

Document Reference: EP16-060(06)—023A

Emerge contact: Anna Welker

24 October 2017

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Blue Tang (WA) Pty Ltd as trustee for The Reef Unit Trust ABN 44656153170 and Emerge Environmental Services Pty Ltd ABN 57144772510 trading as Emerge Associates

Attention: Clearing Permit Section
Department of Water and Environmental Regulation
Locked Bag 33
CLOISTERS SQUARE WA 6850

Delivered by email to: info-der@dwer.wa.gov.au

Dear Sir/Madam,

CLEARING PERMIT (AREA PERMIT) APPLICATION FOR PART LOT 105 STOCK ROAD, LAKELANDS

Introduction and Background

Emerge Associates (Emerge) has been engaged by Lot 105 Lakelands Pty Ltd ('the applicant') to provide environmental consultancy services to support sand extraction activities and subsequent residential development of part of Lot 105 Stock Road, Lakelands (herein referred to as 'the site').

As shown in **Figure 1**, the site is situated within the City of Mandurah, approximately 9 kilometres (km) north-east of Mandurah city centre, and 57 km south of the Perth Central Business District (CBD). The site is approximately 38 hectares (ha) in size and is bound by Stock Road to the east, 'urban' zoned land to the south, a 'regional open space' reserve to the west and extensive areas of remnant vegetation to the north. The site is currently zoned 'urban' under the Peel Region Scheme (PRS) and 'urban development' under the City of Mandurah Town Planning Scheme (TPS) No. 3.

The local structure plan (LSP) for the site is currently with the Western Australian Planning Commission (WAPC) for approval and a subdivision application will be submitted subsequently. The proponent is currently seeking approval to clear a portion of vegetation within the site in advance of subdivision approval in order to allow the extraction of sand from within the site, as well as to allow forward bulk earthworks associated with the future residential development. This area is referred to herein as the 'clearing permit area' (as shown in **Figure 1**), and comprises an area of approximately 8.81 ha.

Environment context

Historical disturbance in the form of grazing and sand extraction has occurred within the clearing permit area over the past few decades, with sand extraction activities concluding circa 2010. Currently, the clearing permit area is not used for any specific purpose, however, unauthorised disturbance in the form of off-road vehicle usage is currently evident.

The key environmental features surrounding the clearing permit area are shown in **Figure 2** and include:

- Paganoni Swamp, which lies to the western side of the clearing permit area and is mapped as a 'conservation' category wetland (CCW) in the *Geomorphic Wetlands of the Swan Coastal Plain* dataset (DPaW 2014).

- Bush Forever Site 395 'Paganoni Swamp and adjacent bushland, Karnup' and the wider Rockingham Lakes Regional Park (RLRP) which lies to the north of the clearing permit area.
- One large environmentally sensitive area (ESA), as prescribed under the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*, which lies to the north and west of the clearing permit area. This ESA appears to be associated with the CCW to the west and with the Bush Forever Site to the north.
- One 'Perth metropolitan ecological linkage' and one 'south west ecological linkage', which occur approximately 350 metres (m) west of the clearing permit area (WALGA and PBP 2004).
- One 'Peel regionally significant natural area' (Peel RSNA), as outlined in *Environmental Protection Bulletin No. 12* (EPA 2013), which occurs within a small portion of the western side of the clearing permit area.

Clearing Permit Attachments

Attachment 1 contains the signed clearing permit (area permit) application form for processing by the Department of Water and Environment Regulation (DWER), and the C3 form with the credit card details applicable for the payment of the clearing permit fee. A copy of the Certificate of Title for the site is provided as **Attachment 2**. **Attachment 3** and **Attachment 4** and the remainder of this letter contain supporting information to assist the DWER in assessing the clearing permit application.

Clearing permit area

Flora and Vegetation Values

A detailed spring flora and vegetation assessment of the site (including the clearing permit area) was undertaken by Emerge Associates in 2016 (Emerge Associates 2017b) (**Attachment 3**). The following information relates to the flora and vegetation located within the clearing permit area only.

An examination of historical imagery shows that the majority of the clearing permit area was used for grazing since 1983, and then cleared of the remaining remnant vegetation for sand extraction circa 2000, and remained cleared until circa 2010. Since this time the area has experienced regrowth of shrubby vegetation, which was classified into one native plant community '**Ap**' which is described as an 'Open shrubland of *Acacia pulchella* var. *glaberrima* over weeds' as illustrated in **Plate 1** and shown in **Figure 3** (Emerge Associates 2017b). Sample data from the two survey locations in the **Ap** plant community recorded a total of nine native species over the two survey locations. No threatened or priority flora species were recorded within plant community **Ap** and thus within the clearing permit area.

Plant community **Ap** was not considered to represent an intact community that would have naturally occurred in the area. Instead it was considered almost a monoculture of one native species, dominated by an understorey of non-native species including the weeds **Asphodelus fistulosus* and **Brassica tournefortii*. Plant community **Ap** was also considered too disturbed to represent a floristic community type (FCT) and does not represent a threatened ecological community (TEC) or priority ecological community (PEC).

Plant community **Ap** was recorded to be in 'degraded - completely degraded' condition using the Keighery (1994) scale, due to the altered vegetation structure, low native species diversity and high cover of non-native species, particularly in the understorey. The vegetation condition within the site including the clearing permit area is shown on **Figure 4**.



Plate 1: Plant community **Ap** in 'degraded - completely degraded' condition (-32.46500, 115.78518).

Fauna values

A level 1 fauna assessment of the site (including the clearing permit area) was undertaken by Greg Harewood in 2016 (Harewood 2016) (**Attachment 4**). The fauna assessment found the fauna habitat values within the site to be substantially reduced due to historical disturbance, and as a result, the fauna diversity was considered well below levels likely to be present in undisturbed areas (Harewood 2016).

The key fauna habitat values recorded during the fauna assessment, were the large old trees located within the site, but outside of the clearing permit area, that potentially support habitat for threatened black cockatoos. Unlike these areas, the clearing permit area, contains only shrubby native regrowth vegetation with an open ground layer dominated by weeds as illustrated in **Plate 1** above.

Proposed Clearing of Native Vegetation

Clearing is proposed within the central portion of the site to facilitate the extraction of sand and bulk earthworks for the future residential development. The clearing permit area comprises the entirety of the **Ap** community, totalling 8.81 ha.

A summary of the vegetation to be removed in the clearing permit area is provided in **Table 1**. The native vegetation within the clearing permit area is shown in **Figure 5**.

Table 1: Area of native vegetation to be removed within clearing permit area according to plant communities and vegetation condition

Plant community	Vegetation Condition	Total within site	Within Clearing Permit Area (ha)
Ap	Degraded - completely degraded	8.81	8.81

Adjacent to clearing permit area

Native vegetation of varying quality is present within the site, adjacent to the clearing permit area. Approximately 10 individuals of the Priority 2 (P2) flora species, *Acacia benthamii*, were recorded to the south-east of the clearing permit area. These individuals were recorded in a 25 square metre

(m²) patch of vegetation in the south-eastern corner of the site, as shown in **Figure 3**. No other occurrences of this or any other threatened or priority flora species were recorded within the site or the clearing permit area.

Two native plant communities and areas of non-native vegetation were recorded within the site, outside of the clearing permit area (Emerge Associates 2017b). Plant community **EmBKg** is located to the south-east of the clearing permit area. Plant community **EgCcEm** is located primarily to the west of the clearing permit area, with a narrow portion located to the north-east. Non-native vegetation comprises the remainder of the site outside the clearing permit area.

The plant communities adjacent to the clearing permit area and within the site are described below and illustrated in **Figure 3**.

- **EmBKg:** Open woodland of *Eucalyptus marginata* (with occasional *Corymbia calophylla*) over low open woodland of *Banksia menziesii*, *Banksia attenuata* and *Xylomelum occidentale* over low open woodland of *Kunzea glabrescens* and *Hibbertia hypericoides* over occasional native forbs and weeds.
- **EgCcEm:** Woodland of *Eucalyptus gomphocephala*, *Corymbia calophylla* and *Eucalyptus marginata* over sparse shrubland of *Hakea prostrata* over weeds.
- **Non-native vegetation.**

A portion of plant community **EmBKg**, in the south-eastern corner of the clearing permit area, consists of vegetation in 'good' condition. This vegetation retains its natural structure and has moderate native species diversity. Evidence of both historical and recent disturbance was present in this vegetation, with recent unauthorized felling and lopping of *Eucalyptus marginata* (jarrah) trees for firewood and associated tracks.

