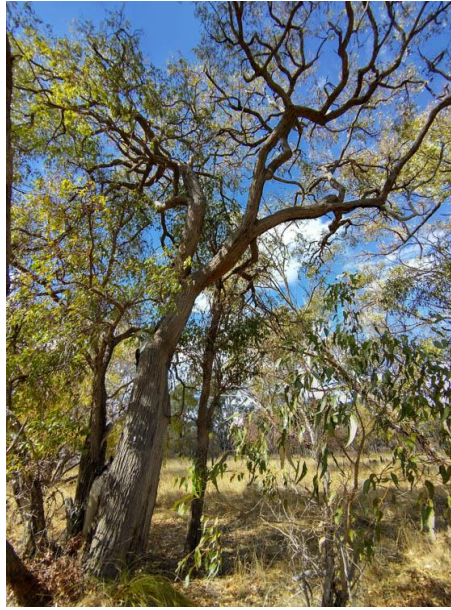
Tree 166



Tree 167



Tree 168



Tree 169



Tree 170



Tree 171



Tree 172



Tree 173



Tree 173



Tre 174



Tree 175



Tree 176



Tree 177



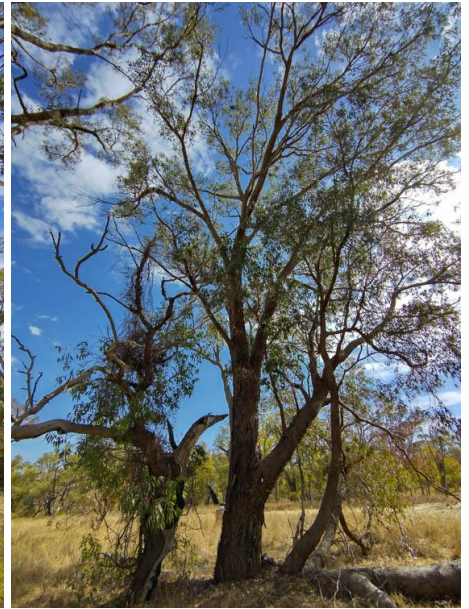
Tree 178



Tree 179



Tree 180



Tree 181



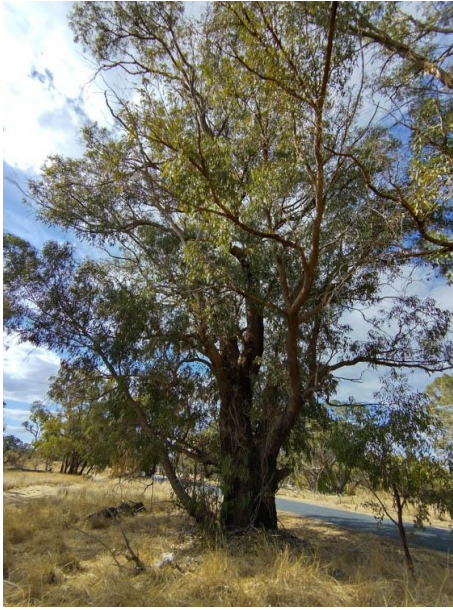
Tree 182



Tree 183



Tree 184



Tree 185



Tree 186



Tree 187



Tree 188



Tree 189



Tree 190



Tree 191



Tree 192



Tree 193



Tree 194



Tree 195



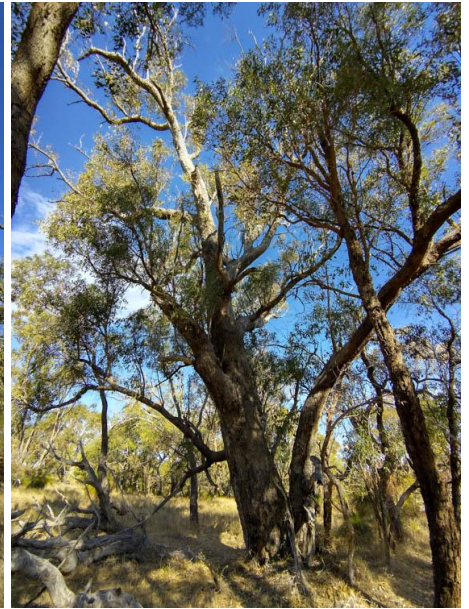
Tree 196



Tree 197



Tree 198



Tree 199



Tree 200



Tree 201



Tree 202



Tree 202



Tree 203



Tree 204



Tree 205



Tree 206



Tree 207



Tree 208



Tree 209



Tree 210



Tree 211



Tree 212



Tree 213



Tree 214



Tree 215



Tree 216



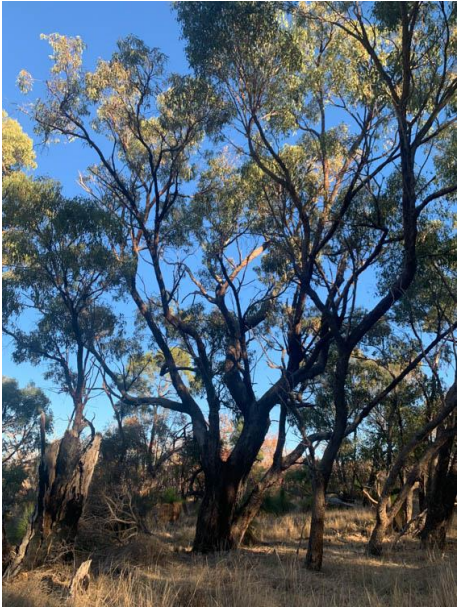
Tree 217



Tree 218



Tree 219



Tree 220



Tree 221



Tree 222



Tree 223



Tree 224



Tree 225



Tree 226



Tree 226



Tree 227



Tree 228



Tree 229



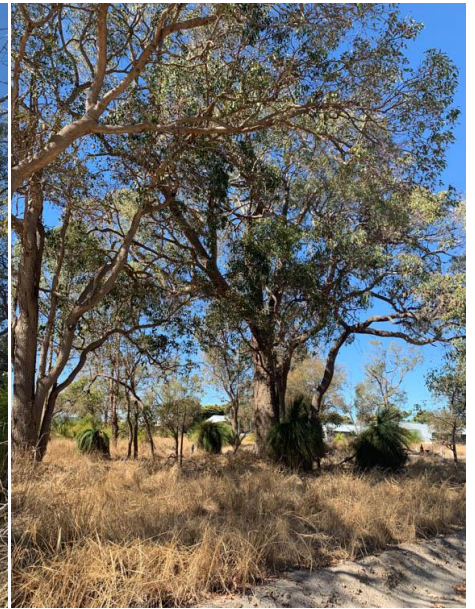
Tree 230



Tree 231



Tree 232



Tree 233



Tree 234



Tree 235



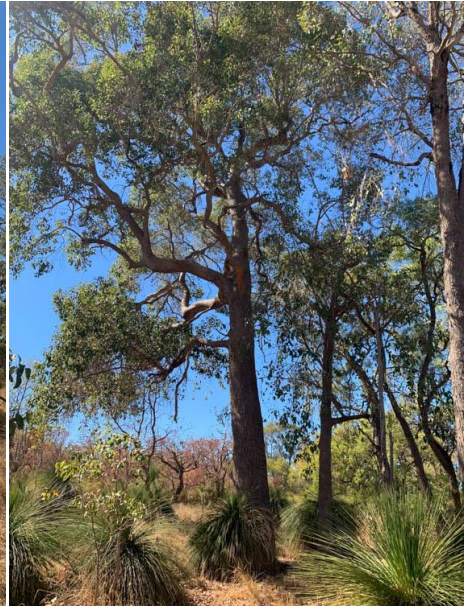
Tree 236



Tree 237



Tree 238



Tree 239



Tree 240



Tree 241

Appendix E.

Vertebrate Fauna Recorded in Biological Surveys in the Region

Basic Vertebrate Fauna Survey and Targeted Black Cockatoo Assessment
Lot 107 Godel Road, Nowergup



E.1 VERTEBRATE FAUNA ASSESSMENTS

Family	Species	Common name	Surveys																									
			A	B					C					D			E											
			Lot 1002	Lot 4	Lot 1	Lot 5	Lot 2477	Opportunis	Site 4	Site 1	Site 6	Site 5	Site 2	Site 3	Opportunis	Site B	Site D	Site N	Site 15B	Site 14B	Site 11B	Site 10B	Site 11A	Site 15A	Site 10A	Site 14A	Site 15	Site 11
Amphibians																												
Limnodynastidae	<i>Heleioporus eyrei</i>	Moaning Frog	X	109	37	1	1	120	1	27	5	12	13	9	24		7	12		2	2	2	1					
	<i>Limnodynastes dorsalis</i>	Western Banjo Frog	X		4			6		4							3					1	2	1				
Myobatrachidae	<i>Crinia georgiana</i>	Quacking Frog	X							4																		
	<i>Crinia insignifera</i>	Sin-bearing Froglet	X							1																		
	<i>Myobatrachus gouldii</i>	Turtle Frog	X																									
	<i>Pseudophryne guentheri</i>	Gunther's Toadlet	X							1																		
Pelodyadidae	<i>Litoria adelaidensis</i>	Slender Tree Frog	X																									
	<i>Litoria moorei</i>	Motorbike Frog	X																									
Reptiles																												
Agamidae	<i>Ctenophorus adelaidensis</i>	Western Heath Dragon	X																									
	<i>Ctenophorus ornatus</i>	Ornate Crevice Dragon	X																									
	<i>Pogona minor</i>	Western Bearded Dragon	X		2			2		1	1	2	1			1	2	2			1		1					
Diplodactylidae	<i>Crenadactylus ocellatus</i>	Clawless Gecko	X																									
	<i>Diplodactylus polyophthalmus</i>	Spotted Sand Plain Gecko	X																									
	<i>Oedura marmorata</i>	Marbled Velvet Gecko								1			1															
	<i>Strophurus spinigerus</i>	South-western Spiny-tailed Gecko	X																									
Elapidae	<i>Brachyuropsis semifasciata</i>	Half-girdled Snake	X																									
	<i>Echiopsis curta</i>	Bardick	X			1																						
	<i>Narophis bimaculatus</i>	Black-naped Burrowing Snake	X				1							1														
	<i>Neelaps calonotos</i>	Black-striped Burrowing Snake	X																									
	<i>Notechis scutatus</i>	Tiger Snake	X																									
	<i>Suta gouldii</i>	Gould's Snake	X		1																							
	<i>Pseudonaja affinis</i>	Dugite	X					4					1	1				2										
	<i>Simoselaps bertholdi</i>	Jan's Banded Snake	X		3		2	2	1				1							1								
Gekkonidae	<i>Christinus marmoratus</i>	Marbled Gecko	X																									
Pygopodidae	<i>Aprasia repens</i>	Southwest Sandplain Worm Lizard	X						1	2	4			1				1										
	<i>Delma fraseri</i>	Fraser's Delma	X															1										
	<i>Delma grayii</i>	Side-barred Delma	X																									
	<i>Lialis burtonis</i>	Burton's Legless Lizard	X		3			5		13	2	9	10	4		2	7	1				1						
	<i>Pletholax gracilis</i>	West Coast Keeled Legless Lizard	X		1			1		1																		

