Desktop Assessment of Selected Lots within Kemerton Industrial Area

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Abbreviations

Abbreviation	Description
BAM Act	Biosecurity and Agriculture Management Act 2007
BoM	Bureau of Meteorology
DEC	Department of Environment and Conservation
DotEE	Department of the Environment and Energy
ELA	Eco Logical Australia
EPA	Environmental Protection Authority
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999
FCCT	Floristic Community Type
ha	Hectares
IBRA	Interim Biogeographical Regionalisation for Australia
km	Kilometers
mm	Millimeters
Parks and Wildlife	Department of Parks and Wildlife
PEC	Priority Ecological Community
PMST	Protected Matters Search Tool
S2V	S2V Consulting
TEC	Threatened Ecological Community
WA	Western Australia
WC Act	Wildlife Conservation Act 1950

Executive summary

Eco Logical Australia was engaged by S2V Consulting to undertake a desktop study and site inspection for two lots (referred to as the eastern lot and western lot for the purpose of guiding development options) within Kemerton Industrial Area, Western Australia. The purpose of this work was to develop a stand-alone report encompassing existing biological data and information, as well as results from a brief site inspection, with the purpose of informing site planning providing input into environmental assessment and approvals documentation for any future industrial facility on the lots.

As part of this work, Eco Logical Australia reviewed existing reports and data for the broader Kemerton Industrial Area and undertook a site inspection to verify and update findings of the desktop assessment where required. The site inspection was undertaken over a single day on the 20 March 2017.

The western lot of the study area supports numerous ecological values, including conservation significant species and vegetation communities that may represent a higher level of constraint for future development as compared to the eastern lot. The western lot almost entirely contains remnant vegetation, mostly of Very Good and Good condition with few disturbances. This vegetation supports the conservation significant flora species, *Acacia semitrullata* (Priority 4), and potentially provides habitat for several other conservation significant flora species, many of which are significant at a state and federal level. Most of this vegetation also represents the federally listed Threatened Ecological Community 'Banksia Woodlands of the Swan Coastal Plain' and the Parks and Wildlife Priority 3 ecological community 'Low lying *Banksia attenuata* woodlands or shrublands'. This vegetation also provides high - moderate value foraging and breeding habitat (including several trees which have been verified as suitable breeding trees) for the conservation significant fauna species, Black Cockatoos (Carnaby's Black Cockatoo, Forest Red-tailed Black-Cockatoo and Baudin's Cockatoo).

The eastern lot has almost entirely been historically cleared, leaving only a small area (2 ha) of remnant vegetation. The small area of remnant vegetation in the eastern lot supports similar ecological values as the western lot (habitat for conservation significant flora and fauna and represents the 'Banksia Woodlands of the Swan Coastal Plain' TEC), apart from breeding habitat for the Black Cockatoo, which is considered to be of moderate value in this vegetation.

Apart from the area of remnant vegetation, the remaining areas of the eastern lot consist of pine plantation, partially cleared pine plantation and previously cleared paddocks. While many of these previously cleared areas are regenerating with native species, the condition of this vegetation is Degraded or Completely Degraded. Of note, is that the pine plantation represents high quality foraging habitat for the listed threatened Carnaby's Cockatoo and Baudin's Cockatoo.

Approximately 30 ha of the eastern lot is a mapped wetland however this wetland has been assigned a management category of 'Multiple Use', which is a wetland possessing few remaining important attributes and functions, except for local hydrological function. Consideration should be given to the implications of draining and/or filling in of the wetland on local hydrology if proposed for development.

1 Introduction

Eco Logical Australia (ELA) was engaged by S2V Consulting (S2V) to undertake a desktop study and site inspection for two lots (study area) within Kemerton Industrial Area, Western Australia. The purpose of this work was to develop a stand-alone report encompassing existing biological data and information that has been ground-truthed as far as practicable from site inspection with the purpose of informing site planning providing input into environmental assessment and approvals documentation for any future industrial facility on the lots.

The tasks involved for these works were:

- A desktop study utilising previous studies and data to extract and describe known flora, vegetation and fauna values and characteristics that occur on site;
- A site inspection to validate existing data and determine presence of the 'Banksia woodlands of the Swan Coastal Plain (Endangered) Threatened Ecological Community' (TEC) and to identify the likelihood of previous unrecorded populations of threatened species occurring; and
- Preparation of a stand-alone summary report detailing the outcomes of the desktop study and site inspection, including all relevant figures, describing the known and potential environmental values of the site with the purpose of being attached to any future State or Commonwealth referrals.

1.1 Study area

The study area is approximately 22 kilometres (km) north of Bunbury, Western Australia. The study area is made up of two sites bound by Marriott Road to the south and an unnamed road to the west within the Kemerton Industrial Area. The northern and eastern boundaries are bound by agricultural land (**Figure 1**). For the purpose of this report, and in context of known development options, the study area consists of two parts, which are referred to as the eastern lot and western lot where applicable (**Figure 1**).

1.2 Climate

The study area is in the Perth subregion, which experiences a warm, Mediterranean climate with hot dry summers and mild wet winters (Mitchell et al. 2002). Based on climate data from the nearby Bureau of Meteorology (BoM) Brunswick Junction Weather Station (Station number 9513, rainfall data 1972 – current, approximately 10 km east of the study area), the study area has received a total of 91.2 millimetres (mm) of rainfall in the three months prior to the site inspection in March 2017, which is well above the annual average rainfall of 40.8 mm for the same period (BoM 2017).

Based on climate data from the nearby BoM Bunbury Weather Station (Station number 9965, temperature data 1972 – current, approximately 27 km southwest of the study area), mean monthly maximum temperatures in the area range from 17.3 ^{o}C in July to 30.1 ^{o}C in February, and mean monthly minimum temperatures range from 7 ^{o}C in July to 15.9 ^{o}C in February (BoM 2017).

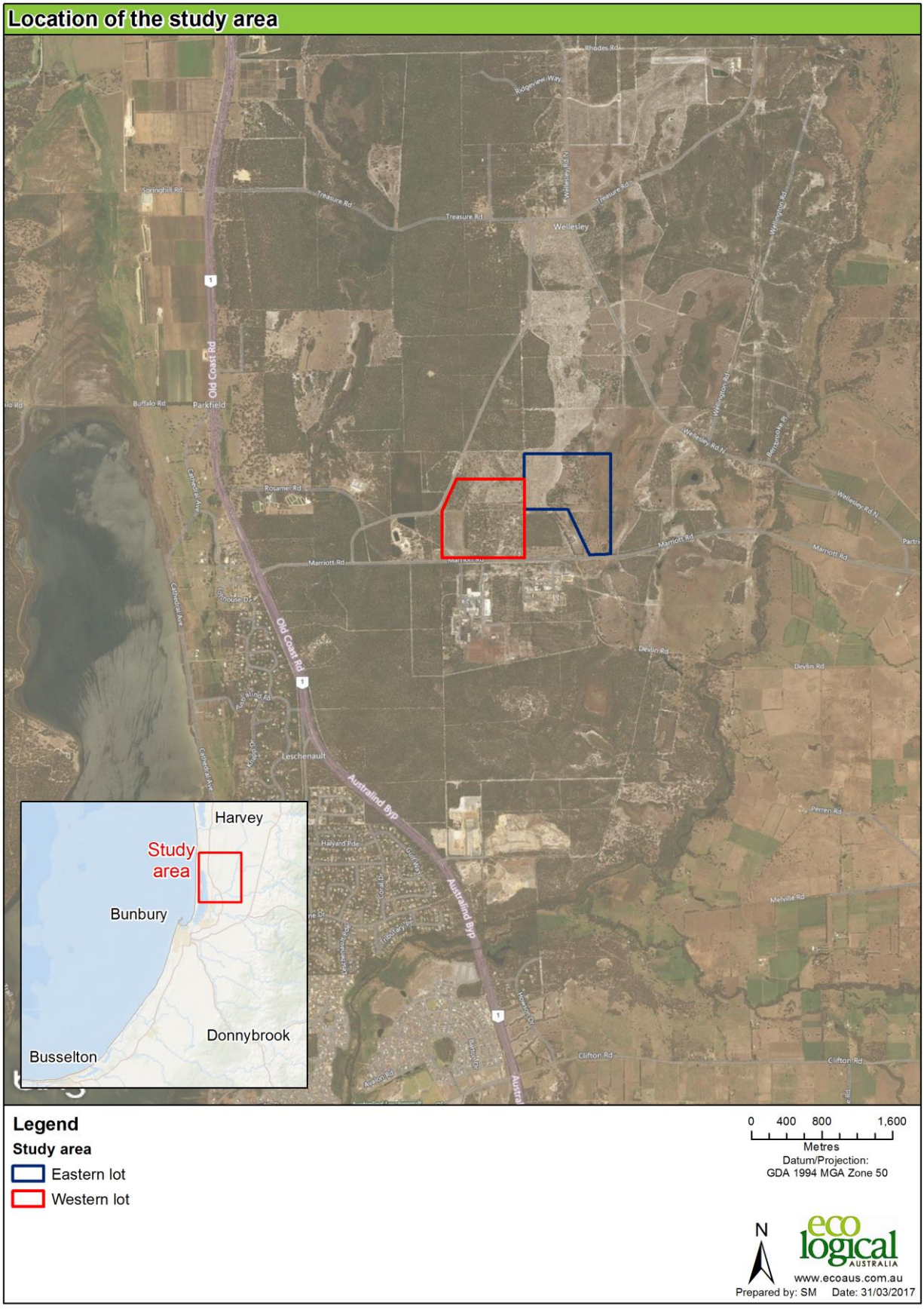

Figure 1: Location of the study area

1.3 Regional context

The existing environmental attributes relevant to the study area is presented in **Table 1**.

Table 1: Existing environmental attributes of the study area

Existing Environment Attributes	Study Area
Interim Biogeographical Regionalisation for Australia (IBRA) Bioregion*	Swan Coastal Plain
IBRA Subregion*	Perth (SWA2)
Soil landscape system**	Bassendean Sands and Guilford Formation
Vegetation complex^	Bassendean complex

* Department of the Environment and Energy [DotEE] 2017a

**Government of Western Australia 2000

^Heddle et al. 1980

1.4 Broad-scale vegetation mapping

Vegetation of the Swan Coastal Plain has been mapped and described by Heddle et al. (1980) as 'vegetation complexes', which represents the structural and floristic description linked to geomorphology (Environmental Protection Authority [EPA] 2016).

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

The study area is situated in the Bassendean complex – central and south, vegetation association 1000. The remaining pre-European extent of the Bassendean complex – central and south on the Swan Coastal Plain is 26.1% (EPA 2015). The remaining pre-European extent of vegetation association 1000 on the Swan Coastal Plain is 25.24% (Government of Western Australia 2015).

2 Methodology

2.1 Desktop assessment and literature review

ELA previously consolidated and extrapolated existing ecological data and undertook further surveys at Kemerton to assist in determining relationships between vegetation communities mapped and defined in previous investigations and fill knowledge gaps. The purpose of this was to fill identified knowledge gaps to increase understanding of ecological values at Kemerton for purpose of informing environmental approvals and management. This work included the current study area and hence the report *Targeted Ecological Surveys for Kemerton Industrial Park* (ELA 2014) forms the primary basis for the desktop review.