Plant community **EmBKg** was determined to represent FCT 21a 'Central *Banksia attenuata* – *Eucalyptus marginata* woodlands'. The **EmBKg** vegetation meets the criteria to represent the 'Banksia Woodlands of the Swan Coastal Plain' TEC. This TEC, herein referred to as the 'banksia woodland TEC', is listed as 'endangered' under the *Environment Biodiversity and Conservation Act 1999* (EPBC Act). The 1.67 ha of **EmBKg** vegetation in 'good' condition does not meet the banksia woodland TEC minimum patch size criterion of 2 ha for 'good' condition vegetation. However, the adjoining **EmBKg** vegetation in 'degraded' condition would be viewed as contiguous and part of the same patch. Therefore, the entire 3.16 ha of **EmBKg** vegetation in the site, outside of the clearing permit area, comprises a patch of the banksia woodland TEC. This vegetation also represents the Priority 3 (P3) 'Banksia dominated woodlands of the Swan Coastal Plain IBRA region' priority ecological community (PEC).

Plant community **EgCcEm** is in 'degraded' condition as it comprises an intact canopy, but the understorey shows signs of disturbance and sparse native plants. Plant community **EgCcEm** was considered too disturbed to represent a FCT.

Native vegetation is also present to the west and north of the site, within Paganoni Swamp and Bush Forever Site 395. To the east of the site lies roadside vegetation along Stock Road and native vegetation within private holdings. Land south of the clearing permit area is currently being developed for residential subdivision.

Response to EP Act Clearing Principles

Pursuant to Section 51C of the *Environmental Protection Act 1986* (EP Act) clearing of native vegetation is an offence unless a clearing permit has been obtained or an exemption applies. When assessing clearing applications, the DWER have regard to the ten clearing principles contained in Schedule 5 of the EP Act so far as they are relevant to the matter under consideration.

In support of this clearing application, we have considered and responded to the ten clearing principles, which are detailed below.

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

The clearing permit area contains one native plant community, **Ap**, that comprises regrowth following vegetation clearing within the site from 2000 to 2010. This native plant community was observed to be dominated by one native species, *Acacia pulchella* var. *glaberrima*, with the understorey vegetation considered sparse and dominated by non-native species (Emerge Associates 2017b). The plant community was also considered too disturbed to represent a FCT.

Sample data from the two survey locations in the **Ap** plant community recorded a total of nine native species over the two survey locations. The plant community was considered to be in 'degraded - completely degraded' condition, due to the altered vegetation structure, low native species diversity and high cover of non-native species, particularly in the understorey.

In conclusion, the high level of historical land disturbance and degradation has significantly reduced the flora species diversity in the clearing permit area. Therefore, the proposed clearing is not considered to be at variance with this principle.

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

Due to historical disturbance within the site, the fauna habitat values are considered reduced, and the fauna diversity is considered well below levels likely to be present prior to historical disturbances (Harewood 2016) (**Attachment 4**). The key areas of fauna habitat recorded within the site, were the large old trees that contain potential habitat for the threatened black cockatoos, which do not occur within the clearing permit area. The clearing permit area is highly disturbed and contains only shrubby native vegetation with open ground layer dominated by weeds, and is therefore unlikely to represent significant fauna habitat.

Based on the above, the proposed clearing is not considered to be at variance with this principle.

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

A search of State and Commonwealth threatened ('declared rare') and priority flora databases was completed as part of the flora and vegetation survey (Emerge Associates 2017b). Based on the results of this search and in consideration of the existing environment of the site, no threatened (rare) or priority flora species were identified as potentially occurring within the **Ap** plant community. Furthermore, site surveys within the clearing permit area did not record any threatened or priority flora species. Therefore, the proposed clearing is not considered to be at variance with this principle.

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

The native vegetation in the clearing permit area, plant community **Ap**, has been historically disturbed and comprises regrowth dominated by one native shrub species. Therefore, this community does not represent a threatened or priority ecological community. The proposed clearing is not considered to be at variance with this principle.

Principle (e) – native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared.

Examination of historical imagery illustrates that the clearing permit area was used for grazing since 1983, and the remaining remnant vegetation was cleared for sand extraction circa 2000, and remained cleared until circa 2010. Since this time the area has experienced the regrowth of shrubby vegetation which has been classified into one native plant community **Ap**, as illustrated in **Figure 3** and shown in **Plate 1** above (Emerge Associates 2017b).

This plant community is dominated by non-native species including the weeds **Asphodelus fistulosus* and **Brassica tournefortii*, and is not considered to represent an intact plant community that would have naturally occurred in the area. Rather, the vegetation is almost a monoculture of one native

species, and was considered too disturbed to represent a FCT. Therefore, this plant community is not considered to be a remnant of native vegetation plant community and not considered at variance with this principle.

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

A review of the *Geomorphic Wetlands of the Swan Coastal Plain* dataset indicated that no wetland features occur within the clearing permit area.

One CCW (UFI 13887) named Paganoni Swamp occurs to the west of the clearing permit area, outside of the site, and one small ‘multiple use’ category wetland feature (UFI 13884) occurs to the south-west of the site which is also associated with Paganoni Swamp. Both features are classified as sumpland wetlands. There are also several other CCW wetlands in a 5 km radius of the site.

The site survey (Emerge Associates 2017b) confirmed that the clearing permit area is a sandy upland community with non-wetland vegetation, and therefore although Paganoni Swamp is nearby, the clearing permit area does not contain native vegetation growing in, or associated with, a watercourse or wetland. Thus, the proposed clearing of native vegetation is not considered to be at variance with this principle.

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

Landform and soil mapping undertaken by Churchward and McArthur (1980) indicates that the majority of the clearing permit area is within the Yoongarillup soil association, described as plains with low ridges and swales, with shallow and brown sands over marine limestone. The western portion of the clearing permit area is within the Karrakatta soil association, described as an undulating landscape with deep yellow sands over limestone. Finer scale mapping by Gozzard (2011) places the clearing permit area in the Spearwood dunes which was later confirmed during the field survey. The Spearwood association typically has yellow sub horizons which often contain limestone and is at an intermediate stage of leaching and formation.

The *Perth Metropolitan Region 1: 50,000 Environmental Geology Series, Rockingham (Part of sheets 2033 II and 2033 III)* (Gozzard 1983) indicates the clearing permit area to be comprised of ‘sand’ (map unit S7) derived from Tamala Limestone.

A geotechnical investigation of the site (including the clearing permit area) was completed by JDSi in July 2016 (JDSi 2016), with natural soils encountered at the site identified to be consistent with regional mapping, comprising loose to medium density sand. The clearing permit area was observed to have been previously used for sand extraction activities. This area was further observed to have since been backfilled, with uncontrolled fill observed.

The elevation of the site ranges from approximately 2.5 mAHD in the south-west to 18 mAHD in the north-west. The highly permeable sands characterising the area and the relative undulating topography will result in surface water draining freely across the site. Water erosion from surface runoff from the area would occur infrequently and only in response to intense events. Wind erosion and land degradation have the potential to occur due to proposed clearing of vegetation. Despite this, any risk of land degradation will be mitigated post clearing via watering and hydromulching, where required. JDSi Consultant Engineers have been engaged by the applicant to manage the clearing permit area site works and ensure it is appropriately stabilised in the short term prior to development.

In conclusion, the clearing of vegetation within the clearing permit area is unlikely to have significant impacts on land degradation and therefore the clearing is not considered to be at variance with this principle.

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

No *Bush Forever* sites occur within the clearing permit area, given its location outside of the Metropolitan Region Scheme (MRS) boundary. Remnant bushland north of the clearing permit area, outside the site, comprises the most southerly mapped *Bush Forever* site: Bush Forever Site 395 'Paganoni Swamp and adjacent bushland, Karnup'. This reserve covers an area of over 705.5 ha and is part of the RLRP, which is owned by the WAPC and managed by DBCA.

One very large ESA is located to the west of the clearing permit area. This ESA extends to the north, south-west and south-east over an area of approximately 598 square kilometers (km²), and is considered to relate to the Bush Forever Site 395 and Paganoni Swamp CCW. No mapped ecological linkages occur within the clearing permit area. One regional ecological linkage occurs approximately 200 m north-west of the site, and joins a south-west ecological linkage which continues south. Part of one Peel RSNA, as outlined in *Environmental Protection Bulletin No. 12* (EPA 2013), is located within the clearing permit area. This Peel RSNA is named 'Paganoni Swamp South', extends beyond the clearing permit to the west towards Paganoni Swamp. The locations of environmental values in the vicinity of the clearing permit area are shown in **Figure 4**.