Family	Species	Common name	Surveys																									
			A	B					C					D			E											
			Lot 1002	Lot 4	Lot 1	Lot 5	Lot 2477	Opportunis	Site 4	Site 1	Site 6	Site 5	Site 2	Site 3	Opportunis	Site B	Site D	Site N	Site 15B	Site 14B	Site 11B	Site 10B	Site 11A	Site 15A	Site 10A	Site 14A	Site 15	Site 11
	<i>Pygopus lepidopodus</i>	Common Scaly-foot	X																									
Pythonidae	<i>Antaresia stimsoni</i>	Stimson's Python	X																									
	<i>Morelia spilota</i>	Carpet Python	X										2															
Scincidae	<i>Acritoscincus trilineatus</i>	Western Three-lined Skink	X						3	1									1					3				
	<i>Cryptoblepharus buchananii</i>	Buchanan's Snake-eyed Skink	X	9	8	1				3	8	5	7	4		1	2	2					1	1	1			
	<i>Ctenotus australis</i>	Western Limestone Ctenotus	X	1	9	1	4			2	2	1																
	<i>Ctenotus fallens</i>	West-coast Laterite Ctenotus	X	27	41	10	12			8	1	7					2				9		8	1				
	<i>Cyclodomorphus celatus</i>	Western Slender Bluetongue	X										1															
	<i>Egernia kingii</i>	King's Skink																						2				
	<i>Egernia napoleonis</i>	Southwestern Crevice Skink	X													1								1				
	<i>Hemiergis initialis</i>	South-western Earless Skink			10	1		7																				
	<i>Hemiergis quadrilineata</i>	Two-toed Earless Skink	X		13	9	1	18	4	28	15	9	37	14		3	3	8	4	11	2	7	4			5		
	<i>Lerista elegans</i>	West Coast Four-toed Lerista	X		4		1	2		1	7	6	5	18		1		6	1	1	2			2	3			
	<i>Lerista praepedita</i>	Blunt-tailed West-coast Slider	X							1		1				1												
	<i>Menetia greyii</i>	Common Dwarf Skink	X		12	1	2	2		20	3	6	2	1	18	2	4	3	2			2	4	4	2			
	<i>Morethia lineoocellata</i>	Pale-flecked Morethia								2	3	1	4															
	<i>Morethia obscura</i>	Shrubland Pale-flecked Morethia	X		30	5	1	6		1	3	3	2	5		5	15	9	1	6	7		1		2			
	<i>Tiliqua occipitalis</i>	Western Blue-tongued Lizard			2			2																				
	<i>Tiliqua rugosa</i>	Bobtail	X		9	8	3	1	4	7	3	3	7	3		1	1			5	1	1	1	1		3	2	2
Typhlopidae	<i>Anilius australis</i>	Austral Blind Snake	X				1							1														
Varanidae	<i>Varanus gouldii</i>	Gould's Goanna			1			1																				
	<i>Varanus tristis</i>	Black-headed Monitor	X											1		1												
Chelidae	<i>Chelodina oblonga</i>	South-western Snake-necked Turtle	X																									
Birds																												
Anatidae	<i>Anas superciliosa</i>	Pacific Black Duck							2																			
Columbidae	<i>Streptopelia senegalensis</i>	Laughing Dove						1	2																			
	<i>Phaps chalcoptera</i>	Common Bronzewing						9	1					1														
	<i>Ocyphaps lophotes</i>	Crested Pigeon						2																				
Cuculidae	<i>Chrysococcyx basalis</i>	Horsfield's Bronze-Cuckoo						5					1															
	<i>Chrysococcyx lucidus</i>	Shining Bronze-Cuckoo								3							1											
Podargidae	<i>Podargus strigoides</i>	Tawny Frogmouth						1																				
Turnicidae	<i>Turnix varius</i>	Painted Buttonquail						1																				
Ardeidae	<i>Egretta novaehollandiae</i>	White-faced Heron												1	1													

Family	Species	Common name	Surveys																									
			A	B					C					D			E											
			Lot 1002	Lot 4	Lot 1	Lot 5	Lot 2477	Opportunis	Site 4	Site 1	Site 6	Site 5	Site 2	Site 3	Opportunis	Site B	Site D	Site N	Site 15B	Site 14B	Site 11B	Site 10B	Site 11A	Site 15A	Site 10A	Site 14A	Site 15	Site 11
Pelecanidae	<i>Pelecanus conspicillatus</i>	Australian Pelican																										
Threskiornithidae	<i>Threskiornis spinicollis</i>	Straw-necked Ibis						1																				
Accipitridae	<i>Elanus axillaris</i>	Black-shouldered Kite												1														
	<i>Hieraaetus morphnoides</i>	Little Eagle											1															
	<i>Accipiter fasciatus</i>	Brown Goshawk						1						1														
	<i>Accipiter cirrocephalus</i>	Collared Sparrowhawk						1																				
Tytonidae	<i>Tyto alba</i>	Barn Owl						2																				
Cuculidae	<i>Heteroscenes pallidus</i>	Pallid Cuckoo							1																			
Strigidae	<i>Ninox boobook</i>	Southern Boobook						1					1				1											
Alcedinidae	<i>Dacelo novaeguineae</i>	Laughing Kookaburra						4	7	1		2					1											
	<i>Todiramphus sanctus</i>	Sacred Kingfisher						2	6	1	1	1	3			1												
Meropidae	<i>Merops ornatus</i>	Rainbow Bee-eater						16	1	1			8		1	1												
Falconidae	<i>Falco berigora</i>	Brown Falcon											1															
	<i>Falco peregrinus</i>	Peregrine Falcon						1																				
Cacatuidae	<i>Zanda latirostris</i>	Carnaby's Black-Cockatoo						22				2	6	3				1										
	<i>Eolophus roseicapilla</i>	Galah						78	2	15	5	6	13					1										
	<i>Cacatua sanguinea</i>	Little Corella						18					5															
	<i>Nymphicus hollandicus</i>	Cockatiel						1																				
Psittaculidae	<i>Neophema elegans</i>	Elegant Parrot						10																				
	<i>Barnardius zonarius</i>	Australian Ringneck						60	33	36	7	26	33	3	1	1	1	1										
	<i>Purpureicephalus spurius</i>	Red-capped Parrot						48	1		1					1	1	1										
	<i>Trichoglossus haematodus</i>	Coconut Lorikeet						24		10			4															
Maluridae	<i>Malurus assimilis</i>	Purple-backed Fairywren	X																									
	<i>Malurus lamberti</i>	Variagated Fairywren	X																									
	<i>Malurus splendens</i>	Splendid Fairywren	X					72	5				14			1	1											
	<i>Malurus leucopterus</i>	White-winged Fairywren	X																									
Meliphagidae	<i>Acanthorhynchus superciliosus</i>	Western Spinebill	X					4								1		1										
	<i>Manorina flavigula</i>	Yellow-throated Miner	X																									
	<i>Anthochaera chrysoptera</i>	Little Wattlebird														1	1											
	<i>Anthochaera lunulata</i>	Western Wattlebird	X																									
	<i>Anthochaera carunculata</i>	Red Wattlebird	X					120	14	12	4	10	13	2	1	1	1	1										
	<i>Gavicalis virescens</i>	Singing Honeyeater	X						4	6	6	7	7															
	<i>Ptilotula ornata</i>	Yellow-plumed Honeyeater	X																									
	<i>Epthianura albifrons</i>	White-fronted Chat	X																									