Methods and results of the desktop assessment and literature review, and comparisons of vegetation communities mapped by previous investigations, specific to the study area are outlined in the following sections.

2.1.1 Previous studies relevant to the study area

The ELA (2014) study consolidates a number of reports and datasets pertaining to the Kemerton Industrial Area and surrounds were reviewed and consolidated:

- AECOM (2012) 'Kemerton Industrial Park: Threatened Orchid Survey'
- Bamford Consulting (2011) 'Black Cockatoo and Western Ringtail Possum Habitat Assessment, Kemerton Industrial Park, Bunbury'
- Cardno (2010a) 'Kemerton Industrial Core: Flora and Vegetation Survey'
- Cardno (2010b) 'Kemerton Industrial Core: Fauna Survey'
- Coffey Environments (2007) 'Kemerton Industrial Park Environmental Overview for the KIP Strategy Plan'
- Coffey Environments (2008) 'Flora, Vegetation, Wetlands and Fauna Assessment Kemerton Industrial Park'
- Mattiske Consulting (2011a) 'EPBC Act Significance Criteria Review of the Proposed Kemerton Industrial Park Development'
- Mattiske Consulting (2011b) 'EPBC Act Significance Test of the Proposed Subdivision of 510 Marriott Road, Kemerton'
- Muir Environmental (1999a) 'Report of Biological Survey – Phase 1: Kemerton Industrial Estate Volume 1 Report'
- Muir Environmental (1999b) 'Summary Report – Kemerton Industrial Area Phase 1 Biological Survey'
- Paul Armstrong and Associates (1999a) 'Kemerton Industrial Estate (Original Core Zone) Spring 1999 Rare Flora Search'
- Paul Armstrong and Associates (1999b) 'Kemerton Industrial Estate (Expanded Core Zone) Mid- and Late Spring 1999 Rare Flora Search'
- Paul Armstrong and Associates (1999c) 'Kemerton Industrial Estate (Support Industry Area) Mid- and Late Spring 1999 Rare Flora Search'
- Paul Armstrong and Associates (2007) 'Review of Vegetation Types Monitored within the Kemerton Industrial Estate and Identification of Deficiencies.'

Vegetation mapping available for the Kemerton Industrial Park consolidated in ELA (2014) included:

- Vegetation mapping by Muir (1999c) which covers the whole of Kemerton Industrial Park

- Vegetation mapping by Coffey (2008) which covers part of the core within Kemerton Industrial Park
- Vegetation mapping by Cardno (2010a) which covers the core of Kemerton Industrial Park
- Vegetation condition mapping by Mattiske (2011c) which covers the whole of Kemerton Industrial Park
- Heddle et al. (1980) vegetation complex mapping which covers the whole of Kemerton Industrial Park
- Geomorphic Wetlands Swan Coastal Plain dataset (DEC 2013a)

2.1.2 Database searches

The following Commonwealth and State databases were searched for information relating to conservation listed flora, fauna and ecological communities, to compile and summarise existing data to inform the field inspection. **Table 2** presents the database searches undertaken around the central coordinate (383935m E, 6324968m N).

Table 2: Database searches

Database	Reference	Buffer (km)
Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) Protected Matters Search Tool (PMST) for Threatened species and communities listed under the EPBC Act	DotEE 2017b	10
NatureMap online flora and fauna database	Parks and Wildlife 2007 - 2017	10
Threatened Flora listed under the latest WA Wildlife Conservation (Rare Flora) Notice and Priority listed flora[1], acquired by Landcorp in December 2012	DEC 2012	n/a
Threatened Ecological Communities database search, acquired by Landcorp in January, 2013	DEC 2013b	n/a

[1]As of 1 July 2013, the DEC was renamed the Department of Parks and Wildlife (Parks and Wildlife). As data searches were obtained by LandCorp from DEC prior to 1 July 2013, and/or mapping was undertaken prior to the change to Parks and Wildlife, references to searches/mapping are made to DEC.

2.1.3 Likelihood of occurrence assessment

Conservation listed flora and fauna species that possibly occur within the survey area were identified from a review of key datasets and literature. An assessment of the likelihood of occurrence of conservation listed flora and fauna was made using existing species records from the database searches and the results of the site inspection.

The following criteria was used:

- Known to occur: Recorded from the study area, through database search results and/or from previous surveys of the study area (<20 years)
- Likely to occur: The study area is within the species current distribution and contains suitable habitat for the species, however;
    - The species utilises seasonal habitat or has a large home range, so is not always present/visible in the study area; and/or
    - Survey limitations identified.
- Potential to occur: The study area is within the species current distribution and contains habitat, however (at least two of below);
    - The study area is located on the edge of the species range or it has a patchy distribution; and/or
    - Survey limitations identified; and/or
    - Habitat is less suitable; and/or
    - Species is cryptic, and/or difficult to record utilising traditional survey methods.
- Unlikely to occur: The study area is within the species current distribution and either:
    - contains habitat, was adequately surveyed (including for seasonal, migratory and cryptic species and fauna species with large home ranges) and did not record the species; or
    - the habitat is modified and unlikely to support the species and survey limitations identified.
- Does not occur: The study area is within the species current distribution, and was adequately surveyed (including for seasonal, migratory and cryptic species and fauna species with large home ranges) and did not record the species. The study area may not contain suitable habitat. There is certainty that the species is not present in the study area.

2.2 Site inspection

A site inspection was conducted on the 20 March 2017 by ELA Senior Botanist Joel Collins, to ground truth values identified in previous surveys and update where required. These included vegetation communities, previously recorded conservation significant flora, and identification of any suitable habitat for conservation listed flora and fauna species.

3 Results

3.1 Flora

The most recent flora report to date, which included a survey of full floristics of the Kemerton Industrial Area inner core where the study area is located, was undertaken by Cardno (2010a). In this study, 324 native species and 74 introduced (weed) species were recorded from 61 families and 178 genera representing an area of approximately 2,500 ha. The top three most dominant families were Orchidaceae (43 native, 1 weed taxon), Fabaceae (29 native, 9 weed taxa) and Myrtaceae (23 native taxa, no weed taxon). The three most common genera were *Acacia* (15 species), *Caladenia* (13 species) and *Lomandra* (11 species). Results returned from a search of the NatureMap database (Parks and Wildlife 2007 – 2017), with a 5 km buffer, included a total of 309 flora species with the three most dominant families comprising Fabaceae (25 native, 1 weed taxon), Orchidaceae (20 native, 1 weed taxon) and Asteraceae (9 native, 4 weed taxon).

Of the 74 weed species recorded by Cardno (2010a), two species are listed as a Declared Pest under the *Biosecurity and Agriculture Management Act 2007* (BAM Act). These species include: **Gomphocarpus fruticosus* (Narrow Leaf Cotton Bush) and **Zantedeschia aethiopica* (Arum Lily).

Common weed species observed within the study area during the site inspection included **Ursinia anthemoides* subsp. *anthemoides* (Ursinia), **Hypochaeris glabra* (Smooth Catsear), **Ehrharta calycina* (Perennial Veldt Grass), **Cynodon dactylon* (Couch) and **Briza maxima* (Blowfly Grass). In particular, **Ehrharta calycina* (Perennial Veldt Grass) is widespread and occurs in previously cleared areas in high densities.

3.1.1 Conservation significant flora

One conservation significant flora species, *Acacia semitrullata* (Priority 4) has previously been recorded within the study area at four locations, including three within the western lot and one in the eastern lot (**Figure 2**). This species was observed in the western lot during the site inspection. Apart from within a small area of remnant vegetation covering approximately two hectares (ha), the remaining area of the eastern lot is considered unlikely to support this species.

The database searches identified an additional 25 flora species of conservation significance which may occur within the study area. A likelihood of occurrence assessment (**Appendix A**) undertaken for these species against criteria outlined in section 2.1.3 has determined that of those 25 additional species, 13 have the potential (albeit not such that they are considered 'likely') to occur within the study area:

- *Acacia flagelliformis* (Parks and Wildlife Priority 4)
- *Boronia juncea* subsp. *juncea* (Parks and Wildlife Priority 1)
- *Caladenia huegelii* (EPBC Act Endangered; *Wildlife Conservation Act 1950* [WC Act] Threatened)
- *Caladenia speciosa* (Priority 4)
- *Diuris purdiei* (EPBC Act Endangered; WC Act Threatened)
- *Drakaea elastica* (EPBC Act Endangered; WC Act Threatened)
- *Drakaea micrantha* (EPBC Act Vulnerable; WC Act Threatened)
- *Lasiopetalum membranaceum* (Parks and Wildlife Priority 3)
- *Microtis quadrata* (Parks and Wildlife Priority 4)
- *Pterostylis frenchii* (Parks and Wildlife Priority 2)
- *Pultenaea skinneri* (Parks and Wildlife Priority 4)
- *Tripterococcus* sp. Brachylobus (A.S. George 14234; Parks and Wildlife Priority 4)
- *Verticordia attenuata* (Parks and Wildlife Priority 3).

The remaining 12 taxa are considered unlikely to occur within the study area.

Observations made during the site inspection noted suitable habitat, for those conservation significant flora species considered to have the potential to occur, in almost the entire western lot of the study area.

In regards to the eastern lot, apart from a small area covering 2 ha in the south-western portion, the remaining area of this lot is considered unlikely to support any conservation significant flora species. This is due to historical disturbances such as clearing, grazing and plantations which has significantly altered the structure of native vegetation and resulted in low condition.

3.2 Vegetation

3.2.1 Vegetation communities

The most recent vegetation mapping undertaken at Kemerton (Cardno 2010a) described two vegetation communities as occurring within the study area: EmCcBa and BaBiKg. The remaining portions of the study area were mapped by Cardno (2010a) as cleared paddocks, revegetation areas, plantations and existing infrastructure or cleared mining areas.

As part of the site inspection, the Cardno (2010a) vegetation mapping was reviewed and refined and mapping and descriptions updated where applicable. Following this review, the vegetation of the study area is considered to support four vegetation communities with some differences to vegetation communities that were previously mapped by Cardno (2010a; **Table 3**). Specifically, the following was noted during the site inspection:

- Vegetation previously mapped as EmCcBa and BaBiKg, within the study area, by Cardno (2010a), did not have Banksia species comprising a dominant structural layer.
- Areas of vegetation within the study area that were previously mapped as EmCcBa and BaBiKg were found to consist of a single vegetation community dominated by *Eucalyptus marginata* subsp. *marginata* and *Corymbia calophylla* woodland with very occasional *Allocasuarina fraseriana*, *Banksia attenuata* and *Xylomelum occidentale* isolated trees. This vegetation community covers approximately 117 ha of the study area and is mostly confined to the western lot of the study area (79 ha).