The clearing permit area comprises degraded regrowth vegetation that is unlikely to contribute to the ecological connectivity between the above-mentioned conservation areas. Furthermore, a large portion of the native vegetation within the site (outside of the clearing permit area), is proposed to be retained within Public Open Space and the 50m buffer to the CCW as part of the future residential development, which will ensure that this connectivity is maintained. Therefore, the proposed clearing is not considered to be at variance with this principle.

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

Available information (DER 2015) indicates that the clearing permit area has been classified as having no known risk of acid sulfate soils (ASS) occurring within three metres of the natural soil surface.

Depth to groundwater ranges between 0.11 m and 19.11 m across the site with a measured maximum groundwater level (MGL) of 1.89 m AHD (Emerge Associates 2017a). Groundwater underlying the site flows west towards the Indian Ocean. Groundwater salinity within the clearing permit area is 500-1000 milligrams per litre of total dissolved solids (TDS). This level of groundwater salinity is considered to be marginal (DoW 2017).

There are no surface water features occurring within the clearing permit area, however Paganoni Swamp is located to the west. As no potential contaminants will be brought into the clearing permit area as part of clearing works, and given the proposed clearing is associated with areas that have low salinity and no ASS risk, the proposed clearing is unlikely to have an effect on the quality of surface or groundwater. Furthermore, the retention of native vegetation west of the clearing permit area near Paganoni Swamp will assist to provide a natural filtration of surface water flow in this direction.

In conclusion, given the above and given the small scale clearing proposed, within an area that has already been extensively cleared and used for sand extraction purposes in the past, the clearing is not considered to be at variance with this principle.

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

The site is primarily characterised by highly permeable sands which results in surface water draining freely across the clearing permit area. Surface runoff from the area would occur infrequently and only in response to intense events. To the west of the site is Paganoni Swamp, a CCW that is surrounded by melaleuca woodlands. Depth to groundwater in the site ranges from 0.11 m and 19.11 m and flows to the west, in the direction of Paganoni Swamp.

Given the highly permeable sands within the clearing permit area and given the small scale clearing proposed, within an area that has already been extensively cleared and currently contains shrubby

regrowth in degraded - completely degraded condition, the proposed clearing of vegetation is unlikely to increase the risk of flooding, thus clearing is not considered to be at variance with this principle.

Summary and closing

Native vegetation to be cleared from the site consists of 8.81 ha of regrowth vegetation in 'degraded – completely degraded' condition. As detailed above, the proposed clearing is not considered to be at variance to any of the ten clearing principles.

Yours sincerely
Emerge Associates



Anna Welker
SENIOR ENVIRONMENTAL CONSULTANT

cc: Tom Kroyer, Lot 105 Lakelands Pty Ltd

Encl: Figure 1: Site Location
Figure 2: Environmental Features
Figure 3: Plant Communities and Priority Flora
Figure 4: Vegetation Condition
Figure 5: Native Vegetation in Clearing Permit Area
Attachment 1: Clearing Permit Application Form and C3 form
Attachment 2: Certificate of title
Attachment 3: *Spring Flora and Vegetation Assessment* (Emerge Associates 2017b)
Attachment 4: *Fauna Assessment* (Harewood 2016)

General references

- Beard, J. S. 1990, *Plant Life of Western Australia*, Kangaroo Press Pty Ltd., Kenthurst, N.S.W.
- Beard, J. S., Beeston, G. R., Harvey, J. M., Hopkins, A. J. M. and Shepherd, D. P. 2013, *The vegetation of Western Australia at the 1:3,000,000 scale. Explanatory memoir. Second edition.*, Conservation Science Western Australia, 9: 1-152.
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Online references

- Department of Water (DoW) 2017, Perth Groundwater Atlas, viewed January 2017, <<http://atlases.water.wa.gov.au/idelve/gwa/>>.

Figures



Figure 1: Site Location

Figure 2: Environmental Features

Figure 3: Plant Communities and Priority Flora

Figure 4: Vegetation Condition

Figure 5: Native vegetation Within the Clearing Permit Area



Figure 1: Site Location

Project: Clearing Permit
Part Lot 105 Stock Road, Lakelands

Client: Lot 105 Lakelands Pty Ltd

Plan Number: EP16-060(06)--F64a
Drawn: RAO
Date: 20/10/2017
Checked: ACW
Approved: ACW
Date: 23/10/2017



0 100 200 300
Metres
Scale: 1:12,500@A4
GDA 1994 MGA Zone 50



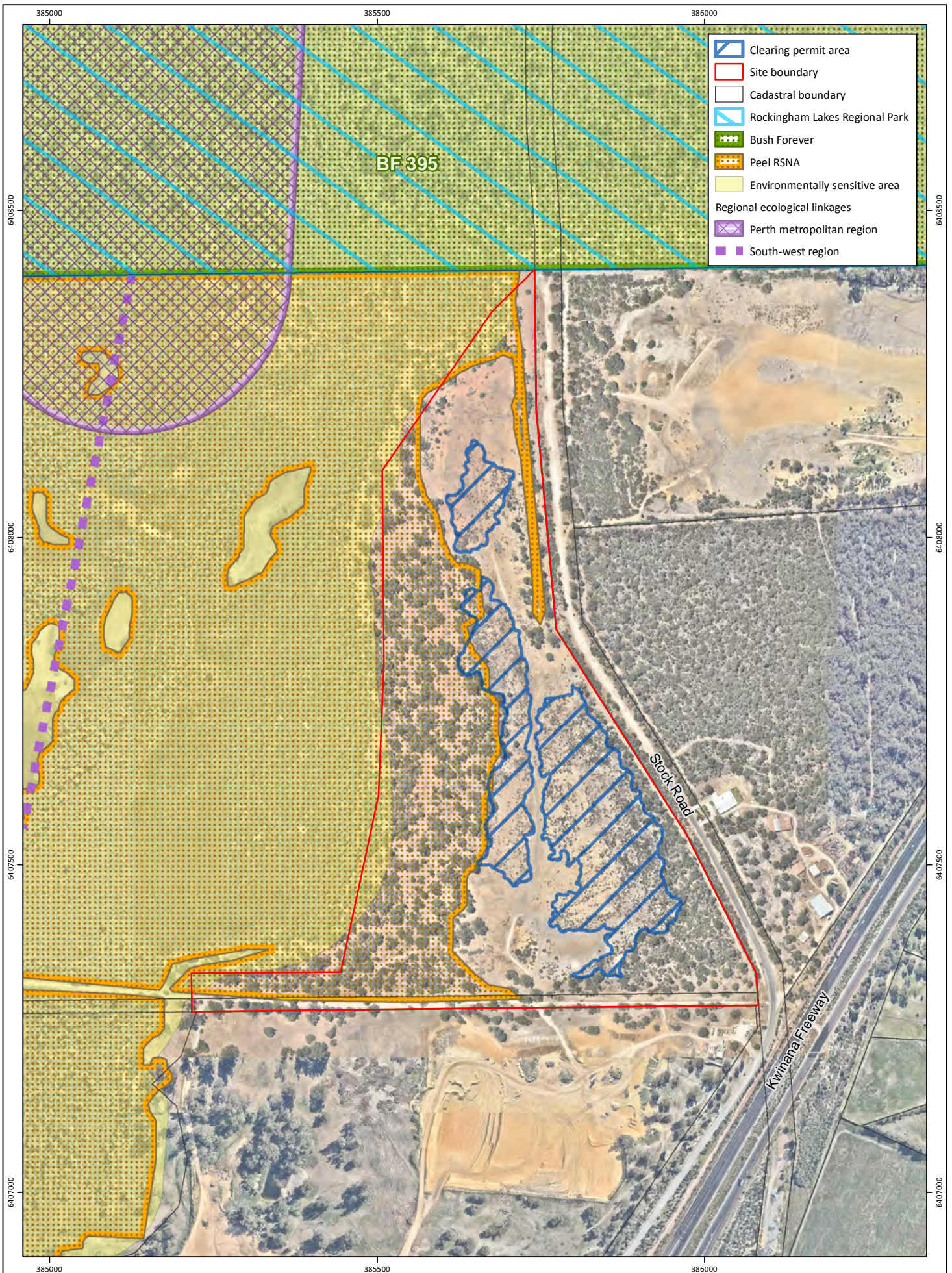


Figure 2: Environmental Features

Plan Number:
EP16-060(06)--F67a
Drawn: RAO
Date: 20/10/2017
Checked: ACW
Approved: ACW
Date: 23/10/2017