Family	Species	Common name	Surveys																										
			A	B					C					D			E												
			Lot 1002	Lot 4	Lot 1	Lot 5	Lot 2477	Opportunis	Site 4	Site 1	Site 6	Site 5	Site 2	Site 3	Opportunis	Site B	Site D	Site N	Site 15B	Site 14B	Site 11B	Site 10B	Site 11A	Site 15A	Site 10A	Site 14A	Site 15	Site 11	
	<i>Gliciphila melanops</i>	Tawny-crowned Honeyeater	X																										
	<i>Lichmera indistincta</i>	Brown Honeyeater	X					719	3	9		5				1	1	1											
	<i>Phylidonyris novaehollandiae</i>	New Holland Honeyeater	X														1												
	<i>Phylidonyris niger</i>	White-cheeked Honeyeater	X					165	3	1	6	4																	
	<i>Nesoptilotis leucotis</i>	White-eared Honeyeater	X																										
	<i>Melithreptus chloropsis</i>	Gilbert's Honeyeater	X																										
Pardalotidae	<i>Pardalotus punctatus</i>	Spotted Pardalote	X																										
	<i>Pardalotus striatus</i>	Striated Pardalote	X					9		4	4	3	1			1	1												
Acanthizidae	<i>Sericornis frontalis</i>	White-browed Scrubwren	X																										
	<i>Acanthiza inornata</i>	Western Thornbill	X					84		9		17				1		1											
	<i>Acanthiza apicalis</i>	Inland Thornbill	X					11	4																				
	<i>Acanthiza chrysorrhoa</i>	Yellow-rumped Thornbill	X						25	9	10	4																	
	<i>Smicronis brevirostris</i>	Weebill	X					21		3	14	1	12	8															
	<i>Gerygone fusca</i>	Western Gerygone	X					69	6	25	24	10	47	20	2	1	1	1											
Campephagidae	<i>Coracina novaehollandiae</i>	Black-faced Cuckooshrike	X					16	1	11	7	2	5		1	1		1											
	<i>Lalage tricolor</i>	White-winged Triller	X																										
Neosittidae	<i>Daphoenositta chrysoptera</i>	Varied Sittella	X					19																					
Pachycephalidae	<i>Colluricincla harmonica</i>	Grey Shrikethrush	X					36				2					1												
	<i>Pachycephala pectoralis</i>	Golden Whistler	X							1		2					1												
	<i>Pachycephala rufiventris</i>	Rufous Whistler	X					6	3	1	6	1	5	2	1	1	1												
Artamidae	<i>Artamus cinereus</i>	Black-faced Woodswallow	X																										
	<i>Artamus cyanopterus</i>	Dusky Woodswallow	X																										
	<i>Cracticus torquatus</i>	Grey Butcherbird	X					26	7	2	8	8	4	2	1	1	1	1											
	<i>Cracticus nigrogularis</i>	Pied Butcherbird	X																										
	<i>Gymnorhina tibicen</i>	Australian Magpie	X					69	21	11	6	6	9	3	1	1	1												
	<i>Strepera versicolor</i>	Grey Currawong	X																										
Rhipiduridae	<i>Rhipidura leucophrys</i>	Willie Wagtail	X					5																					
	<i>Rhipidura albiscapa</i>	Grey Fantail	X					63	50	3	2	1	11	2	1	1	1												
	<i>Rhipidura fuliginosa</i>	New Zealand Fantail	X																										
Monarchidae	<i>Grallina cyanoleuca</i>	Magpie-lark	X						3	1	2	2	1																
	<i>Myiagra inquieta</i>	Restless Flycatcher	X																										
Corvidae	<i>Corvus coronoides</i>	Australian Raven	X					53	6	22	5	8	14	3	1	1	1	1											
Petroicidae	<i>Microeca fascinans</i>	Jacky Winter	X																										
	<i>Petroica boodang</i>	Scarlet Robin	X									1				1	1												

Family	Species	Common name	Surveys																										
			A	B					C					D			E												
			Lot 1002	Lot 4	Lot 1	Lot 5	Lot 2477	Opportunis	Site 4	Site 1	Site 6	Site 5	Site 2	Site 3	Opportunis	Site B	Site D	Site N	Site 15B	Site 14B	Site 11B	Site 10B	Site 11A	Site 15A	Site 10A	Site 14A	Site 15	Site 11	
	<i>Petroica multicolor</i>	Norfolk Robin						3																					
	<i>Eopsaltria griseogularis</i>	Western Yellow Robin	X																										
	<i>Eopsaltria georgiana</i>	White-breasted Robin	X																										
Acrocephalidae	<i>Acrocephalus australis</i>	Australian Reed Warbler	X																										
Locustellidae	<i>Poodytes gramineus</i>	Little Grassbird	X																										
	<i>Cincloramphus mathewsi</i>	Rufous Songlark	X																										
Hirundinidae	<i>Hirundo neoxena</i>	Welcome Swallow	X																										
	<i>Petrochelidon nigricans</i>	Tree Martin	X																										
	<i>Cheramoeca leucosterna</i>	White-backed Swallow	X																										
Zosteropidae	<i>Zosterops lateralis</i>	Silvereye	X					219	34	26	8	15	90	4		1	1	1											
Dicaeidae	<i>Dicaeum hirundinaceum</i>	Mistletoebird	X																										
Motacillidae	<i>Anthus novaeseelandiae</i>	Australasian Pipit	X																										
Mammals																													
Bovidae	<i>Bos taurus</i>	Cow	X																										
	<i>Ovis aries</i>	Sheep	X																										
Molossidae	<i>Austronomus australis</i>	White-striped Freetail Bat										1					1												
Vespertilionidae	<i>Chalinolobus gouldii</i>	Gould's Wattled Bat									1																		
Dasyuridae	<i>Dasyurus geoffroii</i>	Chuditch	X																										
	<i>Phascogale calura</i>	Red-tailed Phascogale	X																										
Macropodidae	<i>Macropus fuliginosus</i>	Western Grey Kangaroo	X				7	1	11	2	1	1	5	2		1	1	1											
	<i>Notamacropus irma</i>	Western Brush Wallaby	X																										
Phalangeridae	<i>Trichosurus vulpecula</i>	Common Brushtail Possum	X								1		4	4															
Tarsipedidae	<i>Tarsipes rostratus</i>	Honey Possum	X	2												1	2	3	1		1			2					
Leporidae	<i>Oryctolagus cuniculus</i>	Rabbit						1	1				1			1	1	1											
Peramelidae	<i>Isoodon fusciventer</i>	Quenda	X								1																		
Equidae	<i>Equus caballus</i>	Horse							1																				
Muridae	<i>Mus musculus</i>	House Mouse	X	6	4	4	21		8	3	1					1			5	3	3	2	2	2	5	1	1		
	<i>Rattus fuscipes</i>	Bush Rat	X																						1				
	<i>Rattus rattus</i>	Black Rat																	1										

A Atlas of Living Australia

B ATA Environmental (2007) *Flora, Vegetation and Vertebrate Fauna Assessment Neerabup Industrial Area (NIA), Neerabup*. Unpublished report for City of Wanneroo, Perth.

C Biota Environmental Sciences (2000) *Lot 52 Burns Beach Road Fauna Survey*. Unpublished report for ATA Environmental, Perth.

D Department of Conservation and Land Management (1993) *Fauna Studies in Water Supply Reserve 34537, adjacent to Neerabup National Park*. Unpublished report of Department of Environment and Conservation, Perth.

- E Valentine, L.E., Wilson, B.A., Reaveley, A., Huang, N., Johnson, B. and Brown, P. (2009) *Patterns of Ground-dwelling Vertebrate Biodiversity in the Gnangara Sustainability Strategy Study Area*. Department of Environment and Conservation, Perth.

Family	Species	Common name	Surveys													D	E			F	G	H													
			A	B	C										E																				
			Banksia	Eucalypt & Banksia	Dryandra	Acacia	Trinity	Trap Site 4	Trap Site 5	Active 10	Trap Site 3	Trap Site 1	Trap Site 6	Trap Site 2	Trap Site 7	Trap Site 9	Trap Site 8	Cage Line 11	Cage Line 10	Active searches	Bats	Carramar Park	Site 6	Site 5	Site 4	Opportunistic	Unknown	Naturaliste Park	Brighton	Burns Beach	Neerabup National				
Amphibians																																			
Limnodynastidae	<i>Heleioporus eyrei</i>	Moaning Frog	17	1			1																												
	<i>Limnodynastes dorsalis</i>	Western Banjo Frog	2	1	23	4		1	1													1													
Myobatrachidae	<i>Myobatrachus gouldii</i>	Turtle Frog																				1													
Pelodyadidae	<i>Litoria adelaidensis</i>	Slender Tree Frog								1																									
Reptiles																																			
Agamidae	<i>Pogona minor</i>	Western Bearded Dragon	3	1		2	35	1			2	2	4	1		1						4	1												
Diplodactylidae	<i>Strophurus elderi</i>	Jewelled Gecko				1																													
	<i>Strophurus spinigerus</i>	South-western Spiny-tailed Gecko			4	8	81	4			4		3		1	3					1		3												
Elapidae	<i>Brachyuropsis semifasciata</i>	Half-girdled Snake	2				12									1									1										
	<i>Demansia psammophis</i>	Yellow-faced Whipsnake	2	1	2	7	15									1																			
	<i>Echiopsis curta</i>	Bardick				1	8	3							1																				
	<i>Narophis bimaculatus</i>	Black-naped Burrowing Snake					3	1													1														
	<i>Neelaps calonotos</i>	Black-striped Burrowing Snake																									1								
	<i>Suta gouldii</i>	Gould's Snake				1	12		3																										
	<i>Pseudechis australis</i>	Mulga Snake																				1													
	<i>Pseudonaja affinis</i>	Dugite		2	1		9	1				3	2		1	1					1		3												
	<i>Pseudonaja mengdeni</i>	Western Brown Snake					1																												
	<i>Simoselaps bertholdi</i>	Jan's Banded Snake	6		2	2	38	1			1					2																			
Gekkonidae	<i>Christinus marmoratus</i>	Marbled Gecko					10		1												1														
Pygopodidae	<i>Aprasia repens</i>	Southwest Sandplain Worm Lizard																					3	3	2										
	<i>Delma concinna</i>	Javelin Lizard					6	1																											
	<i>Delma fraseri</i>	Fraser's Delma	1				7		3		2	1		1		1					1														
	<i>Delma grayii</i>	Side-barred Delma					22	2								1																			
	<i>Lialis burtonis</i>	Burton's Legless Lizard	1	1			57	2	2			3	12	1	3		4				1		2	3	6										
	<i>Pletholax gracilis</i>	West Coast Keeled Legless Lizard					6																												
	<i>Pygopus lepidopus</i>	Common Scaly-foot			1		22								2																				
Scincidae	<i>Cryptoblepharus buechananii</i>	Buchanan's Snake-eyed Skink	5	2	2		19	3					7								4	1		4	5										
	<i>Ctenotus australis</i>	Western Limestone Ctenotus	5	1	11	3	73	1						1		12																			
	<i>Ctenotus fallens</i>	West-coast Laterite Ctenotus	16	22	20	6	57	9	7		12	6	11	4	8	3	11				2		7	4	2										
	<i>Cyclodomorphus celatus</i>	Western Slender Bluetongue		1	2			4	2		7	6	8	2	4	1	1				2														