The additional vegetation communities to those previously recorded by Cardno (2010a) included areas which were previously mapped as cleared paddocks and pine plantation, which at the time of site inspection comprised areas of native vegetation (representing native species re-growth). These areas are almost entirely confined to the eastern lot and comprise *Xanthorrhoea brunonis* open shrubland, which has regrown on previously cleared farmland and *Juncus kraussii* subsp. *australiensis* and *Juncus pallidus* closed rushland in low lying seasonal dampland, amongst partly cleared pine plantation (**Figure 3**).

Additionally, in the eastern lot there is also a small area (approximately 2 ha) of remnant vegetation consisting of *Eucalyptus marginata* subsp. *marginata* woodland along the western boundary of the eastern lot (**Figure 3**). The remaining areas of the eastern lot consist of pine plantation (**Figure 3**).

The western lot also contains an area of regrowth, which currently consists of a mixed open shrubland with scattered isolated trees.

3.2.2 Vegetation condition

Based on ground truthing during the site inspection, the condition of native vegetation within the study area ranges from Very Good to Completely Degraded (**Figure 4**). The most intact areas of native vegetation with the highest quality are in the western lot of the study area. This area of vegetation is

mostly in Very Good (32 ha) and Good (38 ha) condition with a narrow area of Degraded (10 ha) condition along the edge of the southern boundary. In the eastern lot of the study area, vegetation in over half of this lot is in a Completely Degraded condition (55 ha) while the remaining area has Degraded (21 ha) condition and a small portion in Very Good condition (2 ha). Areas with lower condition were experiencing disturbances such as previous clearing/logging, rubbish dumping proliferation of tracks, grazing, edge effects and weeds.

Table 3: Vegetation communities within the study area confirmed during the site inspection

Vegetation community	Description	Condition	Approximate extent within the study area	
XbEc	*Xanthorrhoea brunonis* open shrubland with *Acacia pulchella*, *Kunzea glabrescens* and *Daviesia decurrens* subsp. *decurrens* isolated shrubs over **Ehrharta calycina* (Perennial Veldt Grass) open grassland in previously cleared farmland. Associated species include *Banksia ilicifolia* and *Acacia semitrullata* (Priority 4).	Degraded	22 hectares, within the eastern lot only	
PJp	*Pinus* sp. open woodland over *Hypocalymma angustifolium* and *Astartea scoparia* isolated shrubs over **Cynodon dactylon* (Couch) sparse grassland over *Juncus kraussii* subsp. *australiensis* and *Juncus pallidus* closed rushland in low lying seasonal dampland.	Completely Degraded	18 hectares, within the eastern lot only	

Vegetation community	Description	Condition	Approximate extent within the study area	
EmCcXb	*Eucalyptus marginata* subsp. *marginata* and *Corymbia calophylla* woodland with *Allocasuarina fraseriana*, *Banksia attenuata* and *Xylomelum occidentale* isolated trees over *Xanthorrhoea brunonis*, *Acacia pulchella* and *Adenanthos meisneri* shrubland over *Ehrharta calycina* open grassland over *Dasypogon bromeliifolius* open forbland on uplands. Associated species include *Macrozamia riedlei*, *Jacksonia furcellata* and *Melaleuca preissiana* in low lying areas.	Very Good – Degraded	65 hectares, within the western and 2 ha in the eastern lot	
KgAmJfDb	*Banksia ilicifolia*, *Banksia attenuata* and *Xylomelum occidentale* isolated trees over *Kunzea glabrescens*, *Adenanthos meisneri* and *Jacksonia furcellata* open shrubland over *Dasypogon bromeliifolius* open forbland regrowth.	Good – Degraded	12 hectares within the western lot only	

3.2.3 Threatened and priority ecological communities

Previous surveys (Cardno 2010a and Coffey 2008) that included the study area found vegetation communities, which closely resemble the Floristic Community Type (FCT) 21c. This FCT is listed by Parks and Wildlife as the Priority Ecological Community (PEC) 'Low lying *Banksia attenuata* woodlands or shrublands' (Priority 3; Parks and Wildlife 2016a). In the study undertaken by Cardno (2010a), which is the most recent vegetation mapping of the study area to date, this PEC is represented by the vegetation community EmCcBa and covers almost the entire western lot (**Table 3**). Statistical analysis undertaken by Cardno (2010a) found quadrats (three of which occur within the current study area) comprising vegetation community EmCcBa most closely aligned to FCT21c. This PEC is not currently recognised by Parks and Wildlife as occurring within the study area, with the closest mapped occurrence located approximately 1 km to the south (DEC 2013b).

Since previous studies were undertaken, the TEC, 'Banksia Woodlands of the Swan Coastal Plain' has been is listed as Endangered under the EPBC Act (Department of the Environment and Energy [DotEE] 2016). For information to assist in any referral, environmental assessment and compliance issue, it is recommended to refer to the Listing Advice and/or Conservation Advice and Recovery Plan on the DotEE Species Profile and Threats Database (DotEE 2016). The Listing Advice and/or Conservation Advice defines the national ecological community and includes key diagnostic characteristics, condition thresholds and additional considerations (DotEE 2016). To determine whether the Banksia Woodlands of the Swan Coastal Plain TEC is present in the study area, key diagnostic characteristics must be met under Section 2 of the Conservation Advice (DotEE 2016).

Following the steps provided in the Conservation Advice administered by the Commonwealth government, the vegetation community described during the site inspection as EmCcXb - *Eucalyptus marginata* subsp. *marginata* and *Corymbia calophylla* woodland over *Xanthorrhoea brunonis* shrubland on uplands is considered to represent the EPBC Act listed 'Banksia Woodlands of the Swan Coastal Plain' TEC as it meets the relevant guideline criteria (DotEE 2016; **Appendix C**). Although key diagnostic *Banksia* species do not form a dominant structural layer, the assessment has considered that the definition indicates these Banksia species are 'typically' or 'commonly' present, implying that there may be some variation in a vegetation community where they are not strictly a dominant species. Vegetation community EmCcXb was assessed as representing the TEC as this community meets all criteria of the Banksia TEC listing, minus key diagnostic *Banksia* species forming a dominant structural layer (but rather some species such as *Banksia attenuata* were present occasionally as an associated species).

Vegetation within the study area, represented by vegetation community EmCcXb, has also been previously determined to align with FCT 21c (Coffey 2008; Cardno 2010a); FCT 21c is listed as a community which has a relationship to the TEC. The portion of this community within the study area appears to have either natural variation where other co-dominant species (e.g. *Eucalyptus* spp.) become dominant or key Banksia species have been removed through historical activities (e.g. logging). The presence of key Banksia species also increases where the vegetation community continues outside the study area. Vegetation community EmCcXb occurs throughout almost the entire western lot of the study area and covers approximately 2 ha of the eastern lot (**Figure 3**).

There is also approximately 12 ha of vegetation between the two lots, which it is understood has been excluded from consideration for development. The vegetation in this area is consistent with vegetation community EmCcXb and is considered to also represent the EPBC Act listed 'Banksia Woodlands of the Swan Coastal Plain' TEC. Quadrats undertaken by Coffey (2008) and Cardno (2010a) also confirmed that this area of vegetation contains dominant key indicator species of this TEC: *Banksia ilicifolia* and *B. attenuata*. This vegetation was also previously determined to align with FCT 21c (Coffey 2008; Cardno 2010a).

There are no other State or Commonwealth listed TECs inferred to be present within the study area.