0 50 100 150
Metres

Scale: 1:7,500@A4
GDA 1994 MGA Zone 50

Project: Clearing Permit
Part Lot 105 Stock Road, Lakelands
Client: Lot 105 Lakelands Pty Ltd



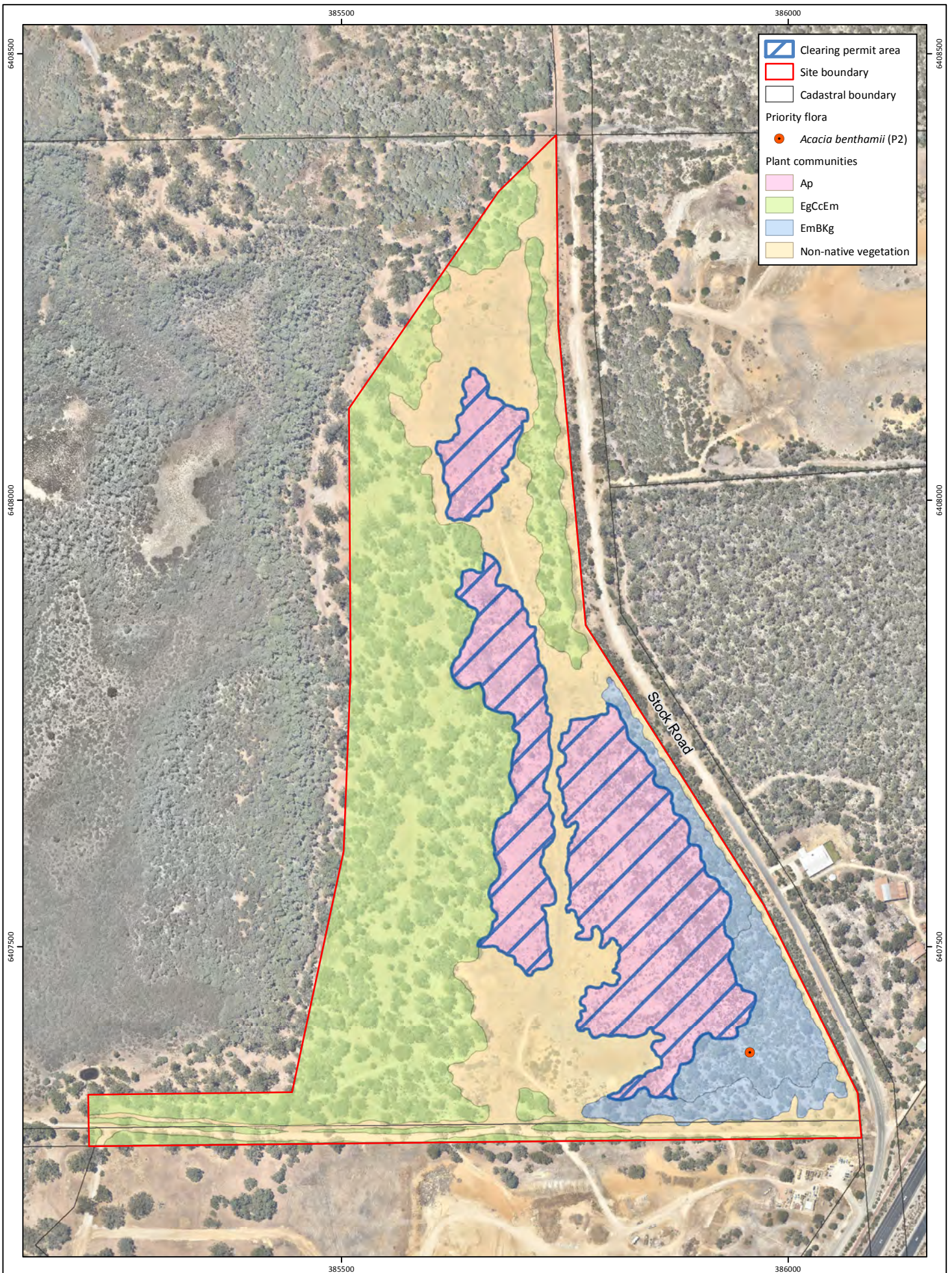


Figure 3: Plant Communities and Priority Flora

Plan Number:
EP16-060(06)--F65a
Drawn: RAO
Date: 20/10/2017
Checked: ACW
Approved: ACW
Date: 23/10/2017



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Metres
Scale: 1:5,500@A4
GDA 1994 MGA Zone 50

Project: Clearing Permit
Part Lot 105 Stock Road, Lakelands
Client: Lot 105 Lakelands Pty Ltd



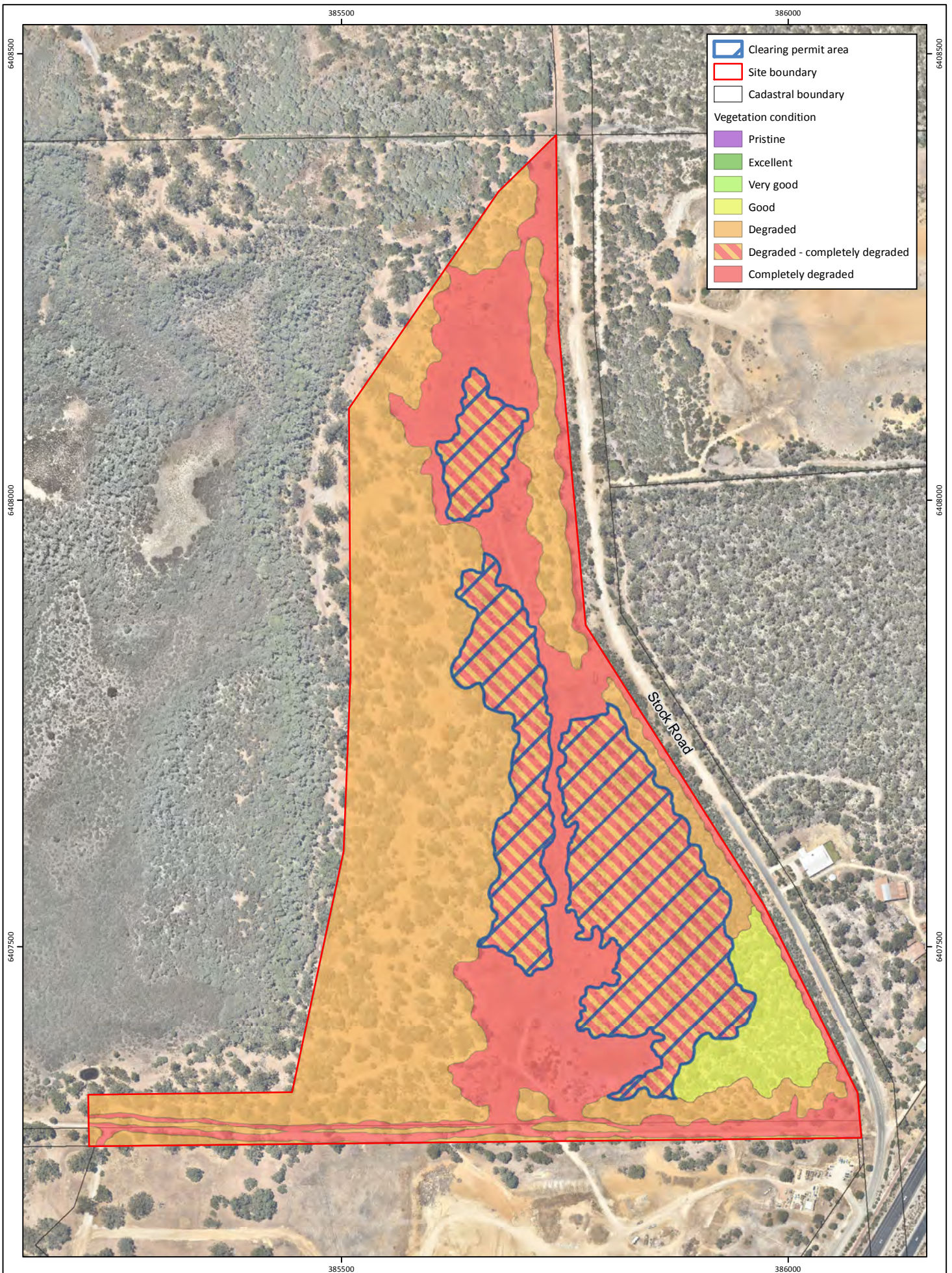


Figure 4: Vegetation Condition

Project: Clearing Permit
Part Lot 105 Stock Road, Lakelands
Client: Lot 105 Lakelands Pty Ltd