Family	Species	Common name	Surveys																														
			A				B	C										D	E	F	G	H											
			Banksia	Eucalypt & Banksia	Dryandra	Acacia	Trinity	Trap Site 4	Trap Site 5	Active 10	Trap Site 3	Trap Site 1	Trap Site 6	Trap Site 2	Trap Site 7	Trap Site 9	Trap Site 8	Cage Line 11	Cage Line 10	Active searches	Bats	Carramar Park	Site 6	Site 5	Site 4	Opportunistic	Unknown	Naturaliste Park	Brighton	Burns Beach	Neerabup National		
	<i>Egernia kingii</i>	King's Skink						1																									
	<i>Egernia napoleonis</i>	Southwestern Crevice Skink		3			20													1													
	<i>Hemiergis quadrilineata</i>	Two-toed Earless Skink	43	32	9	18	123	5	20		6	8	13	23	1	6	17			18			28	58	63								
	<i>Lerista distinguenda</i>	South-western Orange-tailed Slider					1																1	1	4								
	<i>Lerista elegans</i>	West Coast Four-toed Lerista						2	3		9	3	2	3	4	4				4					1	2							
	<i>Lerista elongata</i>	Wide-striped Mulch Slider																				1											
	<i>Lerista lineopunctulata</i>	Dotted-line Robust Slider					2													1													
	<i>Lerista praepedita</i>	Blunt-tailed West-coast Slider					11	4	4		3		1		1	2				6					2	2							
	<i>Menetia greyii</i>	Common Dwarf Skink	3	4	2	2	17	5	8		3	5	7	3	2	4	8			1		1	6	3	5								
	<i>Morethia lineocellata</i>	Pale-flecked Morethia					8						3							1		1	2	1	1								
	<i>Morethia obscura</i>	Shrubland Pale-flecked Morethia	4	3	3		40						7	1						2		1	13	12	8								
	<i>Tiliqua occipitalis</i>	Western Blue-tongued Lizard	2				7		1															1		4							
	<i>Tiliqua rugosa</i>	Bobtail	10	3	3	2	46	6	5		3	3	7	7	2	6	2	3		11		1		1	1	51							
Typhlopidae	<i>Anilius australis</i>	Austral Blind Snake	1				4	1				2												1									
	<i>Anilius pinguis</i>	Rotund Blind Snake					2																										
Varanidae	<i>Varanus gouldii</i>	Gould's Goanna					1	1					1		1	1				1							9						
	<i>Varanus tristis</i>	Black-headed Monitor					1									1				2													
Chelidae	<i>Chelodina oblonga</i>	South-western Snake-necked Turtle								1																							
Birds																																	
Casuariidae	<i>Dromaius novaehollandiae</i>	Emu						1								3											12						
Anatidae	<i>Cygnus atratus</i>	Black Swan								1										1													
	<i>Tadorna tadornoides</i>	Australian Shelduck																		12													
	<i>Anas superciliosa</i>	Pacific Black Duck																		4													
	<i>Biziura lobata</i>	Musk Duck																		1													
Phasianidae	<i>Synoicus ypsilophorus</i>	Brown Quail																									1						
Columbidae	<i>Columba livia</i>	Rock Pigeon						1					2		2												12						
	<i>Streptopelia chinensis</i>	Spotted Dove						4																									
	<i>Streptopelia senegalensis</i>	Laughing Dove			4	6		1					2	2														1					
	<i>Phaps chalcoptera</i>	Common Bronzewing		1	2						3	1		5						5					2	1							
	<i>Phaps elegans</i>	Brush Bronzewing					75																										
	<i>Ocyphaps lophotes</i>	Crested Pigeon			7	3						1														1							

Family	Species	Common name	Surveys																													
			A				B	C						D	E	F	G	H														
			Banksia	Eucalypt & Banksia	Dryandra	Acacia	Trinity	Trap Site 4	Trap Site 5	Active 10	Trap Site 3	Trap Site 1	Trap Site 6	Trap Site 2	Trap Site 7	Trap Site 9	Trap Site 8	Cage Line 11	Cage Line 10	Active searches	Bats	Carramar Park	Site 6	Site 5	Site 4	Opportunistic	Unknown	Naturaliste Park	Brighton	Burns Beach	Neerabup National	
Cuculidae	<i>Chrysococcyx basalis</i>	Horsfield's Bronze-Cuckoo			1	1					1			1												1						
	<i>Chrysococcyx lucidus</i>	Shining Bronze-Cuckoo							1		1		3									1										
	<i>Cacomantis pallidus</i>	Pallid Cuckoo												1	1																	
	<i>Cacomantis flabelliformis</i>	Fan-tailed Cuckoo																							1							
Aegothelidae	<i>Aegotheles cristatus</i>	Australian Owlet-nightjar																								1						
Podargidae	<i>Podargus strigoides</i>	Tawny Frogmouth						1						4	1											1						
Rallidae	<i>Fulica atra</i>	Eurasian Coot								20											2											
	<i>Porphyrio melanotus</i>	Australasian Swampphen								1																						
Scolopacidae	<i>Calidris acuminata</i>	Sharp-tailed Sandpiper																									1					
	<i>Calidris subminuta</i>	Long-toed Stint																								1						
Laridae	<i>Chroicocephalus novaehollandiae</i>	Silver Gull																										1				
Pelecanidae	<i>Pelecanus conspicillatus</i>	Australian Pelican								1											1											
Threskiornithidae	<i>Threskiornis molucca</i>	Australian White Ibis									1										4											
	<i>Threskiornis spinicollis</i>	Straw-necked Ibis																			2											
Accipitridae	<i>Elanus axillaris</i>	Black-shouldered Kite				1																1										
	<i>Hieraaetus morphnoides</i>	Little Eagle						1					1																			
	<i>Accipiter fasciatus</i>	Brown Goshawk	1	1	1									1							1					1						
	<i>Accipiter cirrocephalus</i>	Collared Sparrowhawk																														
	<i>Haliastur sphenurus</i>	Whistling Kite				1											1				4											
Tytonidae	<i>Tyto alba</i>	Barn Owl																								1						
Cuculidae	<i>Heteroscenes pallidus</i>	Pallid Cuckoo																				1										
Strigidae	<i>Ninox boobook</i>	Southern Boobook							1		1	1	1	1			1															
	<i>Ninox novaeseelandiae</i>	Morepork																							1	2						
Alcedinidae	<i>Dacelo novaeguineae</i>	Laughing Kookaburra		6					3	2				5	1	1	1			2		1					1					
	<i>Todiramphus sanctus</i>	Sacred Kingfisher	1	2																			2			1	1		1			
Meropidae	<i>Merops ornatus</i>	Rainbow Bee-eater						18				2	2	5	2		4			1					2	1						
Falconidae	<i>Falco cenchroides</i>	Nankeen Kestrel	1											1								1										
	<i>Falco longipennis</i>	Australian Hobby																								1						
	<i>Falco berigora</i>	Brown Falcon									1										1											
	<i>Falco peregrinus</i>	Peregrine Falcon											1																			
Cacatuidae	<i>Zanda sp.</i>	Black-Cockatoo sp.																									1					
	<i>Calyptorhynchus banksii</i>	Red-tailed Black-Cockatoo															4			1												

Family	Species	Common name	Surveys																												
			A				B		C										D	E		F	G	H							
			Banksia	Eucalypt & Banksia	Dryandra	Acacia	Trinity	Trap Site 4	Trap Site 5	Active 10	Trap Site 3	Trap Site 1	Trap Site 6	Trap Site 2	Trap Site 7	Trap Site 9	Trap Site 8	Cage Line 11	Cage Line 10	Active searches	Bats	Carramar Park	Site 6	Site 5	Site 4	Opportunistic	Unknown	Naturaliste Park	Brighton	Burns Beach	Neerabup National
	<i>Zanda latirostris</i>	Carnaby's Black-Cockatoo	8	1	2			6	17		9	11	9	1	1	3	4			11		1	12	19	3	1	9963				
	<i>Eolophus roseicapilla</i>	Galah	4	12	2			4	6		2	11		15	8	5	8			1		1	10	8	8	1		1			
	<i>Cacatua sanguinea</i>	Little Corella				2									29					4			8	4	2	1					
Psittaculidae	<i>Neophema elegans</i>	Elegant Parrot						3	4		5	2	4			2	2			1											
	<i>Barnardius zonarius</i>	Australian Ringneck		14	2				6			3	6	6	1		6	2		2		1	2	7	4	1		1			
	<i>Purpureicephalus spurius</i>	Red-capped Parrot						4	2			2			1		2					1				1					
	<i>Glossopsitta porphyrocephala</i>	Purple-crowned Lorikeet													2																
	<i>Trichoglossus haematodus</i>	Coconut Lorikeet						1							16	4	7			2					2	1					
Maluridae	<i>Malurus splendens</i>	Splendid Fairywren	18	22	30	12		17	4		2						10	3		18		1	6	3	4	1					
	<i>Malurus leucopterus</i>	White-winged Fairywren															10			9											
Meliphagidae	<i>Acanthorhynchus superciliosus</i>	Western Spinebill									1											1							1		
	<i>Manorina flavigula</i>	Yellow-throated Miner																				1						1	1		
	<i>Anthochaera chrysoptera</i>	Little Wattlebird																				1						1			
	<i>Anthochaera lunulata</i>	Western Wattlebird					1				1	2											2								
	<i>Anthochaera carunculata</i>	Red Wattlebird	15	11	11	1			3		2	11		11	1	1	2			3		1	1	2	5			1			
	<i>Gavicalis virescens</i>	Singing Honeyeater	10		4	7					11	3	2	1			3			1			1			1		1			
	<i>Lichmera indistincta</i>	Brown Honeyeater	11	44		3	3	55	28	2	7				21	21				27		1	6			1		1			
	<i>Phylidonyris novaehollandiae</i>	New Holland Honeyeater					2	34			56		10		8	2				37											
	<i>Phylidonyris niger</i>	White-cheeked Honeyeater		10	230	30					38		1		4					1						1		1			
	<i>Melithreptus brevirostris</i>	Brown-headed Honeyeater					4				2				11					21						1					
Pardalotidae	<i>Pardalotus striatus</i>	Striated Pardalote		1				4			1		4				1			3		1	7	7	5	1		1			
Acanthizidae	<i>Sericornis frontalis</i>	White-browed Scrubwren			3				8				2										2		2	1					
	<i>Acanthiza inornata</i>	Western Thornbill				7		18														1				1					
	<i>Acanthiza apicalis</i>	Inland Thornbill																		4											
	<i>Acanthiza chrysorrhoa</i>	Yellow-rumped Thornbill	3																			1	9	8	4	1					
	<i>Smicronis brevirostris</i>	Weebill		11										15						14						1					
	<i>Gerygone fusca</i>	Western Gerygone	6	10		1		3			1		7	1						3			10	12	6	1					
Campephagidae	<i>Coracina novaehollandiae</i>	Black-faced Cuckooshrike	3	1	3	1	2				8				2					4			2	1		1		1			
	<i>Lalage tricolor</i>	White-winged Triller			1																					1					
Neosittidae	<i>Daphoenositta chrysoptera</i>	Varied Sittella						8	4														4	6							
Pachycephalidae	<i>Colluricincla harmonica</i>	Grey Shrikethrush		8	5				1			1	1			1	1			2		1			2	1					
	<i>Pachycephala pectoralis</i>	Golden Whistler	9	5																			2		1						