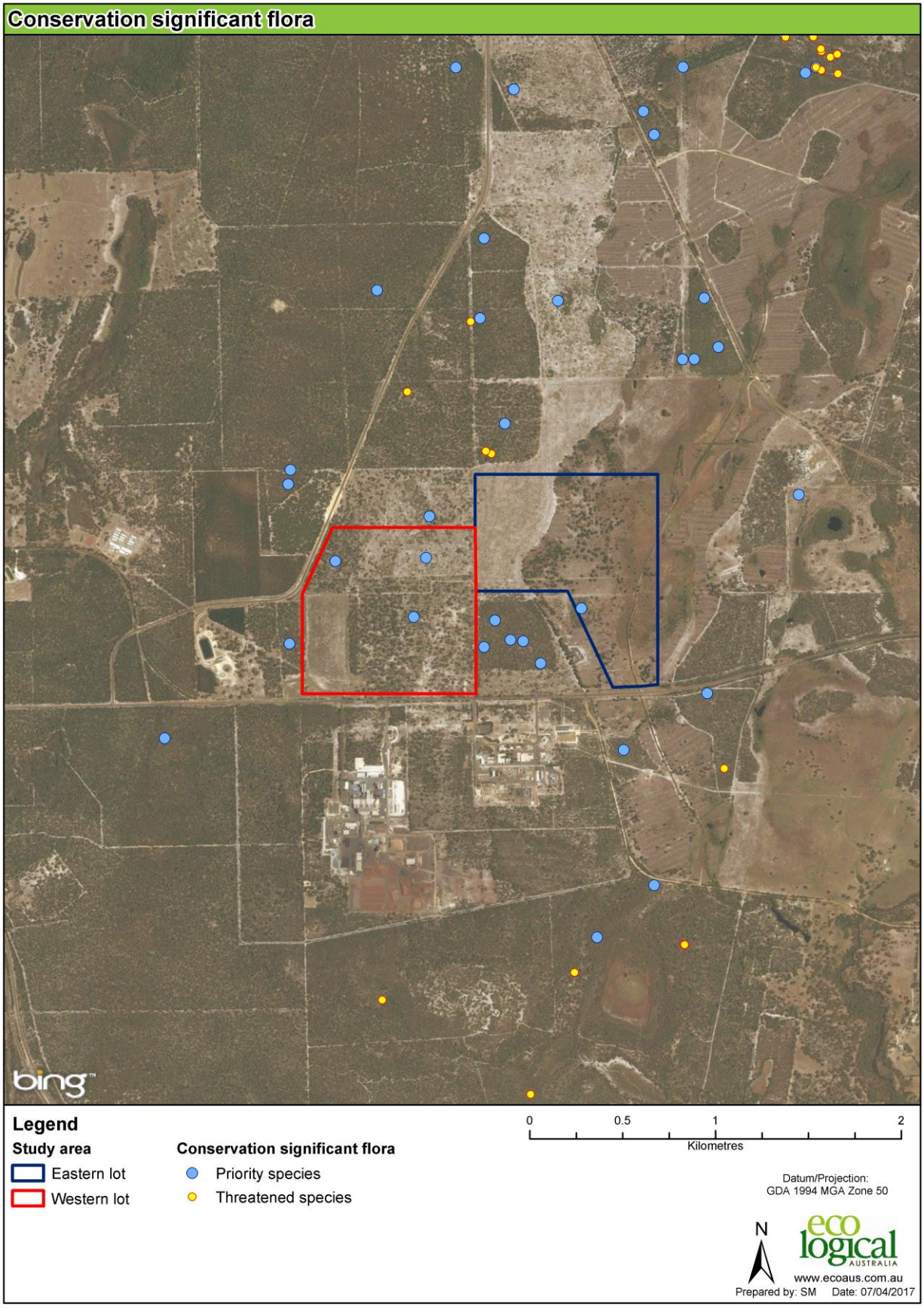

Figure 2: Conservation significant flora recorded in proximity to the study area

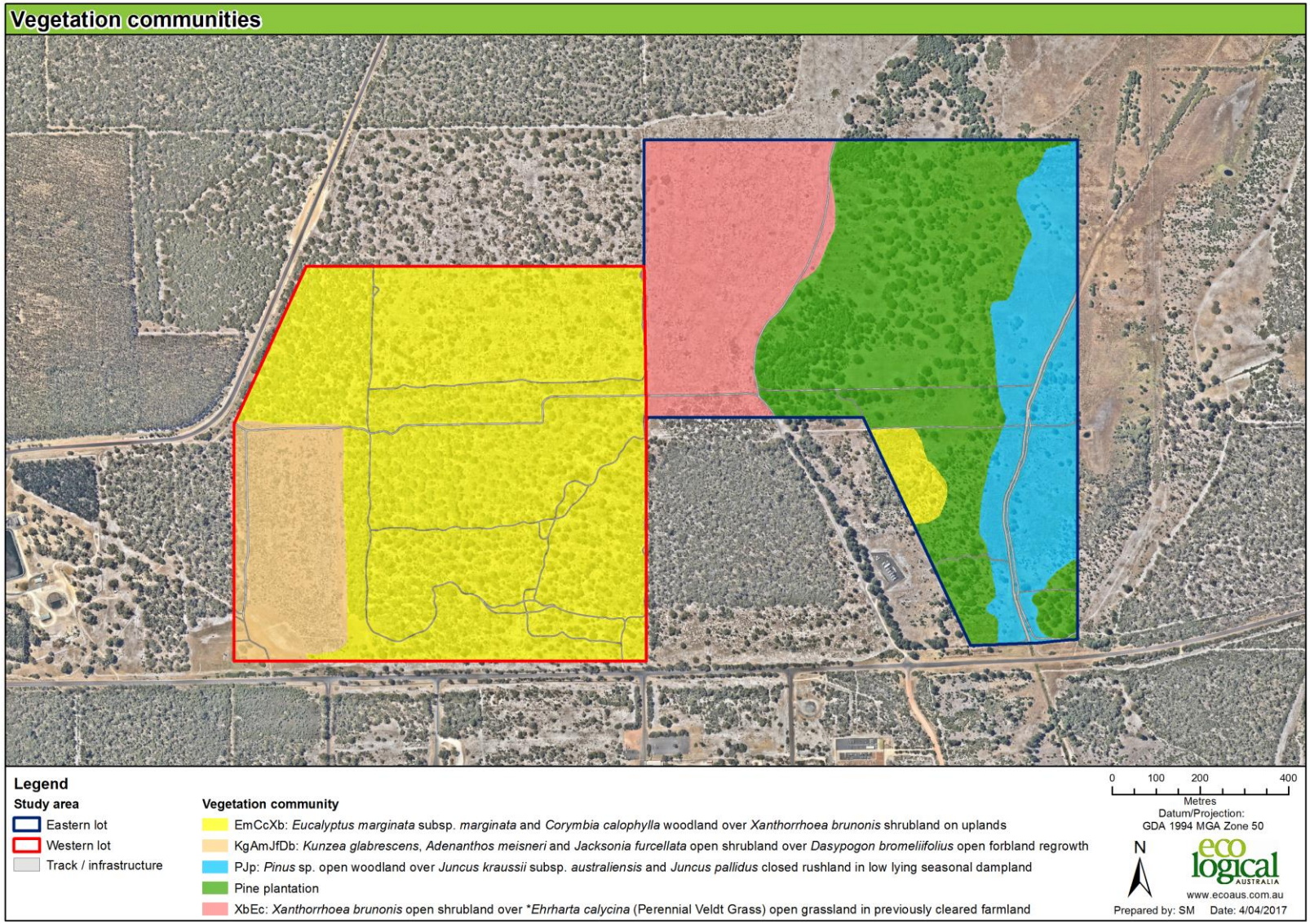

Figure 3: Vegetation communities within the study area as mapped and described March 2017 during the site inspection

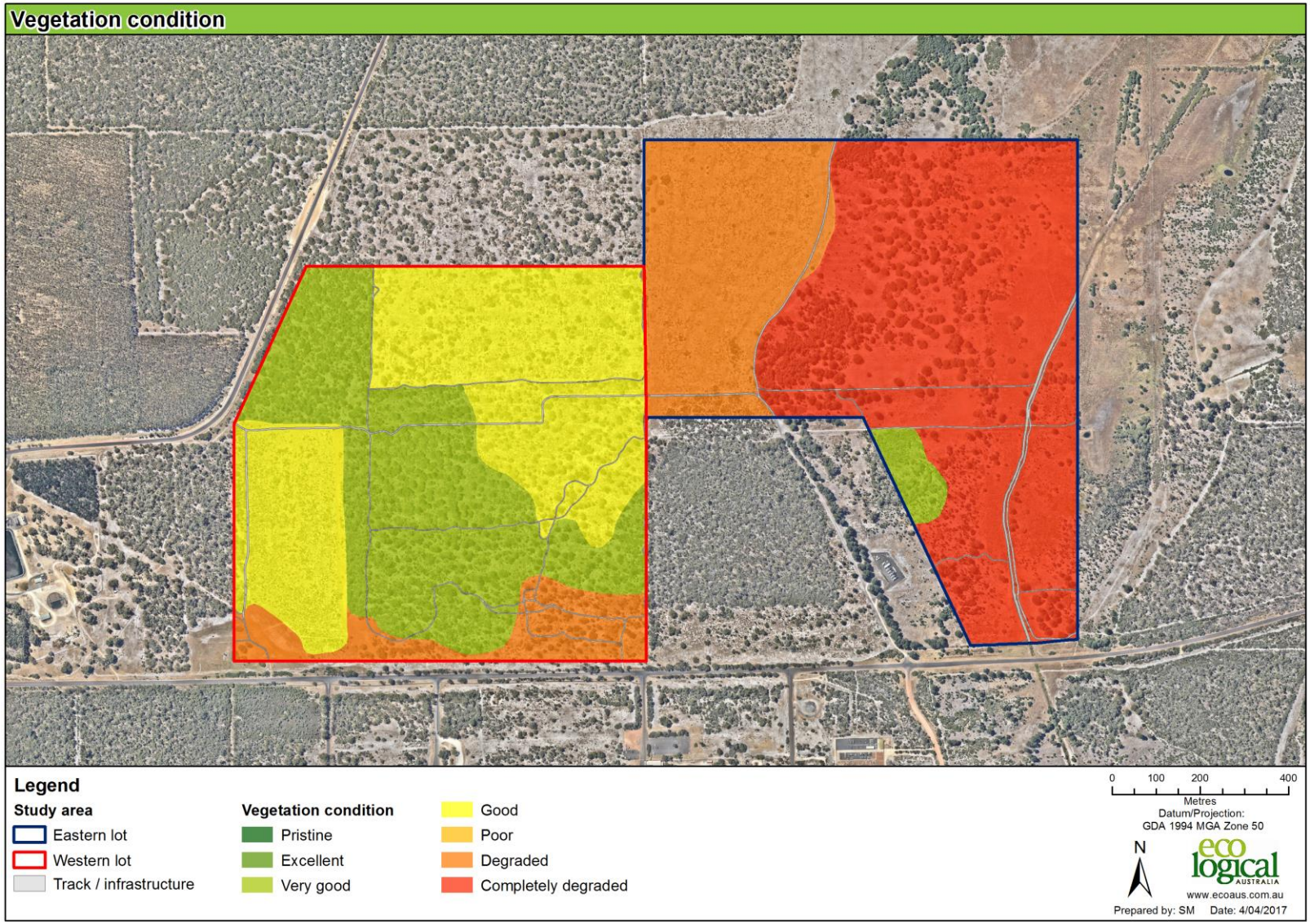

Figure 4: Vegetation condition within the study area, as mapped and described March 2017 during the site inspection

3.3 Fauna

The most recent fauna report involving the study area, which included a full fauna survey of the Kemerton Industrial Area inner core, was undertaken by Cardno (2010b). In this study, 103 species of vertebrate fauna were recorded. This included 56 native bird species (one introduced), 15 native (five introduced) mammal species, 21 reptiles and five amphibians, representing an area of approximately 2,500 ha. Results returned from a search of the NatureMap database (Parks and Wildlife 2007 – 2017), with a 5 km buffer, included a total of 153 vertebrate fauna species, comprising 110 native bird species (two introduced), 15 native mammals (five introduced), 21 reptiles and seven amphibians.

3.3.1 Conservation significant fauna

Two conservation significant species have been previously recorded within the study area including: the WC Act Schedule 2 and EPBC Act Endangered species Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*) and WC Act Schedule 3 and EPBC Act Vulnerable species Forest Red-tailed Black-Cockatoo (*Calyptorhynchus banksii* subsp. *naso*). Evidence of Carnaby's Black Cockatoo and Forest Red-tailed Black-Cockatoo foraging has been previously observed within the study area by Coffey (2008). Both of these species were also directly observed foraging within the study area during the March 2017 site inspection.

The database searches identified an additional 52 fauna species of conservation which may occur within the study area. A likelihood of occurrence assessment (**Appendix B**) undertaken for these species against criteria outlined in section 2.1.3 has determined that another two species are likely to occur within the study area: the WC Act Schedule 2 and EPBC Act Vulnerable species Baudin's Cockatoo (*Calyptorhynchus baudinii*) and WC Act Schedule 5 and EPBC Act Migratory species Rainbow Bee-eater *(Merops ornatus*).

In addition to the species assessed as likely to occur, a further eight have the potential to occur within the study area:

- *Ardea ibis* (Cattle Egret; EPBC Act Migratory, WC Act Schedule 5)
- *Ardea modesta* (Eastern Great Egret; EPBC Act Migratory, WC Act Schedule 5)
- *Dasyurus geoffroii* (Chuditch; EPBC Act Vulnerable, WC Act Schedule 3)
- *Falco peregrinus* (Peregrine Falcon; WC Act Schedule 7)
- *Isoodon obesulus* subsp. *fusciventer* (Quenda; Parks and Wildlife Priority 4)
- *Lerista lineata* (Perth Slider; Parks and Wildlife Priority 3)
- *Macropus irma* (Western Brush Wallaby; Parks and Wildlife Priority 4)
- *Pseudocheirus occidentalis* (Western Ringtail Possum; EPBC Act Vulnerable, WC Act Schedule 1)

A suspected Western Ringtail Possum drey was previously recorded within the study area (Coffey 2008), however this was re-checked during another survey (Bamford Consulting 2011) and was found to be misidentified, and instead was a Magpie nest. Bamford Consulting (2011) also noted that habitat for the Western Ringtail Possum is marginal in the area in which the study area is located.

The remaining 42 species are considered unlikely to occur in or around the study area.