Plan Number: EP16-060(06)--F66a
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Date: 20/10/2017
Checked: ACW
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Date: 23/10/2017



0 50 100 150
Metres
Scale: 1:5,500@A4
GDA 1994 MGA Zone 50



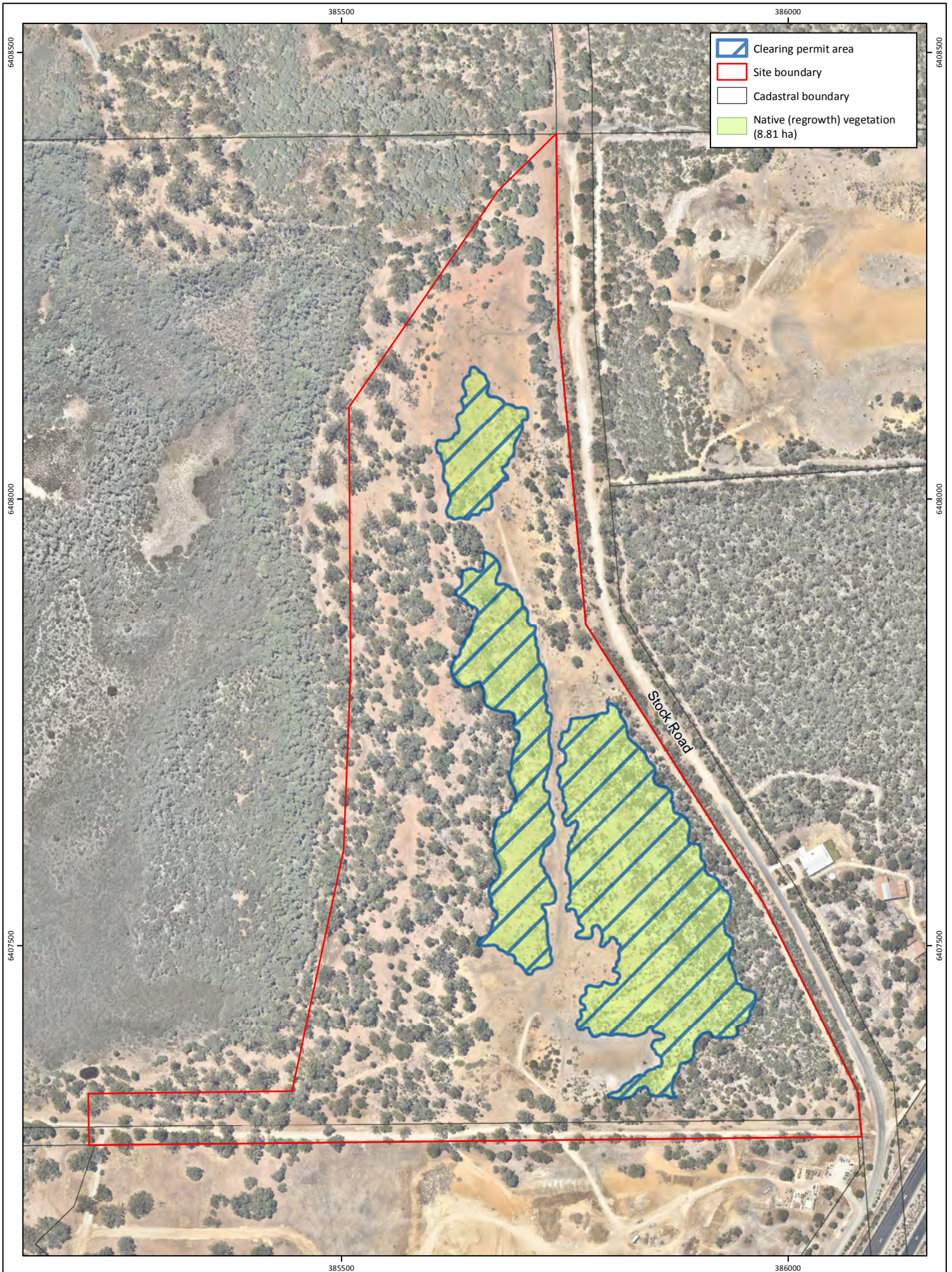


Figure 5: Native Vegetation in Clearing Permit Area

Plan Number:
 EP16-060(06)--F68a
 Drawn: RAO
 Date: 20/10/2017
 Checked: ACW
 Approved: ACW
 Date: 23/10/2017



0 50 100 150
 Metres
 Scale: 1:5,500@A4
 GDA 1994 MGA Zone 50

Project: Clearing Permit
 Part Lot 105 Stock Road, Lakelands
Client: Lot 105 Lakelands Pty Ltd



Attachment 1

Clearing Permit Application Form and C3 Form



Attachment 2

Certificate of Title



WESTERN



AUSTRALIA

REGISTER NUMBER 105/DP37823	
DUPLICATE EDITION 5	DATE DUPLICATE ISSUED 1/10/2014

RECORD OF CERTIFICATE OF TITLE
UNDER THE TRANSFER OF LAND ACT 1893

VOLUME
2616

FOLIO
592

The person described in the first schedule is the registered proprietor of an estate in fee simple in the land described below subject to the reservations, conditions and depth limit contained in the original grant (if a grant issued) and to the limitations, interests, encumbrances and notifications shown in the second schedule.

REGISTRAR OF TITLES



LAND DESCRIPTION:

LOT 105 ON DEPOSITED PLAN 37823

REGISTERED PROPRIETOR:
(FIRST SCHEDULE)

LOT 105 LAKELANDS PTY LTD OF POST OFFICE BOX 477 APPECROSS
(T N166480) REGISTERED 4 NOVEMBER 2015

LIMITATIONS, INTERESTS, ENCUMBRANCES AND NOTIFICATIONS:
(SECOND SCHEDULE)

1. C865676 EASEMENT BURDEN SEE SKETCH ON VOL 2131 FOL 36. REGISTERED 27.9.1984.
2. *N166481 MORTGAGE TO NATIONAL AUSTRALIA BANK LTD REGISTERED 4.11.2015.
3. *N325703 NOTIFICATION - SECTION 180 COMPENSATION PAID PLANNING & DEVELOPMENT ACT 2005 REGISTERED 12.5.2016.

Warning: A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required.
* Any entries preceded by an asterisk may not appear on the current edition of the duplicate certificate of title.
Lot as described in the land description may be a lot or location.

-----END OF CERTIFICATE OF TITLE-----

STATEMENTS:

The statements set out below are not intended to be nor should they be relied on as substitutes for inspection of the land and the relevant documents or for local government, legal, surveying or other professional advice.

SKETCH OF LAND: DP37823.
PREVIOUS TITLE: 2131-36.
PROPERTY STREET ADDRESS: LOT 105 STOCK RD, LAKELANDS.
LOCAL GOVERNMENT AREA: CITY OF MANDURAH.

NOTE 1: M579233 SECTION 138D TLA APPLIES TO CAVEAT M300450.
NOTE 2: DUPLICATE CERTIFICATE OF TITLE NOT ISSUED AS REQUESTED BY DEALING N166481

Attachment 3

Spring Flora and Vegetation Assessment
(Emerge Associates 2017b)



Spring Flora and Vegetation Survey

Part Lot 105 Stock Rd, Lakelands

Project No: EP16-060(03)

**Prepared for Lot 105 Lakelands Pty Ltd
April 2017**



Spring Flora and Vegetation Survey

Part Lot 105 Stock Rd, Lakelands



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Spring Flora and Vegetation Survey

Part Lot 105 Stock Rd, Lakelands



Executive Summary

Lot 105 Lakelands Pty Ltd engaged Emerge Associates (Emerge) to undertake a spring flora and vegetation survey within part of Lot 105 Stock Road in Lakelands (referred to herein as 'the site'). The site, which is approximately 38 ha in size, is adjacent to Paganoni Swamp and Bush Forever Site 395 and is zoned 'urban' under the Peel Region Scheme (PRS) and 'urban development' under the City of Mandurah Town Planning Scheme (TPS) No. 3. Historic disturbance has occurred across the site including grazing, vegetation clearing and sand extraction.

Two botanists from Emerge Associates visited the site on 9 September 2016 and undertook a detailed flora and vegetation survey. During the survey targeted searches were conducted for 'threatened' and 'priority' flora and an assessment was made on the type, condition and values of vegetation across the site.