Family	Species	Common name	Surveys										Active searches	Bats	Carramar Park	Site 6	Site 5	Site 4	Opportunistic	Unknown	Naturaliste Park	Brighton	Burns Beach	Neerabup National												
			A	B	C																				D	E	F	G	H							
			Banksia	Eucalypt & Banksia	Dryandra	Acacia	Trinity	Trap Site 4	Trap Site 5	Active 10	Trap Site 3	Trap Site 1	Trap Site 6	Trap Site 2	Trap Site 7	Trap Site 9	Trap Site 8	Cage Line 11	Cage Line 10																	
	<i>Pachycephala occidentalis</i>	Western Whistler																		2																
	<i>Pachycephala rufiventris</i>	Rufous Whistler						1						1		1	2			6		1	4	4	10	1										
Artamidae	<i>Artamus cinereus</i>	Black-faced Woodswallow			11			2																												
	<i>Cracticus torquatus</i>	Grey Butcherbird	3	3	6	2					1			3			2					1	1			1		1	1							
	<i>Gymnorhina tibicen</i>	Australian Magpie	6	7		1								12	5										4	15		1	1							
	<i>Strepera versicolor</i>	Grey Currawong																							1											
Rhipiduridae	<i>Rhipidura leucophrys</i>	Willie Wagtail	1		1						1	2		1											3		1									
	<i>Rhipidura albiscapa</i>	Grey Fantail	1	4							1			1						2		1	3	2	1											
Monarchidae	<i>Grallina cyanoleuca</i>	Magpie-lark												1								1			1		1									
Corvidae	<i>Corvus coronoides</i>	Australian Raven	1			2		4	5	2	2	8		3	9					2		1	1	4	4	14		1								
Petroicidae	<i>Microeca fascians</i>	Jacky Winter																							2											
	<i>Petroica boodang</i>	Scarlet Robin						1														1			1											
	<i>Eopsaltria griseogularis</i>	Western Yellow Robin																							1											
Acrocephalidae	<i>Acrocephalus australis</i>	Australian Reed Warbler								2										1																
Hirundinidae	<i>Hirundo neoxena</i>	Welcome Swallow				4																			1		1									
	<i>Petrochelidon nigricans</i>	Tree Martin									2	4	4							4		1			5											
	<i>Cheramoeca leucosterna</i>	White-backed Swallow									2									4																
Zosteropidae	<i>Zosterops lateralis</i>	Silvereye	11	45	70	62		8	1	12		1		1	1	1	1			17		1	9		1		1	1								
Dicaeidae	<i>Dicaeum hirundinaceum</i>	Mistletoebird																							1											
Motacillidae	<i>Anthus novaeseelandiae</i>	Australasian Pipit				2														1																
Mammals																																				
Tachyglossidae	<i>Tachyglossus aculeatus</i>	Short-beaked Echidna																							1								1			
Canidae	<i>Canis lupus</i>	Dingo																							4											
	<i>Vulpes vulpes</i>	Red Fox	1				1	1			4	2	1	1		1	1			2					58							1	2			
Felidae	<i>Felis catus</i>	Cat						2								1									5							1	1			
Balaenidae	<i>Eubalaena australis</i>	Southern Right Whale																																		
Molossidae	<i>Austronomus australis</i>	White-striped Freetail Bat								4															X											
	<i>Mormopterus sp. 4</i>	South-western Free-tail Bat								6																										
Vespertilionidae	<i>Nyctophilus sp.</i>	Long-eared Bat sp..																		9	5															
	<i>Chalinolobus gouldii</i>	Gould's Wattleed Bat								17										8	9					X										
	<i>Nyctophilus geoffroyi</i>	Lesser Long-eared Bat																									X									
	<i>Vespadelus regulus</i>	Southern Forest Bat																		16																

Family	Species	Common name	Surveys										D	E	F	G	H																						
			A	B	C																																		
			Banksia	Eucalypt & Banksia	Dryandra	Acacia	Trinity	Trap Site 4	Trap Site 5	Active 10	Trap Site 3	Trap Site 1	Trap Site 6	Trap Site 2	Trap Site 7	Trap Site 9	Trap Site 8	Cage Line 11	Cage Line 10	Active searches	Bats	Carramar Park	Site 6	Site 5	Site 4	Opportunistic	Unknown	Naturaliste Park	Brighton	Burns Beach	Neerabup National								
Dasyuridae	<i>Dasyurus geoffroii</i>	Chuditch																														2							
Macropodidae	<i>Macropus fuliginosus</i>	Western Grey Kangaroo	3	1	6			14	2		1	1	2	3		3	1				1														86				
	<i>Notamacropus irma</i>	Western Brush Wallaby						1																													14		
Phalangeridae	<i>Trichosurus vulpecula</i>	Common Brushtail Possum																									9												
Tarsipedidae	<i>Tarsipes rostratus</i>	Honey Possum			16								1																							1			
Leporidae	<i>Oryctolagus cuniculus</i>	Rabbit						2	2				4			2											6												
Peramelidae	<i>Isoodon fusciventer</i>	Quenda					1	4	3		1	4	8	1	2	2	2	2	3									21											
Muridae	<i>Mus musculus</i>	House Mouse	4	7	17	13	98					1	1	3		2					2																		
	<i>Pseudomys albocinereus</i>	Ash-grey Mouse																																			2		
	<i>Rattus fuscipes</i>	Bush Rat			1		6																																
	<i>Rattus rattus</i>	Black Rat					2																		1												5		

- A Coffey Environments (2008) *Vertebrate Fauna Assessment, Lot 3 Romeo Road, Alkimos*. Unpublished report for Northern Corridor Developments Limited, Perth.
- B Terrestrial Ecosystems (2012) *Vertebrate fauna relocation outcomes for Trinity*, Unpublished report for Coterra Environment and LWP, Perth.
- C GHD (2019) *Mitchell Freeway Extension Hester Avenue to Romeo Road Biological Survey*. Unpublished report for Main Roads WA, Perth.
- D Ecoscape (1991) *Biological Survey - Carramar Park*, Unpublished report for City of Wanneroo, Perth.
- E GHD (2014) *Neerabup Road Extension Level 2 Fauna Survey*. Unpublished report for Main Roads, Perth.
- F DBCA threatened species database
- G Gole, C.A. (2003) *Bird Survey in selected Perth Metropolitan Reserves. A Joint Biodiversity Conservation Project between Birds Australia WA and Perth Biodiversity Project*. Unpublished report Birds Australia and Perth Biodiversity Project; Perth.
- H Western Australian Museum (1978) *Faunal Studies of the Northern Swan Coastal Plain: A Consideration of Past and Future Changes*. Report for the Department of Conservation and Environment, Perth.

Appendix F. Definitions of Significant Fauna under the WA Biodiversity Conservation Act 2016 and Priority Species

**Basic Vertebrate Fauna Survey and Targeted Black Cockatoo Assessment
Lot 107 Godel Road, Nowergup**



APPENDIX F

DEFINITIONS OF SIGNIFICANT FAUNA UNDER THE WA BIODIVERSITY CONSERVATION ACT 2016

Threatened, Extinct and Specially Protected fauna or flora¹ are species² 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.

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).

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 birds protected under an international agreement

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 dependant 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

P1 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.

P2 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.

P3 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.

P4 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.

Appendix G.

Fauna habitat assessment results

Basic Vertebrate Fauna Survey and Targeted Black Cockatoo Assessment
Lot 107 Godel Road, Nowergup