3.3.2 Fauna habitats

Broad fauna habitats previously identified in the most recent fauna survey (Cardno 2010b) include the following habitat types within the study area:

- Woodland of Jarrah (*Eucalyptus marginata*) with the occasional Marri (*Corymbia calophylla*) over *Banksia attenuata*, *Banksia ilicifolia* and *Banksia grandis* with the occasional Peppermint (*Agonis flexuosa*) and tall open shrubland of *Kunzea glabrescens* over shrubland to very open shrubland on lower slopes to flats of gently undulating dunes on white to grey sand;
- Plantations of Blue Gums (**Eucalyptus globulus*) and Pines (*Pinus pinaster*).
- Cleared paddocks and areas of existing infrastructure.

The site inspection investigated the presence of these habitats and refined the habitat descriptions and boundaries to reflect current conditions within the study area (**Figure 5**). As a result, broad fauna habitats which currently occur within the study area include the following:

- Woodland - Woodland of Jarrah (*Eucalyptus marginata* subsp. *marginata*) and Marri (*Corymbia calophylla*) with occasional isolated *Banksia attenuata* trees over *Xanthorrhoea brunonis* shrubland on uplands.
- Regenerating farmland - Previously cleared farmland with *Xanthorrhoea brunonis* open shrubland over and open grassland of **Ehrharta calycina* (Perennial Veldt Grass).
- Sedgeland - *Juncus kraussii* subsp. *australiensis* and *Juncus pallidus* closed rushland in low lying seasonal dampland with scattered pine trees.
- Regrowth - Regrowth consisting of mixed open shrubland over *Dasypogon bromeliifolius* open forbland.
- Pine plantation

Some of these habitat types have been identified previously (ELA 2014, Bamford Consulting 2011, Coffey 2008, Cardno 2010b) as having values which support foraging and breeding by the conservation significant Black Cockatoo species (Carnaby's Black Cockatoo, Forest Red-tailed Black-Cockatoo and Baudin's Cockatoo). Mapping was also undertaken by ELA (2014) that delineated the suitability of foraging and breeding habitats within the Kemerton Industrial Area. The current quality of foraging and breeding habitats within the study was validated or updated where required, against ELA (2014) mapping, during the site inspection (**Figure 6** and **Figure 7**). Based on the site inspection, most of the woodland within the western lot of the study area and partially within the eastern lot, provides high quality foraging habitat for Carnaby's Cockatoo and Baudin's Cockatoo (**Figure 6**). This is due to the presence of Jarrah, Marri and Banksia species, which are primary foraging species (Department of Sustainability, Environment, Water, Population and Communities 2012). Marri and Jarrah nuts also provide a very common local food source for Forest Red-tailed Black Cockatoo.

Parts of the woodland which have lower condition are considered to be moderate foraging habitat as primary foraging species were sparse (**Figure 6**). The regrowth area in the western lot also provides moderate foraging habitat (**Figure 6**).

Importantly, the pine plantation areas are considered to be high foraging habitat for Carnaby's and Baudin's Cockatoos (ELA 2014). The eastern lot consists predominantly of pine plantation which covers almost half of this lot; the sedgeland also contains some moderate foraging value as it contains scattered pine trees.

The woodland habitat also provides high potential breeding value for the Black Cockatoos with the presence of Marri and Jarrah trees as a dominant canopy tree species (ELA 2014). Portions of the woodland which contain high quality breeding habitat are confined to the western lot of the study area only (**Figure 7**). Previous mapping of breeding trees within parts of the study area was undertaken by Coffey (2008) and later verified by Bamford Consulting (2011). Bamford Consulting (2011) checked 14 potential breeding trees within the study area, some of which had suitable hollows to support Black

Cockatoo breeding. All of these trees are in the western lot of the study area (**Figure 7**). The eastern lot contains moderate to low breeding habitat value (**Figure 7**).

The entire study area provides habitat for the Rainbow Bee-eater (*Merops ornatus*), which is considered likely to occur. This species is likely to occur only on a transitionary basis utilising the study area opportunistically for foraging. The study area is unlikely to be a significant feeding or breeding site for this species.

3.4 Wetlands

Broad wetland mapping has been coordinated by Parks and Wildlife and included in the Geomorphic Wetlands Swan Coastal Plain dataset (Parks and Wildlife 2016b). This dataset contains information on the location, boundaries, classification, management categories and unique feature identifier numbers of wetlands on the Swan Coastal Plain (Parks and Wildlife 2016b).

The Geomorphic Wetlands Swan Coastal Plain dataset indicates there are no 'Conservation' or 'Resource Enhancement' management category wetlands in the study area.

A large portion of the eastern lot of the study area is a mapped wetland. The extent of this mapped wetland within the study area is approximately 30 ha, which is made up of several discrete map units. This wetland has been assigned a wetland classification of Sumpland with a management category of 'Multiple Use' (Parks and Wildlife 2016b). The management category of 'Multiple Use' is defined as 'Wetlands with few remaining important attributes and functions' (Parks and Wildlife 2013). The objective of Multiple Use wetlands is to use, develop and manage the wetland in the context of ecologically sustainable development and best management catchment planning (Parks and Wildlife 2013).

Areas mapped as wetland within the eastern lot have been historically modified through clearing and establishment of pine plantations and the hydrology is currently altered through excavation of an artificial drainage ditch. The wetland area is also in completely degraded condition, is currently grazed by cattle and has high weed cover. In its current state, the wetland area offers little to no value apart from hydrological function acting as a conduit for stormwater runoff. On occasions when standing water is present, it may provide opportunistic foraging opportunities for wetland birds, however it does not form core habitat which any species would be reliant on.

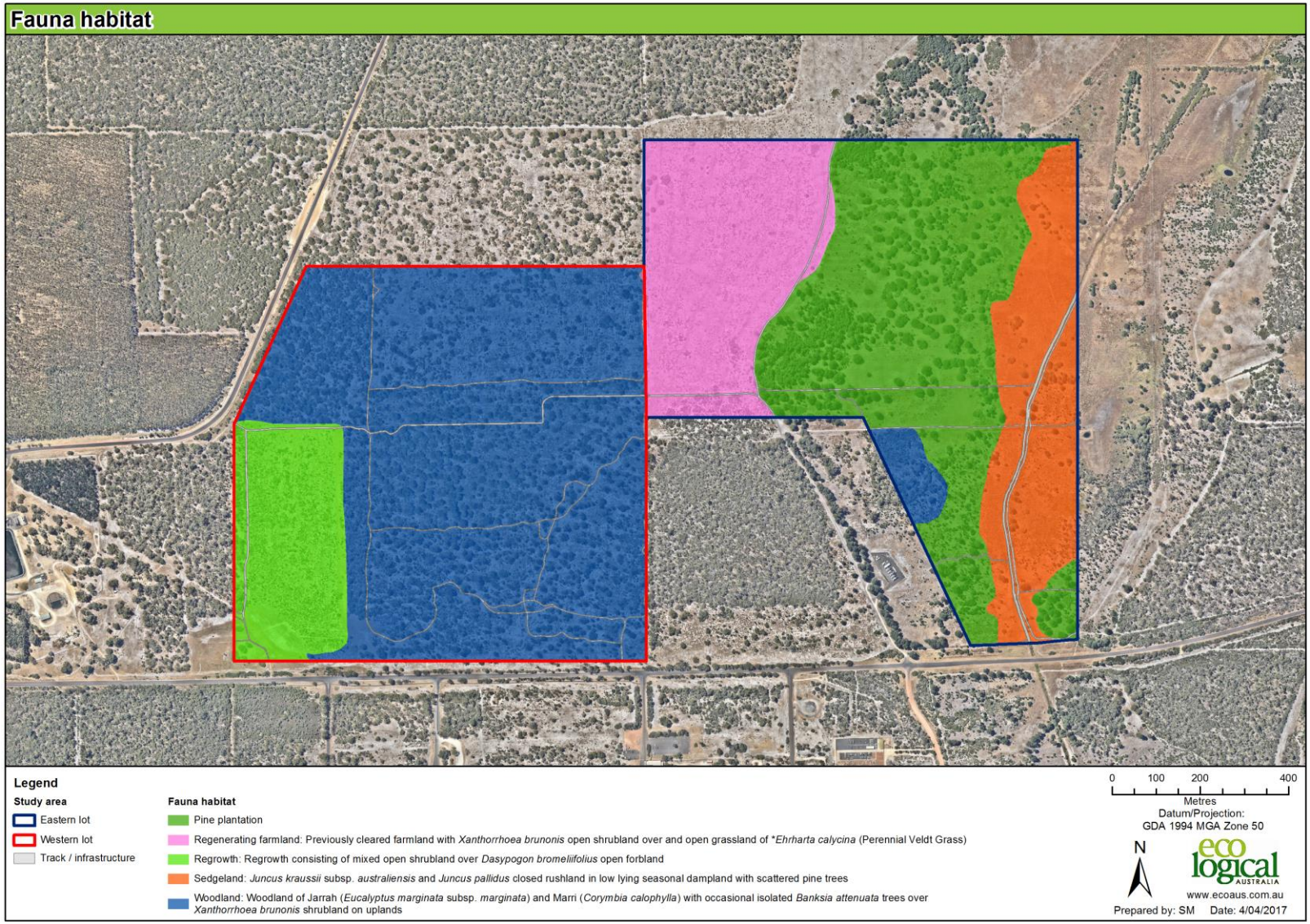

Figure 5: Fauna habitats within the study area, as mapped and described March 2017 during the site inspection