Outcomes of the survey include:

- Non-native vegetation is present across 9.88 ha of the site.
- Remnant native vegetation is present across 28.2 ha of the site in varying levels of condition.
- A total of 63 native and 28 non-native (weed) species were recorded in the site.
- Approximately 10 individuals of the priority two species *Acacia benthamii* were recorded in the south-eastern corner of the site.
- No other threatened or priority flora species were recorded or are considered likely to occur within the site.
- The native vegetation within the site was classified into three plant communities: **EmBKg**, **EgCcEm** and **Ap** that are present in 'good', 'degraded', 'degraded to completely degraded' and 'completely degraded' condition:
 - Plant community **EmBKg** includes the highest quality vegetation in the site and aligns with 'floristic community type' (FCT) 21a 'Central *Banksia attenuata* – *Eucalyptus marginata* woodlands'.
 - Plant community **EgCcEm** consists of a canopy of large native trees over introduced pasture grasses that represents a degraded form of FCT 25 'Eucalyptus gomphocephala – *Agonis flexuosa* woodlands'.
 - Plant community **Ap** is highly disturbed and consists of low shrubland of *Acacia pulchella* var. *glaberrima* over weeds that is too degraded to assign to an FCT.
- Based on the relevant criteria, the plant community **EmBKg** represents the '*Banksia Woodlands of the Swan Coastal Plain*' threatened ecological community (TEC), which was recently listed as 'endangered' under the *Environment Protection and Biodiversity Conservation Act 1999*. A patch of approximately 3.16 ha of banksia woodland is present within the site. The **EmBKg** community also represents the state listed PEC 'Banksia dominated woodlands of the Swan Coastal Plain IBRA region'.
- Due to their potential as black cockatoo habitat and close proximity to Paganoni Swamp the large trees present in parts of the **EgCcEm** plant community on the western side of the site may be locally and regionally significant.

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1 Introduction

1.1 Project background

Lot 105 Lakelands Pty Ltd intends to develop part of Lot 105 Stock Road in Lakelands for residential purposes. This lot is located approximately 57 kilometres (km) south of the Perth Central Business District within the City of Mandurah (CoM). Part of this lot (referred to herein as 'the site') is zoned 'urban' under the Peel Region Scheme (PRS) and 'urban development' under the CoM Town Planning Scheme (TPS) No. 3.

The site is approximately 38 hectares (ha) in size and is bound by Stock Road to the east, Bush Forever Site 395 to the north (Paganoni Swamp and adjacent bushland), Paganoni Swamp to the west and private land to the south. The location of the site is shown in **Figure 1**.

1.2 Purpose and scope of work

Emerge Associates (Emerge) were engaged by Lot 105 Lakelands Pty Ltd to provide environmental consultancy services to support the planning process for the site. The purpose of this survey is to provide sufficient information on the flora and vegetation values within the site to inform this process.

The scope of work was specifically to undertake a spring flora and vegetation assessment (to the standard required of a level 2 'detailed' survey in accordance with the Environmental Protection Authority's (EPA's) *Guidance Statement No. 51 – Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia* (EPA 2004) and the more recent *Technical Guide - Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016).

As part of this scope of work, the following tasks were undertaken:

- Desktop review of relevant background information pertaining to the site and surrounds, including database searches for threatened flora species and ecological communities.
- Compilation of a comprehensive list of flora species recorded as part of the field survey.
- Mapping of plant communities and vegetation condition.
- Identification of conservation significant flora and vegetation.
- Documentation of the desktop assessment, survey methodology and results into a report.

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2 Background

2.1 Climate

The south west of Western Australia experiences a Mediterranean climate of hot dry summers and cool wet winters. Long-term climatic data was obtained from the Mandurah weather station, which is the nearest current reporting station to the site (Bureau of Meteorology 2016). This data indicates the site is located in an area of moderate rainfall, receiving an average of 671.2 millimetres (mm) annually, the majority of which is received between May and August. Mean maximum temperatures range from 17.4°C in July to 29.9°C in February. Mean minimum temperatures range from 10.6°C in July to 19.4°C in February (Bureau of Meteorology 2016).

Responding appropriately to climatic conditions is critical for flora and vegetation surveys to ensure that surveys are conducted during times when flora species are easiest to detect and identify. In Mediterranean type climates some flora species will typically spend part of their life-cycle as either underground storage organs or as seed. This is an adaptation to unfavourable environmental conditions such as excessive heat and drought that occur over the summer period. These species, known as 'geophytes' or 'annuals', tend to re-emerge during winter when favourable conditions return and are most visible during spring, which is the flowering period for a majority of plant species.

A total of 349.4 mm of rain was recorded from May to September 2016, indicating sufficient rainfall occurred at the site to promote the growth of flora species prior to this survey.

2.2 Geomorphology and soils

The site occurs on the Swan Coastal Plain, which is the geomorphic unit that characterises much of the Perth metropolitan region. The Swan Coastal Plain is approximately 500 km long and 20 to 30 km wide and is roughly bound by the Indian Ocean to the west and the Darling Scarp to the east. Broadly the Swan Coastal Plain consists of two sedimentary belts of different origin. Its eastern side has formed from the deposition of alluvial material washed down from the Darling Scarp. While its western side is comprised of three dune systems that run roughly parallel to the Indian Ocean coastline (Seddon 2004). These dune systems, referred to as Quindalup, Spearwood and Bassendean associations, represent a succession of coastal deposition that has occurred since the late Quaternary period (approximately two million years ago) (Kendrick *et al.* 1991) and, as a result, they contain soils at different stages of leaching and formation.

Examination of broad scale mapping places the eastern portion of the site within the Yoongarillup association and the western portion in the Karrakatta association (Churchward and McArthur 1980). Finer scale mapping by Gozzard (2011) places the site in the Spearwood dunes which was later confirmed during the field survey. The Spearwood association typically has yellow sub horizons which often contain limestone and is at an intermediate stage of leaching and formation.

The site is not known to contain any restricted landforms or unique geological features.

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2.3 Regional vegetation

Native vegetation is described and mapped at different scales in order to illustrate patterns in its distribution. At a continental scale the *Interim Biogeographic Regionalisation of Australia* (IBRA) divides the Swan Coastal Plain into two floristic subregions (Environment Australia 2000). The site is contained within the 'SWA02' or Perth subregion, which is characterised as mainly containing *Banksia* low woodland on leached sands with *Melaleuca* swamps where ill-drained; and woodland of *Eucalyptus gomphocephala* (tuart), *E. marginata* (jarrah) and *Corymbia calophylla* (marri) on less leached soils (Beard 1990). This subregion is recognised as a biodiversity hotspot and contains a wide variety of endemic flora and vegetation types.

Variations in native vegetation within the site can be further classified based on regional vegetation associations. Beard *et al.* (2013) mapping shows the majority of the site excepting the south-eastern corner as comprising vegetation association 'Spearwood 998'. This association is described as 'medium woodland; tuart' (Beard *et al.* 2013). Spearwood 998 Association has 35.9% of its pre-european extent remaining on the Swan Coastal Plain with 32.9% protected for conservation purposes (Government of WA 2014).

The south-eastern corner of the site comprises vegetation association 'Spearwood 1001' which is described as 'medium very sparse woodland; jarrah, with low woodland; banksia & casuarina' (Beard *et al.* 2013). Spearwood 1001 Association has 27.6% of its pre-European extent remaining on the Swan Coastal Plain, with 4.2% protected for conservation purposes (Government of WA 2014).

Studies have indicated that the loss of biodiversity caused by habitat fragmentation is significantly greater once a habitat type falls below 30% of its original extent (Miles 2001). However, this is a purely biodiversity protection orientated objective. On the Swan Coastal Plain, which is considered a 'constrained area', the EPA has applied an objective of retaining 10% of each vegetation complex (EPA 2006). The conserved area of the 'Spearwood 998' vegetation association falls above this retention objective, whereas, the area of 'Spearwood 1001' vegetation association in conservation reserve falls below.

2.4 Topography

The elevation of the site ranges from 2.5 metres (m) Australian height datum (AHD) on the western boundary to 18 mAHD on the southern boundary of the site (DoW 2008).

2.5 Wetlands

Wetlands include "areas of seasonally, intermittently or permanently waterlogged soils or inundated land, whether natural or otherwise, fresh and saline, e.g. waterlogged soils, ponds, billabongs, lakes, swamps, tidal flats, estuaries, rivers and their tributaries" (Wetlands Advisory Committee 1977). Wetlands can further be recognised by the presence of vegetation associated with waterlogging or the presence of hydric soils such as peat, peaty sand or carbonate mud (Hill *et al.* 1996).