Date: 12/04/2024

Habitat Assessment #: 1

Observer: Simon Pitt

GDA94 50; 380534 mE 6500429 mN

Fire History: > 5yrs

Landform: Flat

Soil Type: Sand

Habitat Quality: Disturbed

Surface: Sand

Habitat Type: Eucalypt woodlands over grass



Date: 12/04/2024

Habitat Assessment #: 2

Observer: Simon Pitt

GDA94 50; 380476 mE 6500423 mN

Fire History: > 5yrs

Landform: Flat

Soil Type: Sand

Habitat Quality: Disturbed

Surface: Sand

Habitat Type: Eucalypt woodlands over grass



Date: 12/04/2024

Habitat Assessment #: 3

Observer: Simon Pitt

GDA94 50; 380431 mE 6500424 mN

Fire History: > 5yrs

Landform: Flat

Soil Type: Sand

Habitat Quality: Good

Surface: Sand

Habitat Type: Eucalypt woodlands over grass



Date: 12/04/2024

Habitat Assessment #: 4

Observer: Simon Pitt

GDA94 50; 380326 mE 6500426 mN

Fire History: > 5yrs

Landform: Flat

Soil Type: Sand

Habitat Quality: Very Good

Surface: Sand

Habitat Type: Eucalypt woodlands over grass



Date: 12/04/2024

Habitat Assessment #: 5

Observer: Simon Pitt

GDA94 50; 380226 mE 6500421 mN

Fire History: > 5yrs

Landform: Flat

Soil Type: Sand

Habitat Quality: Very Good

Surface: Sand

Habitat Type: Eucalypt woodlands over grass



Date: 12/04/2024

Habitat Assessment #: 6

Observer: Simon Pitt

GDA94 50; 380182 mE 6500402 mN

Fire History: > 5yrs

Landform: Flat

Soil Type: Sand

Habitat Quality: Disturbed

Surface: Sand

Habitat Type: Eucalypt woodlands over grass



Date: 12/04/2024

Habitat Assessment #: 7

Observer: Simon Pitt

GDA94 50; 380185 mE 6500333 mN

Fire History: > 5yrs

Landform: Slope

Soil Type: Sand

Habitat Quality: Disturbed

Surface: Sand

Habitat Type: Eucalypt woodlands over grass



Date: 12/04/2024

Habitat Assessment #: 8

Observer: Simon Pitt

GDA94 50; 380235 mE 6500336 mN

Fire History: > 5yrs

Landform: Slope

Soil Type: Sand

Habitat Quality: Very Good

Surface: Sand

Habitat Type: Eucalypt woodlands over grass



Date: 12/04/2024

Habitat Assessment #: 9

Observer: Simon Pitt

GDA94 50; 380306 mE 6500336 mN

Fire History: > 5yrs

Landform: Slope

Soil Type: Sand

Habitat Quality: Disturbed

Surface: Sand

Habitat Type: Eucalypt woodlands over grass



Date: 12/04/2024

Habitat Assessment #: 10

Observer: Simon Pitt

GDA94 50; 380422 mE 6500340 mN

Fire History: > 5yrs

Landform: Flat

Soil Type: Sand

Habitat Quality: Very Good

Surface: Sand

Habitat Type: Eucalypt woodlands over grass



Date: 12/04/2024

Habitat Assessment #: 11

Observer: Simon Pitt

GDA94 50; 380521 mE 6500329 mN

Fire History: > 5yrs

Landform: Flat

Soil Type: Sand

Habitat Quality: Disturbed

Surface: Sand

Habitat Type: Eucalypt woodlands over grass



Date: 12/04/2024

Habitat Assessment #: 12

Observer: Simon Pitt

GDA94 50; 380506 mE 6500246 mN

Fire History: > 5yrs

Landform: Flat

Soil Type: Sand

Habitat Quality: Very Good

Surface: Sand

Habitat Type: Eucalypt woodlands over grass



Date: 12/04/2024

Habitat Assessment #: 13

Observer: Simon Pitt

GDA94 50; 380429 mE 6500250 mN

Fire History: > 5yrs

Landform: Flat

Soil Type: Sand

Habitat Quality: Good

Surface: Sand

Habitat Type: Eucalypt woodlands over grass



Date: 12/04/2024

Habitat Assessment #: 14

Observer: Simon Pitt

GDA94 50; 380330 mE 6500245 mN

Fire History: > 5yrs

Landform: Flat

Soil Type: Sand

Habitat Quality: Disturbed

Surface: Sand

Habitat Type: Eucalypt woodlands over grass



Date: 12/04/2024

Habitat Assessment #: 15

Observer: Simon Pitt

GDA94 50; 380228 mE 6500241 mN

Fire History: > 5yrs

Landform: Slope

Soil Type: Sand

Habitat Quality: Very Good

Surface: Sand

Habitat Type: Eucalypt woodlands over grass



Date: 12/04/2024

Habitat Assessment #: 16

Observer: Simon Pitt

GDA94 50; 380220 mE 6500155 mN

Fire History: > 5yrs

Landform: Slope

Soil Type: Sand

Habitat Quality: Very Good

Surface: Sand

Habitat Type: Eucalypt woodlands over grass



Date: 12/04/2024

Habitat Assessment #: 17

Observer: Simon Pitt

GDA94 50; 380322 mE 6500157 mN

Fire History: > 5yrs

Landform: Slope

Soil Type: Sand

Habitat Quality: Good

Surface: Sand

Habitat Type: Eucalypt woodlands over grass



Date: 12/04/2024

Habitat Assessment #: 18

Observer: Simon Pitt

GDA94 50; 380429 mE 6500156 mN

Fire History: > 5yrs

Landform: Flat

Soil Type: Sand

Habitat Quality: Very Good

Surface: Sand

Habitat Type: Eucalypt woodlands over grass



Date: 12/04/2024

Habitat Assessment #: 19

Observer: Simon Pitt

GDA94 50; 380495 mE 6500146 mN

Fire History: > 5yrs

Landform: Flat

Soil Type: Sand

Habitat Quality: Disturbed

Surface: Sand

Habitat Type: Eucalypt woodlands over grass



Date: 12/04/2024

Habitat Assessment #: 20

Observer: Simon Pitt

GDA94 50; 380452 mE 6500051 mN

Fire History: > 5yrs

Landform: Slope

Soil Type: Sand

Habitat Quality: Very Good

Surface: Sand

Habitat Type: Eucalypt woodlands over grass



Date: 12/04/2024

Habitat Assessment #: 21

Observer: Simon Pitt

GDA94 50; 380321 mE 6500037 mN

Fire History: > 5yrs

Landform: slope

Soil Type: Sand

Habitat Quality: Very Good

Surface: Sand

Habitat Type: Low Eucalypt woodlands over grass tree shrubland



Date: 12/04/2024

Habitat Assessment #: 22

Observer: Simon Pitt

GDA94 50; 380225 mE 6500046 mN

Fire History: > 5yrs

Landform: Slope

Soil Type: Sand

Habitat Quality: Very Good

Surface: Sand

Habitat Type: Low Eucalypt woodlands over grass tree shrubland



Date: 12/04/2024

Habitat Assessment #: 23

Observer: Simon Pitt

GDA94 50; 380204 mE 6499979 mN

Fire History: > 5yrs

Landform: Slope

Soil Type: Sand

Habitat Quality: Very Good

Surface: Sand

Habitat Type: Low Eucalypt woodlands over grass tree shrubland



Date: 12/04/2024

Habitat Assessment #: 24

Observer: Simon Pitt

GDA94 50; 380322 mE 6499939 mN

Fire History: > 5yrs

Landform: Flat

Soil Type: Sand

Habitat Quality: Very Good

Surface: Sand

Habitat Type: Low Eucalypt woodlands over grass tree shrubland



Date: 12/04/2024

Habitat Assessment #: 25

Observer: Simon Pitt

GDA94 50; 380392 mE 6499959 mN

Fire History: > 5yrs

Landform: slope

Soil Type: Sand

Habitat Quality: Very Good

Surface: Sand

Habitat Type: Low Eucalypt woodlands over grass tree shrubland



Date: 12/04/2024

Habitat Assessment #: 26

Observer: Simon Pitt

GDA94 50; 380432 mE 6499965 mN

Fire History: > 5yrs

Landform: Slope

Soil Type: Sand

Habitat Quality: Very Good

Surface: Sand

Habitat Type: Low Eucalypt woodlands over grass tree shrubland







Appendix 3 Black Cockatoo Hollow Assessment

6 August 2025

Claire Norman
Senior Scientist
Coterra Environment
Level 1
98 Colin St
West Perth WA 6005

Re: **Black-Cockatoo tree assessment**

Dear Claire

Terrestrial Ecosystems is pleased to provide the results of the assessment of five tree hollows on Lot 107 Godel Rd, Nowergup.

Terrestrial Ecosystems zoologist Mitch Plozza used a Mavic Mini 1 drone (Plate 1) to inspect five tree hollows on 1 August 2025.



Plate 1. DJI Mavic mini drone

Each tree was given a ranking following Bamford's ranking methodology, as follows:

- Rank 1: Activity at hollow observed; adult (or immature) bird seen entering or emerging from hollow. Can also be used for a known nest tree active in the previous 12 months (although this should be noted in the description). Note that activity at a hollow does not absolutely mean that breeding is occurring unless a young bird in hollow is observed.
- Rank 2: Hollow of suitable size visible with chew marks around entrance. Record if chew-marks are recent or old.
- Rank 3: Potentially suitable hollow visible but no chew marks present at entrance; or potentially suitable hollow suspected to be present - as suggested by structure of tree, such as large, vertical trunk broken off at a height of >8m; but note that hollow height is contextual. Carnaby's Black-Cockatoo will nest in hollows < 5m so in a Wheatbelt breeding site a lower criterion may be more appropriate.
- Rank 4: Tree with large hollows or broken branches that might contain large hollows, but hollows or potential hollows (nest chamber) 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. Trees with low but otherwise suitable hollows can also be assigned a rank or 4, depending on the species of black-cockatoo likely to be present.
- Rank 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.

Tree number 157 (Plate 4) is ranked 2 based on old chew marks around the entrance to the hollow and is of suitable size (Plate 5). Tree number 147 (Plate 2) is ranked 4 based on the hollow chamber is not vertical and deep enough to support Carnaby cockatoo nesting (Plate 3). Tree number 173 (Plate 6) is ranked 4 because the hollow is filled with large organic pieces of matter (Plate 7). Trees 202 and 226 (Plates 8 and 10) are ranked 3, as both hollows have large pieces of organic matter inside the chamber (Plates 9 and 11). A summary of the results is provided in Table 1.

A new hollow was found in a different marked tree, with results provided in Table 2. The hollow (Plates 12 and 13) is ranked 3 based on a large entrance and chamber into the trunk. It is likely that the hollow is newly formed from a fallen limb, exposing the entrance, and not enough time has passed for cockatoos to occupy the hollow, and they have not yet chewed around the hollow entrance. The tree supports nesting Galahs in an obscured hollow (Plates 14 and 15). The occupied hollow is not suitable for Carnaby Cockatoos, so data were not recorded.

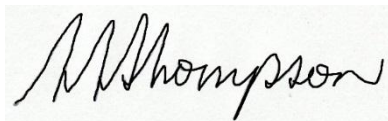
Table 1. Summary of results

Tree #	Ranking	Notes
T147	Rank 4	Hollow chamber not vertical and shallow. Unlikely to support Carnaby's Cockatoo.
T157	Rank 2	Old chew marks around entrance.
T173	Rank 4	Hollow filled with large organic matter pieces and shallow chamber.
T202	Rank 3	Large organic matter pieces.
T226	Rank 3	Large organic matter pieces.