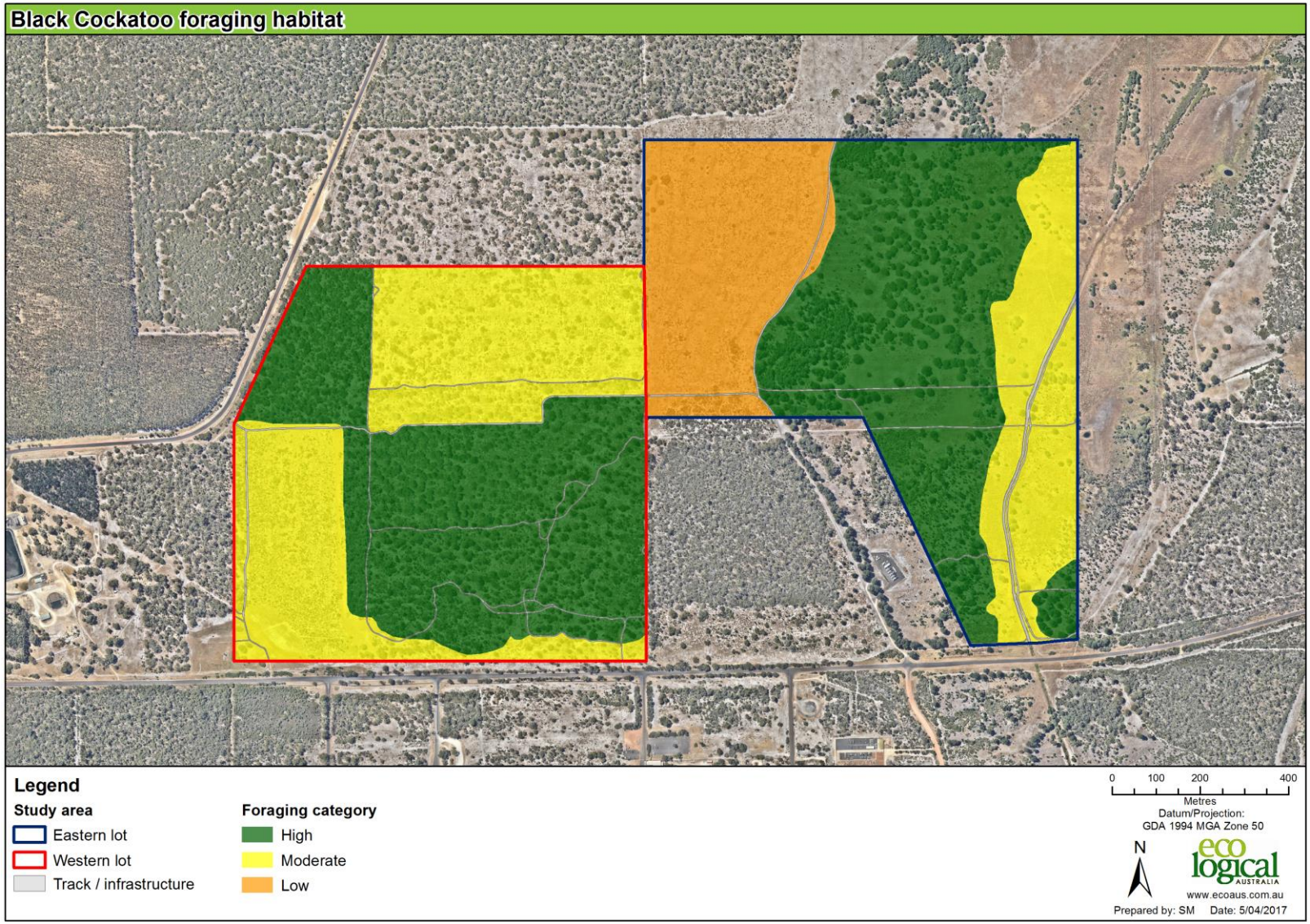

Figure 6: Black Cockatoo foraging habitat as mapped and described March 2017during the site inspection

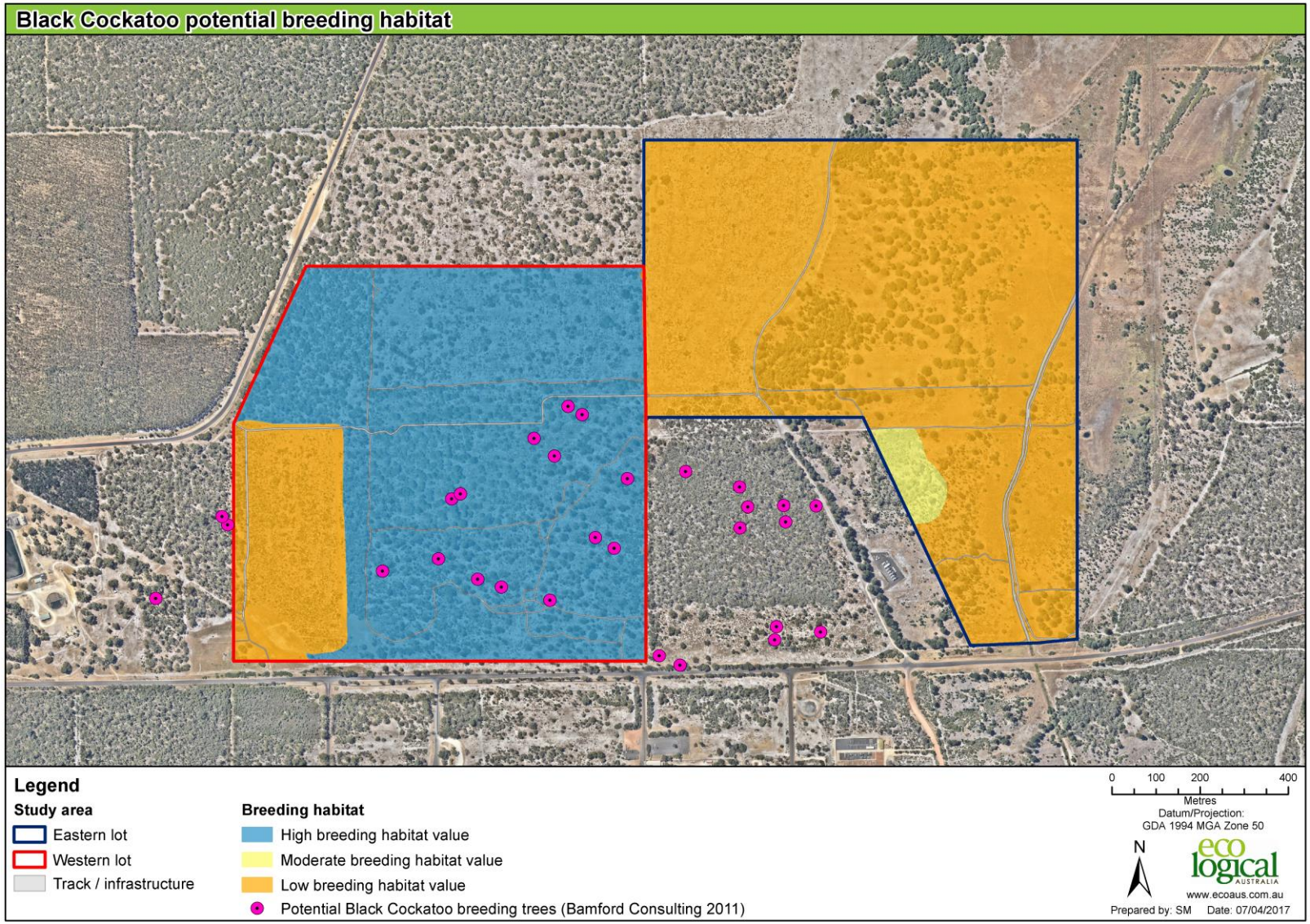

Figure 7: Black Cockatoo breeding habitat, confirmed during the site inspection

4 Summary and conclusion

The western lot of the study supports numerous ecological values, including conservation significant species and vegetation communities that may represent a higher level of constraint for future development as compared to the eastern lot. The western lot almost entirely contains remnant vegetation, mostly of Very Good and Good condition with few disturbances. This vegetation supports the conservation significant flora species, *Acacia semitrullata* (Priority 4), and potentially provides habitat for several other conservation significant flora species, many of which are significant at a state and federal level. Most of this vegetation also represents the federally listed Threatened Ecological Community 'Banksia Woodlands of the Swan Coastal Plain' and the Parks and Wildlife Priority 3 ecological community 'Low lying *Banksia attenuata* woodlands or shrublands'. This vegetation also provides high - moderate value foraging and breeding habitat (including several trees which have been verified as suitable breeding trees) for the conservation significant fauna species, Black Cockatoos (Carnaby's Black Cockatoo, Forest Red-tailed Black-Cockatoo and Baudin's Cockatoo).

The eastern lot has almost entirely been historically cleared, leaving only a small area (approximately 2 ha) of remnant vegetation. The small area of remnant vegetation in the eastern lot supports similar ecological values as the western lot (habitat for conservation significant flora and fauna and represents the 'Banksia Woodlands of the Swan Coastal Plain' TEC), apart from breeding habitat for the Black Cockatoo, which is considered to be of moderate value in this vegetation. This area of vegetation in the eastern lot however covers 2 ha, which equates to approximately 2.5% of the entire area covered by this lot. This vegetation also occurs as a single discrete area along the south-western boundary of the eastern lot.

Apart from the area of remnant vegetation, the remaining areas of the eastern lot consist of pine plantation, partially cleared pine plantation and previously cleared paddocks. While many of these previously cleared areas are regenerating with native species, the condition of this vegetation is Degraded or Completely Degraded. Of note, is that the pine plantation represents high quality foraging habitat for the listed threatened Carnaby's Cockatoo and Baudin's Cockatoo.

Approximately 30 ha of the eastern lot is a mapped wetland assigned a management category of 'Multiple Use', which is a wetland possessing few remaining important attributes and functions, except for local hydrological function. Consideration should be given to the implications of draining and/or filling in of the wetland on local hydrology if proposed for development.

Overall, the eastern lot contains less constraints that may affect development compared to the western lot. **Table 4** provides a summary of the ecological values within the study area.

Table 4: Summary of ecological values occurring within the study area

Ecological value	Western lot	Eastern lot
Overview	Almost entirely covered by remnant vegetation, apart from a small cleared area which has now been revegetated.	Comprises a small area of remnant vegetation (approximately 2 ha), remaining areas significantly disturbed through historical activities such as clearing and plantations.
Conservation significant flora	*Acacia semitrullata* (Priority 4) has previously recorded at several locations and was observed during the site inspection. Almost the entire western lot has the potential to support other flora species of conservation significance, including for species of state and federal significance	*Acacia semitrullata* (Priority 4) recorded at a single location. Unlikely to occur in remainder of this lot outside the area of remnant vegetation (which covers approximately 2 ha). Apart from small area of remnant vegetation, this lot is unlikely to support other conservation significant species
Vegetation communities	Contains two vegetation communities, the largest which covers almost the entire western lot consists of remnant woodland. The remaining areas are diverse regrowth in a previously cleared area.	Contains a small area of remnant vegetation (approximately 2 ha). Remaining areas comprise pine plantation, previously cleared paddock and pine plantation which are both at various stages of naturally regeneration.
Vegetation condition	Mostly in Very Good and Good condition. Small area of Good condition along the southern edge.	Mostly in Completely Degraded and Degraded condition. Small area of Very Good condition.
Conservation significant vegetation	Vegetation representing the Parks and Wildlife as the Priority 3 ecological community 'Low lying Banksia attenuata woodlands or shrublands' PEC previously determined to occur within the western lot Approximately 81% of the western lot contains vegetation which represents the EPBC Act listed 'Banksia Woodlands of the Swan Coastal Plain' TEC	Approximately 2.5% of the eastern lot contains vegetation which represents the EPBC Act listed 'Banksia Woodlands of the Swan Coastal Plain' TEC
Conservation significant fauna	Two conservation significant species have been previously recorded: Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*) and Forest Red-tailed Black-Cockatoo (*Calyptorhynchus banksii* subsp. *naso*).	Two conservation significant species have been previously recorded: Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*) and Forest Red-tailed Black-Cockatoo (*Calyptorhynchus banksii* subsp. *naso*).