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Wetlands of regional, national, international or cultural significance may be added to registers, lists or databases aimed at ensuring their protection. The following lists were checked as part of this assessment:

- *Ramsar List of Wetlands of International Importance*
- *A Directory of Important Wetlands in Australia.*

No Ramsar or listed 'important wetlands' are located near the site.

The geomorphic wetland classification system of Semeniuk (1987) is used to classify wetlands on the Swan Coastal Plain based on their landform and water permanence (hydro-period). The Department of Parks and Wildlife's (DPaW) maintains the *Geomorphic Wetland of the Swan Coastal Plain* dataset, which further categorises geomorphic wetland features into specific management categories to guide landuse and conservation. Further information on geomorphic wetland types and their management categories is provided in **Appendix A**.

A review of DPaW's *Geomorphic Wetlands of the Swan Coastal Plain* dataset indicated that one 'conservation' category wetland feature (UFI 13887) occurs adjacent to the western side of the site which contains the majority of Paganoni Swamp. One small 'multiple use' category wetland feature (UFI 13884) occurs to the south-west of the site which is also associated with Paganoni Swamp. Both features are classified as sumpland wetlands. As the *Geomorphic Wetlands of the Swan Coastal Plain dataset* was drafted at a regional scale the boundaries of mapped features are often inconsistent with physical wetland boundaries. Strategen (2014) concluded that the 2mAHD contour provides the most appropriate boundary for Paganoni Swamp adjacent to the site. The location of the geomorphic wetland features and 2mAHD contour are shown in **Figure 2**.

2.6 Historic land use

Review of historical aerial images shows that the site retained native vegetation cover until sometime between 1965 and 1973, at which point understory removal is evident along the western side adjacent to Paganoni Swamp. It is likely that this area was parkland cleared to facilitate grazing. By 1983 wholesale clearing is evident across the majority of the site excepting the central south and north-eastern boundary. Between 1985 and 1995 the native vegetation had regrown in most of those areas, although more vegetation was removed in a southern portion of the site as part of apparent sand extraction. Between 1995 and 2000 a large portion in the centre of the site was then cleared, also for sand extraction, and this area remained cleared until around 2010. Since then low, shrubby vegetation has regrown across the disturbed area. Relatively intact vegetation now remains in the south-eastern corner of the site, although this vegetation is largely regrowth that was previously completely cleared. A relatively intact native canopy is retained to the west of the site near Paganoni Swamp.

The observations made from aerial imagery were confirmed during previous surveys by Emerge Associates (2014b) across the site (refer **Section 2.12**).

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2.7 Threatened and priority flora

Certain flora species that are considered to be rare or under threat warrant special protection under Commonwealth and/or State legislation. At a Commonwealth level, flora species may be listed as ‘threatened’ pursuant to Schedule 1 of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Any action likely to have a significant impact on a species listed under the EPBC Act requires approval from the Commonwealth Minister for the Environment.

In Western Australia plant species may also be classed as ‘threatened’ or ‘priority’ species under the *Wildlife Conservation Act 1950* (WC Act). Threatened flora species are gazetted under subsection 2 of section 23F of the WC Act and it is an offence to “take” or damage rare flora without Ministerial approval. Priority flora species are potentially rare or threatened and are classed in order of threat. Further information on threatened and priority species and their categories is provided in **Appendix A**.

A search was conducted for threatened and priority flora within a 10 km radius of the site using the *Protected Matters Search Tool* (DoEE 2016a), *NatureMap* (DPaW 2016a) and DPaW threatened and priority flora database (reference no. 24-1116FL). Nine threatened and 26 priority flora species were identified as potentially occurring in the wider local area as listed in **Table 1**.

Of the flora species potentially occurring in the local area, only those with habitat preferences of dry elevated sandy soils and were deemed likely to occur in the site. This is because, although the western side of the site near Paganoni Swamp is lower in elevation and would have historically been moister, the high levels of disturbance and alteration to vegetation structure in those areas makes it improbable that any threatened or priority species would now occur. On this basis three threatened flora species (*Caladenia huegelii*, *Drakaea elastica* and *Drakaea micrantha*) and eight priority flora species (*Stachystemon* sp. Keysbrook, *Acacia benthamii*, *Thelymitra variegata*, *Beyeria cinerea* subsp. *cinerea*, *Lasiopetalum membranaceum*, *Conostylis pauciflora* subsp. *pauciflora*, *Dodonaea hackettiana* and *Jacksonia sericea*) were identified as potentially occurring within the site (highlighted green in **Table 1**). Note that *Acacia benthamii* (priority 2) was previously recorded in the site (Emerge Associates 2014a).

Table 1: Significant flora species known to occur within the general area

Species	Level of significance		Life strategy	Habitat	Flowering period	Likelihood of occurrence
	State	EPBC Act				
<i>Synaphea</i> sp. Fairbridge Farm	T	CE	P	Low woodland on grey, clayey sand with lateritic pebbles near winter wet flats.	Sept-Nov	Unlikely
<i>Andersonia gracilis</i>	T	E	P	White/grey sandy, sandy clay, gravelly loam. Winter-wet areas, near swamps.	Sept-Nov	Unlikely
<i>Caladenia huegelii</i>	T	E	PG	Grey or brown sand, clay loam.	Sept-Oct	Possible
<i>Diuris purdiei</i>	T	E	PG	Grey-black sand, moist.	Sept-Oct	Unlikely
<i>Drakaea elastica</i>	T	E	PG	White or grey sand.	Oct-Nov	Possible

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Species	Level of significance		Life strategy	Habitat	Flowering period	Likelihood of occurrence
	T	E				
<i>Lepidosperma rostratum</i>	T	E	P	Peaty sand, clay in swamps.	May-Aug	Unlikely
<i>Diuris drummondii</i>	T	V	PG	In low-lying depressions in peaty and sandy clay swamps.	Nov-Jan	Unlikely
<i>Diuris micrantha</i>	T	V	PG	Brown loamy clay.	Sept-Oct	Unlikely
<i>Drakaea micrantha</i>	T	V	PG	White-grey sand.	Sept-Oct	Possible
<i>Acacia lasiocarpa</i> var. <i>bracteolata</i> long peduncle variant	P1	-	P	Grey or black sand over clay in winter wet areas.	May-Aug	Unlikely
<i>Stachystemon</i> sp. Keysbrook	P1	-	P	White grey sand.	October	Possible
<i>Acacia benthamii</i>	P2	-	P	Sand, typically on limestone breakaways.	Aug-Sep	Previously recorded
<i>Cardamine paucijuga</i>	P2	-	PG	Winter wet areas, sand or clay.	Sep-Oct	Unlikely
<i>Johnsonia pubescens</i> subsp. <i>cygnorum</i>	P2	-	P	Grey white yellow sands on flats and seasonally wet areas.	September	Unlikely
<i>Thelymitra variegata</i>	P2	-	PG	Sandy clay, sand, laterite.	Jun-Sep	Possible
<i>Beyeria cinerea</i> subsp. <i>cinerea</i>	P3	-	P	Sand, limestone.	May-Oct	Possible
<i>Boronia capitata</i> subsp. <i>gracilis</i>	P3	-	P	White/grey or black sand in winter-wet swamps, hillslopes.	Jun-Nov	Unlikely
<i>Calandrinia oraria</i>	P3	-	PG	Coastal dunes, in low heath, sand over limestone.	Aug-Oct	Unlikely
<i>Dillwynia dillwynioides</i>	P3	-	P	Sandy soils. Winter-wet depressions.	Aug-Dec	Unlikely
<i>Eryngium pinnatifidum</i> subsp. <i>Palustre</i>	P3	-	P	Grey brown sand or clay in winter wet flats.	Sep-Nov	Unlikely
<i>Lasiopetalum membranaceum</i>	P3	-	P	Sand over limestone.	Sep-Dec	Possible
<i>Pimelea calcicola</i>	P3	-	P	Sand, limestone, coastal ridges.	Sept-Nov	Unlikely
<i>Schoenus capillifolius</i>	P3	-	A	Brown mud in claypans.	Oct-Nov	Unlikely
<i>Sphaerolobium calcicola</i>	P3	-	P	Sand/sandy clay over limestone, black peaty sandy clay. Tall dunes, winter-wet flats, interdunal swamps, low-lying areas.	Jun or Sep-Nov	Unlikely
<i>Boronia tenuis</i>	P4	-	P	Laterite, stony soils, granite.	Aug-Nov	Unlikely
<i>Caladenia speciosa</i>	P4	-	P	White, grey or black sand.	Sept-Oct	
<i>Calothamnus graniticus</i> subsp. <i>leptophyllus</i>	P4	-	P	Clay over granite, lateritic soils. Hillsides.	Jun-Aug	Unlikely
<i>Conostylis pauciflora</i> subsp. <i>pauciflora</i>	P4	-	P	Grey sand, limestone. Hillslopes, consolidated dunes.	Aug-Oct	Possible
<i>Dodonaea hackettiana</i>	P4	-	P	Sand, outcropping limestone.	Jul-Oct	Possible
<i>Eucalyptus rudis</i> subsp.	P4	-	P	Loam on flats and hillsides.	Jul-Sep	Unlikely