Table 2. New hollow recorded

Tree Number	Ent size (cm)	Orientation	Height above ground (m)	Type	Ranking	Notes
T119	25	North	15	Trunk	3	Nesting galahs in the same tree, but occupying a different hollow that is not suitable for Carnaby's Black-Cockatoo

Yours sincerely



Dr Scott Thompson
Director and Principal Zoologist



Plate 2. Tree 147



Plate 3. Tree 147 hollow chamber



Plate 4. Tree 157



Plate 5. Tree 157 hollow chamber



Plate 6. Tree 173



Plate 7. Tree 173 hollow chamber



Plate 8. Tree 202



Plate 9. Tree 202 hollow chamber



Plate 10. Tree 226



Plate 11. Tree 226 hollow chamber



Plate 12. Tree 199 hollow



Plate 13. Tree 199 hollow chamber



Plate 14. Tree 199 Galah's near nest hollow



Plate 15. Galah nest hollow (obscured entrance)

Disclaimer

This document is prepared in accordance with and subject to an agreement between Terrestrial Ecosystems and the client, Coterra Environment. It has been prepared and is restricted to those issues that have been raised by the client in its engagement of Terrestrial Ecosystems and prepared using the standard of skill and care ordinarily exercised by environmental scientists in the preparation of such reports.

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Appendix 4 Proposed Sand Extraction Earthworks Plan



Appendix 5 Fauna Management

Fauna Management

The clearing of native vegetation associated with resource extraction onsite has the potential to result in injuries and fatalities to native fauna, particularly ground- or tree-dwelling mammals and lizards, if no impact management measures are established.

The below information has been provided to identify the fauna management actions proposed for the site.

City of Wanneroo Local Planning Policy 3.3: Fauna Management

City of Wanneroo (CoW) Local Planning Policy 3.3: Fauna Management identifies the following CoW objectives:

1. Ensure the effective management of macro-fauna by landowners and/or developers of land proposed for urban development; and
2. Avoid the unwanted impacts of displaced macro-fauna due to habitat disturbance.

For the purpose of this Policy, 'fauna' and 'macro-fauna' relates specifically to macro-fauna such as kangaroos and emus.

Fauna management measures are required by the policy prior to any disturbance or clearing of native vegetation/ natural wildlife habitat. A summary of how these measures are addressed by the proposal is provided below in Table 1.

Table 1: Fauna Management Actions

CoW Requirement	Actions Proposed
2.2.1 Survey the fauna (type and number) contained on the site/property intended to be cleared and developed, and document appropriately, including potential impacts to fauna and how those impacts will be avoided or minimised.	A Basic Vertebrate Fauna Survey and Targeted Black Cockatoo Assessment was undertaken for the site by Terrestrial Ecosystems. Reports are provided as Appendix 2 and Appendix 3 to the EAMR.
2.2.2 Install kangaroo and emu proof fencing to the satisfaction of the City of Wanneroo prior to the disturbance of existing habitat where macro-fauna is known to be present. Fencing needs to encompass the entire perimeter of the land holding that is intended to be disturbed and needs to be in place for the duration of site works across all stages of development.	Site fencing which will be Kangaroo and Emu proof will be installed prior to the commencement of site works. Fencing is proposed to be installed progressively along site boundaries, with fauna relocators to be available during fencing installation to encourage fauna movement of kangaroos and emus, if present, toward the habitat available on Lot 201 Gibbs Road and Lot 106 McLennan Drive.
2.2.3 Fencing will include signage at intervals of 75 meters or intervals as required by the City to direct any enquiries to the developer/landowner and the DBCA.	Boundary fencing to the site as outlined within Sections 3.1, 3.2 and 4.0 of the EAMR and discussed below.
2.2.4 Consideration of all available options for effective and humane fauna management must be demonstrated. If the satisfactory relocation of the fauna is not possible, the advice of the DBCA and experienced wildlife management practitioners should be undertaken to develop alternative options for management	Noted. An approved alternative method for fauna management will be investigated if required.
2.2.5 If required, obtain relevant specifications and permits for the relocation of fauna from the DBCA.	Prior to commencement of works onsite the selected fauna consultant will obtain a Fauna Taking (Relocation)

CoW Requirement	Actions Proposed
	Licence, issued by the Department of Biodiversity, Conservation and Attractions (DBCA) . A copy of this licence will be provided to CoW at least 2 weeks prior to fauna relocation commencing onsite.
2.2.6 Undertake the management program in accordance with applicable permits or licence on advice from the DBCA.	Fauna relocation will be undertaken in accordance with the conditions of the DBCA issued licence, including release site requirements.

Fauna and Relocation Management

As noted in Section 2.6 of the EAMR the macrofauna which may be present onsite and could require management as part of site clearing programs include the below (Table 2).

Table 2: Fauna Management

Potential Fauna (Common Name)	Scientific Name	Native Status	Proposed Management
Western Grey Kangaroo	<i>Macropus fuliginosus</i>	Yes	Nil required for uninjured individuals. Kangaroos will disperse into nearby bushland when disturbed. Exclusion fencing is proposed prior to site works commencing to prevent interaction with site machinery.
Quenda	<i>Isoodon fusciventer</i>	Yes	Individuals could be encountered during active foraging and manual capture during the clearing program. Relocation of captured individuals will occur offsite at a suitable location.
Common Brushtail Possum	<i>Trichosurus vulpecula</i>	Yes	Individuals could be encountered during active foraging and manual capture during the clearing program. Relocation of captured individuals will occur offsite at a suitable location.
Snakes including Dugites, Black Striped Snakes and Yellow-faced Whip Snakes	<i>Pseudonaja affinis</i> <i>Neelaps calonotos</i> <i>Demansia psammophis</i>	Yes	Individuals could be encountered during active foraging and manual capture. Relocation of captured individuals will occur offsite at a suitable location.
Ground burrowing frogs	Various	Yes	Individuals could be encountered during active foraging and manual capture. Relocation of individuals will occur offsite at a suitable location.
Bobtails, small geckoes and skinks.	<i>Tiliqua rugosa</i> Various geckoes and skinks	Yes	Individuals could be encountered during active foraging and manual capture. Relocation of individuals will occur offsite at a suitable location.
Feral/ domestic cat	<i>Felis Catus</i>	No	Will vacate site if disturbed. No management proposed.
Red fox	<i>Vulpes vulpes</i>	No	Will vacate site if disturbed. No management proposed.

Potential Fauna (Common Name)	Scientific Name	Native Status	Proposed Management
European rabbit	<i>Oryctolagus cuniculus</i>	No	Will vacate site if disturbed. No management proposed.
House mice and black rats	<i>Mus musculus</i> <i>Rattus rattus</i>	No	Euthanised in line with the recommended DBCA Standard Operating Procedure (SOP) for field euthanasia.

Overview

The following measures will be undertaken for the site:

- Prior to clearing, fencing will be installed around identified boundaries of the proposed clearing extent. Fencing will be installed progressively, encouraging and allowing individuals to move toward retained bushland outside of the site.
- Where possible, clearing is to be undertaken outside of the main breeding season for bushland birds (i.e. between July and November), to avoid inflicting damage to nesting birds and their young.
- Fauna relocation to be undertaken by a qualified wildlife handler during clearing.
- Any native fauna injured during the clearing of vegetation is to be attended to by a qualified wildlife carer / veterinarian.
- Feral fauna attractants and potential native fauna traps such as open skip bins will be minimised onsite.

The specific details of the proposed program are outlined below.

DBCA Liaison and Licencing

A Fauna Taking (Relocation) Licence to Take or Disturb Fauna for the purpose of Relocating (Fauna Licence) will be obtained by the selected fauna relocation contractor. A copy of this licence will be provided to the City of Wanneroo prior to fauna relocation commencing.

Clearing Programme

Fauna relocation is to be undertaken using the following methodology:

Site Reconnaissance

Prior to the commencement of the fauna relocation, the site will be assessed by the Fauna Relocator to determine the current likely-fauna presence based on faunal indicators within the relevant clearing stage. Specifically, current signs of kangaroos and emu presence (e.g. tracks or scats) will be searched for, as they require specific management if present on site, however are considered unlikely to occur based on the proposed exclusion fencing being installed prior to site works. Current signs of Quenda (*Isoodon fusciventer*) foraging will also be searched for, and if deemed to be present cage trapping will be implemented.

If any unforeseen fauna-related issues are identified, these will be brought to the attention of the Proponent and Project Environmental Consultant and further discussed with the City of Wanneroo and/or the DBCA so that an appropriate plan can be made and implemented.

During Clearing

The number of fauna relocators and amount of time taken to complete the search will depend on the extent of vegetation clearing in each stage. As a minimum, one fauna relocator will search the site for one day for each piece of machinery undertaking clearing.

The timeframe between finalising the site reconnaissance and commencement of clearing will be minimised as much as possible, and will not exceed one week.

Capture of Terrestrial Fauna

Manual Capture

Manual capture is a term used to describe a suite of techniques that are used to hand-capture fauna. These techniques primarily target reptiles and nesting birds (in season), although occasionally mammals or frogs may also be found. The specific techniques used are determined by factors such as the weather, site characteristics (e.g. the presence of rubbish, leaf litter, etc.) and the species of fauna likely to be present. Techniques include, but are not necessarily limited to:

- Raking leaf litter and loose soil on windrows
- Lifting or turning large logs, rubbish or rocks for fauna sheltering underneath
- Stripping bark from dead trees for fauna sheltering underneath
- Breaking open rotten logs or dead grasstrees for fauna sheltering inside
- Searching for reptiles (e.g. dragons, bobtails or geckoes) that are basking on tracks or in vegetation
- Searching for nests (in the nesting season) by observing adult bird behaviour or listening for chicks
- Spot-lighting for nocturnal species, such as geckoes or frogs, while they are active at night
- Using a snake hook and bag to capture active snakes.