Ecological value	Western lot	Eastern lot
Fauna habitats	Two habitats identified. The most widespread is a Woodland of Jarrah and Marri which covers almost the entire western lot. The remaining habitat is regrowth consisting of a mixed open shrubland.	Four habitats identified. The most widespread is pine plantation. Remaining habitats include previously cleared farmland which is now naturally regenerating, seasonally wet sedgeland (naturally regenerated) in a partially cleared pine plantation and a small area of Jarrah woodland.
Habitats to support conservation significant fauna known or likely to occur	The Jarrah and Marri woodland provides high to moderate value foraging and breeding habitat (including several trees which have been verified as suitable breeding trees) for the conservation significant fauna species, Black Cockatoos (Carnaby's Black Cockatoo, Forest Red-tailed Black-Cockatoo and Baudin's Cockatoo). Area of this habitat which are considered to be high quality for foraging cover approximately 55% of the western lot while high quality breeding habitat covers approximately 81% of the western lot.	The Jarrah woodland provides high value foraging habitat for the conservation significant fauna species, Black Cockatoos (Carnaby's Black Cockatoo, Forest Red-tailed Black-Cockatoo and Baudin's Cockatoo). This habitat covers approximately 2.5% of the eastern lot. This woodland provides moderate value breeding habitat for these species. The pine plantation provides high quality foraging habitat for the Carnaby's Cockatoo and Baudin's Cockatoo. This habitat covers approximately 45% of the eastern lot.
Wetlands	No mapped wetlands occur within the western lot.	Approximately 30 ha of the eastern lot is mapped wetland. This wetland has been assigned a wetland classification of Sumpland with a management category of 'Multiple Use' which is a wetland which has few remaining important attributes and functions, except for local hydrological function.

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Appendix A Flora Likelihood Assessment

Species	Conservation Code			Source			Likelihood assessment
	EPBC Act	WC Act	Parks and Wildlife	NatureMap	PMST	LandCorp dataset	
Acacia flagelliformis			P4	X			Potential to occur
Acacia semitrullata			P4	X		X	Known to occur
Austrostipa bronwenae		S2	T	X			Unlikely to occur
Boronia juncea subsp. *juncea*			P1	X		X	Potential to occur
Caladenia huegelii	EN	S1	T	X	X		Potential to occur
Caladenia procera	CR	S1	T	X	X		Unlikely to occur
Caladenia speciosa			P4	X		X	Potential to occur
Carex tereticaulis			P3	X			Unlikely to occur
Chamaescilla gibsonii			P3	X			Unlikely to occur
Cyathochaeta teretifolia			P3	X			Unlikely to occur
Dillwynia dillwynioides			P3	X		X	Unlikely to occur
Diuris drummondii	VU	S3	T	X		X	Unlikely to occur
Diuris micrantha	VU	S3	T	X	X	X	Unlikely to occur
Diuris purdiei	EN	S2	T		X		Potential to occur
Drakaea elastica	EN	S1	T	X	X	X	Potential to occur
Drakaea micrantha	VU	S2	T	X	X	X	Potential to occur
Eleocharis keigheryi	VU	S3	T		X		Unlikely to occur
Lasiopetalum membranaceum			P3	X			Potential to occur
Microtis quadrata			P4			X	Potential to occur
Pterostylis frenchii			P2	X			Potential to occur
Puccinellia vassica			P1	X			Unlikely to occur
Pultenaea skinneri			P4	X		X	Potential to occur
Synaphea sp. Fairbridge Farm (D.Papenfus 696)	CR	S1	T		X		Unlikely to occur
Synaphea stenoloba	EN	S1	T		X		Unlikely to occur
Tripterococcus sp. Brachylobus (A.S. George 14234)			P4	X			Potential to occur
Verticordia attenuata			P3	X			Potential to occur

[1]CR = listed as Critically Endangered under the EPBC Act.

EN = listed as Endangered under the EPBC Act.

VU = listed as Vulnerable under the EPBC Act.

S1 = Schedule 1: Flora that are considered likely to become extinct or rare, as critically endangered flora (CR) under the WC Act.

S2 = Schedule 2: Flora that are considered likely to become extinct or rare, as endangered flora (EN) under the WC Act.

S3 = Schedule 3: Flora that are considered likely to become extinct or rare, as vulnerable flora (VU) under the WC Act.

T = Threatened species: flora that has been declared likely to become extinct or is rare, or otherwise in need of special protection, pursuant to section 23F(2) of the WC Act.

P1 = Priority 1: poorly known species that are known from one or a few locations which are potentially at risk, and are in urgent need of further survey. Listed by Department of Parks and Wildlife.

P2 = Priority 2: poorly known species known from one or a few locations, some of which are on lands managed primarily for nature conservation, and are in urgent need of further survey. Listed by Department of Parks and Wildlife.

P3 = Priority 3: poorly-known species known from several specimens or records but not under imminent threat, and need further survey. Listed by Department of Parks and Wildlife.

P4 = Priority 4: Rare, Near Threatened and other species in need of monitoring but not currently threatened; could become threatened if present circumstances change. Listed by Department of Parks and Wildlife.

[2]NatureMap = NatureMap database search (Parks and Wildlife 2007 - 2017)

PMST = EPBC Act Protected Matters Report (DoEE 2017b).

Appendix B Fauna Likelihood Assessment

Species	Conservation Status[1]		Source[2]		Likelihood assessment
	WC Act/Parks and Wildlife	EPBC Act	NatureMap	PMST	
Actitis hypoleucos (Common Sandpiper)		IA	X		Unlikely to occur
Anous tenuirostris subsp. *melanops* (Australian Lesser Noddy)	S2	VU	X	X	Unlikely to occur
Ardea ibis (Cattle Egret)	S5	M	X		Potential to occur
Ardea modesta (Eastern Great Egret)	S5	M	X		Potential to occur
Botaurus poiciloptilus (Australasian Bittern)	S2	EN	X	X	Unlikely to occur
Calidris acuminata (Sharp-tailed Sandpiper)	S5	IA, M	X		Unlikely to occur
Calidris ferruginea (Curlew Sandpiper)	S3, S5	CR		X	Unlikely to occur
Calidris tenuirostris (Great Knot)	S3, S5	CR, IA, M	X		Unlikely to occur
Calyptorhynchus banksii subsp. *naso* (Forest Red-tailed Black-Cockatoo)	S3	VU	X	X	Known to occur
Calyptorhynchus baudinii (Baudin's Cockatoo)	S2	VU	X	X	Likely to occur
Calyptorhynchus latirostris (Carnaby's Cockatoo)	S2	EN	X	X	Known to occur
Charadrius leschenaultii (Greater Sand Plover)	S3	VU, IA, M	X		Unlikely to occur
Dasyurus geoffroii (Chuditch)	S3	VU	X	X	Potential to occur
Diomedea amsterdamensis (Amsterdam Albatross)	S1, S5	EN		X	Unlikely to occur
Diomedea dabbenena (Tristan Albatross)	S1, S5	EN		X	Unlikely to occur
Diomedea epomophora (Southern Royal Albatross)	S3, S5	VU		X	Unlikely to occur
Diomedea exulans (Wantering Albatross)	S3, S5	VU		X	Unlikely to occur
Diomedea sanfordi (Northern Royal Albatross)	S2, S5	EN		X	Unlikely to occur
Falco peregrinus (Peregrine Falcon)	S7		X		Potential to occur
Falsistrellus mackenziei (Western False Pipistrelle)	P4		X		Unlikely to occur
Halobaena caerulea (Blue Petrel)		VU		X	Unlikely to occur
Hydromys chrysogaster (Water-rat)	P4		X		Unlikely to occur

Species	Conservation Status[1]		Source[2]		Likelihood assessment
	WC Act/Parks and Wildlife	EPBC Act	NatureMap	PMST	
Isoodon obesulus subsp. *fusciventer* (Quenda)	P4		X		Potential to occur
Ixobrychus dubius (Australian Little Bittern)	P4		X		Unlikely to occur
Leipoa ocellata (Malleefowl)	S3	VU		X	Unlikely to occur
Lerista lineata (Perth Slider)	P3		X		Potential to occur
Limosa lapponica (Bar-tailed Godwit)	S3	IA, M	X		Unlikely to occur
Limosa lapponica baueri (Western Alaskan Bar-tailed Godwit)	S3	VU		X	Unlikely to occur
Limosa lapponica menzbieri (Northern Siberian Bar-tailed Godwit)	S3	CR		X	Unlikely to occur
Macronectes giganteus (Southern Giant Petrel)	S5	EN, IA, M	X	X	Unlikely to occur
Macronectes halli (Northern Giant Petrel)	S5	VU		X	Unlikely to occur
Macropus irma (Western Brush Wallaby)	P4		X		Potential to occur
Merops ornatus (Rainbow Bee-eater)	S5	M	X		Likely to occur
Myrmecobius fasciatus (Numbat)	S2	VU	X		Unlikely to occur
Numenius madagascariensis (Eastern Curlew)	S3	CR, IA, M	X	X	Unlikely to occur
Oxyura australis (Blue-billed Duck)	P4		X		Unlikely to occur
Pachyptila turtur subantarctica (Fairy Prion)		VU		X	Unlikely to occur
Phoebetria fusca (Sooty Albatross)	S2, S5	VU		X	Unlikely to occur
Plegadis falcinellus (Glossy Ibis)	S5	IA, M	X		Unlikely to occur
Pluvialis fulva (Pacific Golden Plover)	S5	IA, M	X		Unlikely to occur
Pluvialis squatarola (Grey Plover)	S5	IA, M	X		Unlikely to occur
Pseudocheirus occidentalis (Western Ringtail Possum)	S1	VU	X	X	Potential to occur
Pterodroma mollis (Soft-plumaged Petrel)		VU		X	Unlikely to occur

Species	Conservation Status[1]		Source[2]		Likelihood assessment
	WC Act/Parks and Wildlife	EPBC Act	NatureMap	PMST	
Rostratula australis (Australian Painted Snipe)	S2	EN		X	Unlikely to occur
Setonix brachyurus (Quokka)	S3	VU		X	Unlikely to occur
Sternula nereis nereis (Australian Fairy Tern)		VU		X	Unlikely to occur
Thalassarche carteri (Indian Yellow-nosed Albatross)	S2, S5	VU		X	Unlikely to occur
Thalassarche cauta cauta (Shy Albatross)		VU		X	Unlikely to occur
Thalassarche cauta steadi (White-capped Albatross)	S5	VU		X	Unlikely to occur
Thalassarche impavida (Campbell Albatross)	S3, S5	VU		X	Unlikely to occur
Thalassarche melanophris (Black-browed Albatross)	S2, S5	VU		X	Unlikely to occur
Tringa glareola (Wood Sandpiper)	S5	IA, M	X		Unlikely to occur
Tringa nebularia (Common Greenshank)	S5	IA, M	X		Unlikely to occur
Tringa stagnatilis (Marsh Sandpiper)	S5	IA, M	X	X	Unlikely to occur

[1]CR = listed as Critically Endangered under the EPBC Act.

EN = listed as Endangered under the EPBC Act.

VU = listed as Vulnerable under the EPBC Act.

M = listed as Migratory species under the EPBC Act.

IA = migratory species protected under an international agreement under the EPBC Act.

S1 = Schedule 1: Fauna that is rare or is likely to become extinct as critically endangered fauna (CR) under the WC Act.

S2 = Schedule 2: Fauna that is rare or likely to become extinct as endangered fauna (EN) under the WC Act.

S3 = Schedule 3: Fauna that is rare or likely to become extinct as vulnerable fauna (VU) under the WC Act.

S5 = Schedule 5: Migratory birds protected under an international agreement (IA) under the WC Act.

S7 = Schedule 7: Other specially protected fauna (OS) under the WC Act.