These methods will be utilised pre and during clearing, with a Fauna Relocator to remain on site throughout the clearing works to undertake manual capture of fauna that have not been captured prior to clearing. The Fauna Relocator will spend at least three half-days searching for fauna prior to clearing commencing.

As manual capture methods rely on the hand-capture of fauna, hot conditions can result in relatively few captures, as fauna are active and move away too quickly to be caught. Therefore, in the summer months manual capture methods would be employed in the early morning, late afternoon or at night, to avoid extremes of temperature.

Cage Traps

Cage traps are generally used to target medium-sized mammals such as quenda (*Isoodon fusciventer*).

If evidence of quenda is observed during the zoologists pre-clearing inspection of the site, cage traps will be implemented for a period of 7 nights, or until the first night native fauna is not captured within the 7 day period. Where clearing is predicted to take several days, cage traps may be deployed each evening in the areas yet to be cleared and checked and removed in the morning prior to clearing re-commencing.

Traps must be clean prior to deployment. A hessian bag or alternative cover must be placed over cage traps to shade any captured fauna from the heat or rain and traps will be placed in shaded areas, such as under dense shrubby vegetation.

When trapping, a four-day weather forecast will be consulted in order to determine the suitability of the climate for trapping. If it forecast to exceed 30°C, traps will be checked more frequently, or traps may be closed after checking in the morning and re-opened in the late afternoon.

Reptile Trapping

The vegetation clearing may be undertaken in warmer and cooler months.

During the cooler months, most of the terrestrial reptiles will be inactive, or confined to very small home ranges, so there is little value in a pre-clearing fauna trapping program targeting reptiles. There will be no trapping for reptiles in the cooler months, although reptiles will be hand caught during the vegetation clearing program through the active foraging program. The search will involve the raking leaf litter, turning rocks and rubbish and sorting through fallen vegetation.

Kangaroos

The strategy proposed in relation to Kangaroos is to exclude kangaroos from the area through provision of boundary fencing which will allow current family groups who may be present in the vicinity of the site to remain together with minimal stress. This strategy is proposed based on the large area of remnant vegetation present in surrounding areas.

Should the extent of surrounding kangaroo habitat areas change, consultation will be undertaken with CoW and DBCA to discuss the potential need for specific kangaroo management requirements which may include active relocation of kangaroos away from the area.

Tree Inspections

The fauna relocater will inspect suitable trees and shrubs to determine if any active birds' nests are present. Where practicable and when chicks have a good chance of survival and being released into bushland, the chicks will be collected and given to a wildlife carer to raise. Trees likely to contain a hollow (small and large) which could support arboreal fauna or nesting birds (i.e. Brushtail Possum, parrots, etc), will be inspected from the ground or if necessary using ladders/pole cameras/drones, to determine if any hollows are in use.

Where a tree or tree hollow supports a bird's nest containing eggs or chicks, and it is feasible and practical to leave the tree until the chick(s) have fledged, then the tree will be left, otherwise it will be removed, and the on-site zoologist will do his/her best to recover any chicks and a decision will be made on whether they are given to wildlife carers or euthanised. This decision will be made by the on-site fauna relocater based on the probability of these animals being successfully raised, released into bushland and surviving. All eggs will be humanely euthanised. Brushtail Possums and other arboreal mammals will be relocated.

Relocation Sites

Relocation sites are determined specifically for various species. Factors contributing to relocation site selection include:

- size
- soil type
- vegetation complex
- topography
- availability of resources
- nature of the species being released.

Fauna relocation sites proposed to be used as part of this relocation program include regional reserves, adjacent fauna habitats and private/public landholdings where land manager permission has been provided. Highly mobile fauna would not be relocated into adjacent areas as they are likely to return, however, less mobile fauna may be relocated to areas closer to the site as they will not return. The exact location for captured fauna will be at the discretion of the onsite fauna relocater and subject to the conditions of the DBCA licence.

Fate of Captured Fauna

Uninjured adult native fauna will be transported to the release site as soon as practicable, with the maximum hold time being 10 hours for most species. Fauna will be held and transported in a species-appropriate container, usually small calico bags for reptiles, larger heavyweight calico bags for medium-sized mammals and bags or containers with damp soil for frogs. Bags may be placed inside a rigid box or esky for safety during transport.

As noted above, where possible, nestlings and eggs will always be left in situ until the young have fledged. When left in situ, the area around the nest will be clearly demarcated with flagging tape and this will be

communicated to the clearing personnel. Where this is not possible chick and eggs will be removed from the nest or, if a suitable location is available, bird nests will be relocated.

Injured fauna may be humanely euthanised in the field if considered too injured for treatment, referencing DBCA's SOP for field euthanasia. Injured fauna considered to have a chance at recovery will be transported to an appropriate vet or wildlife carer, depending on the species and level of injury.

Small feral fauna such as rats and mice may be euthanised on site following the DBCA Standard Operating Procedure guidance for field euthanasia. All domestic animals, including all cats, will be delivered to the City of Wanneroo Animal Care Centre immediately upon capture.

Beehives

Prior to clearing commencing a search will be undertaken for feral beehives, and if found to be present, these will be removed by an experienced bee management contractor.

Equipment

The following equipment may be used for the capture and relocation of fauna across the site. This list is not considered exhaustive:

- rake, snake hook and bag
- fauna collection bags
- esky and/or boxes for temporary safe storage of bagged fauna prior to relocation
- fauna identification reference books, field guides etc.
- GPS.

Record Keeping and Reporting

The following information is to be recorded during every fauna capture:

- GPS coordinates for capture/trapping sites.
- environmental observations
 - weather
 - topography
 - vegetation type and condition
 - soil type
- Number and species of fauna captured.

The following information is recorded during every trapping for relocation event:

- GPS coordinates for release sites
- environmental observations
 - weather
 - topography
 - vegetation type and condition
 - soil type
- number and species of fauna released.

The information recorded during trapping and relocation (as listed above) will be provided to the City of Wanneroo and DBCA as part of the Fauna Licence requirements. The reporting will also include a discussion regarding the results of implementation the fauna management works.

This information will be provided to aforementioned authorities within 30 days of the conclusion of the vegetation clearing program.

Injured Fauna Protocol

Should injured, abandoned, or distressed fauna be found onsite the following Injured Fauna Protocol will be undertaken:

1. Animal found.
2. Identify animal, if possible (determine if potentially venomous).
3. Contact Project Manager, Fauna Relocator or Environmental Consultant for instructions. If these representatives cannot be reached, contact the DBCA Wildcare helpline (**9474 9055**).
4. If unable to stay with the animal, clearly mark its position so it is visible to all personnel that approach the site.
5. First preference is to leave the animal alone until experienced assistance arrived. If this is not possible the following handling and temporary holding instructions may be enacted (only if absolutely necessary and only as a last resort)
 - Adult nesting birds (and all avifauna) are protected by the *Biodiversity Conservation Act 2016* and should be left undisturbed if uninjured. Young birds found within a nest should only be removed if considered by a specialist to be abandoned or injured.
 - For any small mammals found at any time on site, the best method of storage and transportation would be within hessian sacks. Mammals may become stressed and agitated in traps or hard containers, sometimes resulting in injury. Mammals transported in hessian sacks remain calmer due to the dark environment and if kept in the shade and on a soft, secure surface can be transported with relatively limited stress and injury.
 - Reptiles can, in most cases, be transported within calico bags of varying size to suit the animal. Plastic carry boxes can also be used with some air holes, leaf litter and sand within them. The animals should always be placed within an area of shade so that they do not overheat.
6. If in any doubt about whether the animal is venomous, do not under any circumstances attempt to handle it. Instead, monitor the location of the animal from a safe distance and await arrival of an experienced wildlife officer or reptile handler.
7. Fauna Consultant to contact DBCA or wildlife carers as appropriate.



Appendix 6 Dust Assessment

Dust Assessment

This assessment has been undertaken with reference to the 'Guideline for managing impacts of dust and associated contaminants from land development sites, contaminated sites remediation and other related activities' (DEC, 2011).

Site Classification Assessment

Table 1 and Table 2 below present the completed Site Classification Assessment Charts sourced from the DEC guidelines.

Table 1: Part A Assessment Criteria – Nature of the Site

Item	Score Options				Score
1. Nuisance potential of soil, when disturbed	Very Low	Low	Medium	High	2
	1	2	4	6	
2. Topography and protection provided by undisturbed vegetation	Sheltered and Screened	Medium Screening	Little Screening	Exposed and wind prone	6
	1	6	12	18	
3. Area of site disturbed by the works	Less than 1 ha	Between 1 and 5 ha	Between 5 and 10 ha	More than 10 ha	9
	1	3	6	9	
4. Type of work being done	Roads or shallow trenches	Roads, drains and medium depth sewers	Roads, drains, sewers and partial earthworks	Bulk earthworks and deep trenches	9
	1	3	6	9	
Total Score for Part A					26

Source: DEC, 2011

Table 2 Part B Assessment Criteria – Proximity to Other Land Uses

Item	Score Options				Score
Distance of other and uses from site	More than 1km	Between 1km and 500m	Between 100m and 500m	Less than 100m	12
	1	6	12	18	
Effect of prevailing wind direction (at time of construction) on other land uses	Not affected	Isolated land uses affected by one wind direction	Dense land uses affected by one wind direction	Dense / sensitive land uses highly affected by prevailing winds	1
	1	6	9	12	
Total Score for Part B					13

Source: DEC 2011

Site Classification Score (A x B)	338
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Site Classification Levels:

- Site classification 1 (Negligible risk) — under 199
- Site classification 2 (Low risk) — 200 to 399
- Site classification 3 (Medium risk) — 400 to 799
- Site classification 4 (High risk) — over 800

The classification score for the proposed resource extraction at Lot 107 Godel Road is 338, which considers the site as Classification 2 and at low risk for dust impacts. This classification forms the basis of dust management provisions, contingency arrangements and monitoring requirements as per DEC (2011) guidelines.

COTERRA ENVIRONMENT

Level 1, 98 Colin Street
West Perth WA 6005

T (08) 9381 5513

www.coterra.com.au
info@coterra.com.au