P3 = Priority 3: poorly-known species known from several specimens or records but not under imminent threat, and need further survey. Listed by Department of Parks and Wildlife.

P4 = Priority 4: Rare, Near Threatened and other species in need of monitoring but not currently threatened; could become threatened if present circumstances change. Listed by Department of Parks and Wildlife.

[2]NatureMap = NatureMap database search (Parks and Wildlife 2007 - 2017)

PMST = EPBC Act Protected Matters Report (DoEE 2017b).

Appendix C Banksia Woodlands TEC assessment

In order to determine whether the Banksia Woodlands of the Swan Coastal Plain TEC is present in the study area, key diagnostic characteristics must be met under Section 2 of the Conservation Advice (DotEE 2016).

For EPBC Act referral assessment and compliance purposes, the national ecological community is limited to patches that meet the key diagnostic characteristics (Step 1), condition thresholds (Step 2), and minimum patch sizes (Step 3).

Assessing the key diagnostic characteristics is the first step in identifying the ecological community, acknowledging that the ecological community encompasses a number of recognised sub-communities previously assigned as FCTs (Gibson et al. 1994).

Step two involves assessing the condition threshold of the study area. Condition threshold categories describe different values and functional attributes of the ecological community and the thresholds for their inclusion in the ecological community protected under the EPBC Act. It is recognised that any single patch of a TEC may be degraded to some degree but contributes to the overall function of the ecological community (and other environmental components) across the often fragmented landscape (DotEE 2016c).

Step three involves assessing the patch size as minimum patch sizes apply for consideration of a patch as part of the listed ecological community for EPBC Act referral, assessment and compliance purposes (DotEE 2016c). This concept recognises that even small, fragmented patches of a TEC can contribute to the overall function of the ecological community (and other environmental components) across the landscape.

Step four involves assessing further information to assist in determining the presence of the ecological community and significant impacts.

Step	Key diagnostic characteristics (DotEE 2016c)	Outcome
1	**Location and physical environment** The Banksia Woodlands ecological community primarily occurs in the Swan Coastal Plain IBRA bioregion	The study area is located on the Swan Coastal Plain
	Soil and landform The Banksia Woodlands typically occurs on well drained, low nutrient soils on sandplain landforms, particularly deep Bassendean and Spearwood sands and occasionally on Quindalup sands	The study area is located on Bassendean Dune System
	Structure The structure of the Banksia Woodlands is a low woodland to forest with these features: • A distinctive upper sclerophyllous layer of low trees* (occasionally large shrubs more than 2 m tall), typically dominated or co-dominated by one or more of the Banksia species identified under composition • Emergent trees of medium or tall (>10 m) height *Eucalyptus* or *Allocasuarina* species may sometimes be present above the Banksia canopy • An often highly species-rich understorey that consists of: o a layer of sclerophyllous shrubs of various heights; and, o a herbaceous ground layer of cord rushes, sedges and perennial and ephemeral forbs, that sometimes includes grasses. The development of a ground layer may vary depending on the density of the shrub layer and disturbance history.	The vegetation community EmCcXb consists of a *Eucalyptus marginata* subsp. *marginata* and *Corymbia calophylla* woodland with *Allocasuarina fraseriana*, *Banksia attenuata* and *Xylomelum occidentale* isolated trees over *Xanthorrhoea brunonis*, *Acacia pulchella* and *Adenanthos meisneri* shrubland over *Ehrharta calycina* open grassland over *Dasypogon bromeliifolius* open forbland. Although vegetation community EmCcXb does not contain a dominant layer of key *Banksia* species, it contains all other structural elements which define the TEC. *Banksia attenuata* is also present throughout this community and increases in dominance outside of the study area.
	Composition • The canopy is most commonly dominated or co-dominated by *Banksia attenuata* (candlestick banksia, slender banksia) and/or *B. menziesii* (firewood banksia). Other Banksia species that dominate in some examples of the ecological community are *B. prionotes* (acorn banksia) or *B. ilicifolia* (holly-leaved banksia); and • The patch must include at least one of the following diagnostic species: o *Banksia attenuata* (candlestick banksia) o *Banksia menziesii* (firewood banksia)	The canopy while dominated by *Eucalyptus marginata* and *Corymbia calophylla,* also contains the diagnostic species *Banksia attenuata* which occurs throughout as isolated trees. Dominance of *Banksia attenuata* appears variable throughout this community; this species becomes a dominant canopy species where the vegetation community continues outside the study area. The vegetation community also has a high diversity of shrubs and herb species with many indicator species

Step	Key diagnostic characteristics (DotEE 2016c)	Outcome
	○ *Banksia prionotes* (acorn banksia) ○ *Banksia ilicifolia* (holly-leaved banksia). • If present, the emergent tree layer often includes *Corymbia calophylla* (marri), *E. marginata* (jarrah), or less commonly *Eucalyptus gomphocephala* (tuart); and • Other trees of a medium height that may be present, and may be codominant with the Banksia species across a patch, include *Eucalyptus todtiana* (blackbutt, pricklybark), *Nuytsia floribunda* (Western Australian Christmas tree), *Allocasuarina fraseriana* (western sheoak), *Callitris arenaria* (sandplain cypress), *Callitris pyramidalis* (swamp cypress) and *Xylomelum occidentale* (woody pear); and • The understorey typically contains a high to very high diversity of shrub and herb species that often vary from patch to patch*** • Contra-indicators: ○ Patches clearly dominated by *Banksia littoralis* are not part of the Banksia Woodlands ecological community but indicates a different, dampland community is present. ○ Patches clearly dominated by *Banksia burdettii* are not part of the Banksia Woodlands ecological community but indicates a tall shrubland and not the Banksia Woodlands ecological community. ○ FCT 20c – Eastern shrublands and woodlands, corresponds with a separate EPBC ecological community listing, Shrublands and Woodlands of the eastern Swan Coastal Plain. Occurrences of this FCT should be considered under that separate listing.	recorded. The contra-indicators of *Banksia littoralis* and *Banksia burdettii* were not recorded. The community does not represent FCT 20c – Eastern shrublands and woodlands.
2	**Condition thresholds** • Assessments of a patch should initially be centered on the area of highest native floristic diversity and/or cover, i.e. the best condition area of the patch. • Consideration must be given to the timing of surveys and recent disturbance. Ideally surveys should be undertaken in spring with two sampling periods to capture early and late flowering species. • The surrounding context of a patch must also be taken into account when considering factors that add to the importance of a patch that meets the condition thresholds.	The community was assessed and sampled in the highest condition representation available in the study area.

Step	Key diagnostic characteristics (DotEE 2016c)	Outcome
	• Certain vegetation components of the Banksia Woodlands ecological community merit consideration as critical elements to protect. Three components are recognised as threatened in their own right in WA and, as such, are priorities for protection; refer to Table 1 in the Approved Conservation Advice (DotEE 2016c). • A relevant expert (e.g. ecological consultant, local NRM or environment agency) may be useful to help identify the ecological community and its condition.	
3	**Minimum patch size** Minimum patch sizes apply for consideration of a patch as part of the listed ecological community for EPBC Act referral, assessment and compliance purposes. Where patches meet different levels of condition, different minimum patch sizes apply: • 'Pristine' – no minimum patch size applies • 'Excellent' – 0.5 ha or 5,000 m2 (e.g. 50 m x 100 m) • 'Very Good' – 1 ha or 10,000 m2 (e.g. 100 m x 100 m) • 'Good' – 2 ha or 20,000 m2 (e.g. 200 m x 100 m). Note: To be considered as part of the EPBC Act ecological community, a patch should meet at least the Good Condition category.	The areas of vegetation community EmCcXb are presented in **Table 3**. The community within the study area covered a total of 65 ha and was made up of 32 ha of Very Good and 27 ha of Good condition. The community within the study area therefore meets the condition requirements of a minimum of 1 ha of Very Good condition when considered in isolation from surrounding vegetation. The vegetation community is likely to make significant contributions to conservation, particularly in parts of the distribution where the community is very highly fragmented. This concept recognises that any single patch of a TEC may be degraded to some degree but contributes to the overall function of the ecological community (and other environmental components) across the landscape.
4	**Further information to assist in determining the presence of the ecological community and significant impacts.** • The landscape position of the patch, including its position relative to surrounding vegetation also influences how important it is in the broader landscape. For example, if it enables movement of native fauna or plant material or supports other ecological processes • A patch is a discrete and mostly continuous area of the ecological community. A patch may include small-scale (<30 m) variations, gaps and disturbances, such as tracks, paths or breaks. Where there is a break in native vegetation cover, from the edge of the tree	The vegetation community EmCcXb within the study area represents an occurrence of the Banksia Woodlands of the Swan Coastal Plain TEC. Although key diagnostic *Banksia* species do not form a dominant structural layer, the assessment has taken into account that the definition indicates these *Banksia* species are 'typically' or 'commonly' present, implying that there may be some variation in a vegetation community

Step	Key diagnostic characteristics (DotEE 2016c)	Outcome
	canopy of 30 m or more (e.g. due to permanent artificial structures, wide roads or other barriers; or due to water bodies typically more than 30m wide) then the gap typically indicates that separate patches are present. • Variation in canopy cover, quality or condition of vegetation across a patch should not initially be considered to be evidence of multiple patches. Patches can be spatially variable and are often characterised by one or more areas within a patch that meet the key diagnostic characteristics and condition threshold criteria amongst areas of lower condition. Average canopy cover and quality across the broadest area that meets the general description of the ecological community should be used initially in determining overall canopy cover and vegetation condition. Also note any areas that are either significantly higher or lower in quality, gaps in canopy cover and the condition categories that would apply across different parts of the site respectively. Where the average canopy cover or quality falls below the minimum thresholds, the next largest area or areas that meet key diagnostics (including minimum canopy cover requirements) and minimum condition thresholds should be specified and protected. This may result in multiple patches being identified within the overall area first considered. • A buffer zone is a contiguous area immediately adjacent to a patch of the ecological community that is important for protecting its integrity. The purpose of the buffer zone is to help protect and manage the national threatened ecological community. The edges of a patch are considered particularly susceptible to disturbance and the presence of a buffer zone is intended to act as a barrier to further direct disturbance. • The recommended minimum buffer zone for the ecological community is 20–50 metres from the outer edge of a patch, and the appropriate size depends on the nature of the buffer and local context (e.g. slope). A larger buffer zone should be applied, where practical, to protect patches that are of particularly high conservation value, or if patches are down slope of drainage lines or a source of nutrient enrichment, or groundwater drawdown.	where they are not strictly a dominant species. Vegetation community EmCcXb was assessed as representing the TEC as this community meets all criteria of the *Banksia* TEC listing minus the dominant presence of *Banksia*, this community has also been mapped at a larger extent previously as being a FCT which has a relationship to the TEC. The portion of this community within the study area appears to have either natural variation where other co-dominant species (e.g. *Eucalyptus* spp.) become dominant or key Banksia species have been removed through historical activities (e.g. logging). The presence of key *Banksia* species also increases where the vegetation community continues outside the study area. The portion of the vegetation community is considered important to support ecological processes given it provides a direct connection to occurrences of the TEC outside of the study area.

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