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Species	Level of significance		Life strategy	Habitat	Flowering period	Likelihood of occurrence
<i>cratyantha</i>						
<i>Jacksonia sericea</i>	P4	-	P	Calcareous and sandy soils.	Dec-Feb	Possible
<i>Ornduffia submersa</i>	P4	-	A	Sandy clay in inundated wetland/creek.	Aug-Nov	Unlikely
<i>Parsonsia diaphanophleba</i>	P4	-	P	Alluvial soils. Along rivers.	Jan-Feb or Apr-Sep	Unlikely
<i>Pimelea rara</i>	P4	-		Lateritic soils.	Dec-Jan	Unlikely
<i>Stylidium longitubum</i>	P4	-	PG	Sandy clay, clay. Seasonal wetlands.	Oct-Dec	Unlikely

Note: T=threatened, CE=critically endangered, E=endangered, V=vulnerable, P1=priority 1, P2=priority 2, P3=priority 3, P4=priority 4, P=perennial, PG=perennial geophyte, A=annual.

2.8 Threatened and priority ecological communities

An ecological community is a naturally occurring group of native plants, animals and other organisms that are interacting in a unique habitat. An ecological community's structure, composition and distribution are determined by environmental factors such as soil type, position in the landscape, altitude, climate and water availability (DoEE 2016). 'Threatened ecological communities' (TECs) are ecological communities that are recognised as rare or under threat and therefore warrant special protection.

Selected TECs are afforded statutory protection at a Commonwealth level under section 181 of the EPBC Act. Any action likely to have a significant impact on a community listed under the EPBC Act requires approval from the Commonwealth Minister for the Environment. TECs are also listed within Western Australia but are currently are not afforded direct statutory protection at a State level. Nonetheless their significance is acknowledged through other State environmental approval processes such as 'environmental impact assessment' pursuant to Part IV of the *Environmental Protection Act 1986* (EP Act) and the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*. A plant community that is under consideration for listing as a TEC in Western Australia, but does not yet meet survey criteria or has not been adequately defined, may be listed as a 'priority ecological community' (PEC). Listing as a PEC is similarly considered during state approval processes. Further information on categories of TECs and PECs is provided in **Appendix A**.

Known locations of TECs and PECs within 10 km of the site were searched for using the publicly available *Weed and Native Flora Dataset* (Keighery 2012), *Protected Matters Search Tool* (DoEE 2016a) and DPaW's threatened and priority ecological communities' database (reference no. 06-01116EC). These search results indicate that the northern edge of the site occurs within the buffer zone of one recorded PEC, 'Southern Swan Coastal Plain *Eucalyptus gomphocephala* - *Agonis flexuosa* woodlands'. In addition five Commonwealth listed TECs, one State listed TEC and five PECs occur within 10 km of the site as listed in **Table 2**.

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Table 2: TECs and PECs known to occur within 10 km of the site.

Code	Community name	TEC/ PEC	Level of significance	
			State	EPBC Act
SCP 19b	Woodland over sedgeland in Holocene dune swales of the southern Swan Coastal Plain	TEC	-	Critically Endangered (Sedgelands in Holocene dune swales of the southern Swan Coastal Plain)
SCP 19a	Sedgelands in Holocene dune swales of the southern Swan Coastal Plain	TEC	-	
Multiple	Banksia Woodlands of the Swan Coastal Plain	TEC	-	Endangered
SCP 07	Herb rich saline shrublands in clay pans	TEC	-	Vulnerable (Clay pans of the Swan Coastal Plain)
Coastal Saltmarsh	Subtropical and temperate coastal saltmarsh	TEC	Priority 3	Vulnerable
SCP 15	Forests and woodland of deep seasonal wetlands of the Swan Coastal Plain	TEC	Vulnerable	-
Walyungup Microbial	Brackish microbial community number 1 (Lake Walyungup)	PEC	Priority 1	-
SCB 29b	Acacia shrublands on taller dunes, southern Swan Coastal Plain	PEC	Priority 3	-
Multiple	Banksia dominated woodlands of the Swan Coastal Plain IBRA region	PEC	Priority 3	-
SCP 29a	Coastal shrublands on shallow sands, southern Swan Coastal Plain	PEC	Priority 3	-
SCP 24	Northern Spearwood shrublands and woodlands	PEC	Priority 3	-
SCP 25	Southern Swan Coastal Plain <i>Eucalyptus gomphocephala</i> - <i>Agonis flexuosa</i> woodlands	PEC	Priority 3	-

*Communities considered to potentially be present within the site shaded green

Three of these 12 communities are considered likely to occur in the site based geomorphology, soils and regional vegetation patterns (shaded green in **Table 2**):

- ‘Banksia Woodlands of the Swan Coastal Plain’ TEC (endangered under EPBC Act)
- ‘Banksia dominated woodlands of the Swan Coastal Plain IBRA region’ PEC
- ‘Southern Swan Coastal Plain *Eucalyptus gomphocephala* - *Agonis flexuosa* woodlands’ PEC.

The main diagnostic feature for both “banksia woodland” communities is the presence of a prominent tree layer of *Banksia attenuata* and/or *B. menziesii*, although other criteria are also applied at Commonwealth (DoEE 2016) and State level (DPaW 2016b). A wide range of ‘floristic community types’ (FCTs) common to the Swan Coastal Plain can be related to these two communities (Gibson *et al.* 1994).

The ‘Southern Swan Coastal Plain *Eucalyptus gomphocephala* - *Agonis flexuosa* woodlands’ PEC occurs on the Karrakatta, Cottlesloe and Vasse soil units and consists of woodland dominated by *Eucalyptus gomphocephala* (tuart), although other species such as *Corymbia calophylla* and

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Eucalyptus decipiens may also be present. 'FCT 25' is typically related to this community (Gibson *et al.* 1994).

2.9 Land use planning considerations

A range of legislation, regulations and policies are relevant to the evaluation of vegetation in Western Australia. Key instruments applicable to the site are described below and also shown in **Figure 2**.

2.9.1 *Bush Forever*

The Government of Western Australia's *Bush Forever* policy is a strategic plan for conserving regionally significant bushland within the Swan Coastal Plain portion of the Perth Metropolitan Region. The objective of *Bush Forever* is to protect comprehensive representations of all original ecological communities by targeting a minimum of 10% of each vegetation complex for protection (Government of WA 2000). *Bush Forever* sites are representative of regional ecosystems and habitat and have a key role in the conservation of Perth's biodiversity. The *Bush Forever* policy is only applicable within the boundary of the Metropolitan Region Scheme (MRS).

No *Bush Forever* sites occur within the site, given it is located outside of the Metropolitan Region Scheme boundary. However, remnant bushland immediately north of the site is included within Bush Forever Site 395 'Paganoni Swamp and adjacent bushland, Karnup'. This reserve covers an area of over 705.5 ha and is part of the Rockingham Lakes Regional Park, which is owned by the West Australian Planning Commission (WAPC) and managed by DPaW.

2.9.2 Peel regional natural areas

Environmental Protection Bulletin no. 12 *Swan Bioplan – Peel Regionally Significant Natural Areas* (EPB 12) (EPA 2013) is used to inform strategic land use planning in the Peel Region by identifying 'Peel regionally significant natural areas' (Peel RSNAs). Peel RSNAs are natural areas which have significant flora, vegetation and landform values that represent the original landscape of the Peel Region. Development proposals which may potentially impact upon a Peel RSNA require detailed flora, vegetation and fauna investigations to be undertaken. Based on the outcomes of these investigations, development proposals should firstly aim to avoid, and then minimise, potential impacts on identified natural areas.

The eastern extent of the 'Paganoni Swamp South' Peel RSNA intersects portions of the site. This Peel RSNA extends over a large area, the majority of which occurs outside of the site, and encompasses remnant vegetation associated with Paganoni Swamp to the west and adjacent to Bush Forever Site 395 to the north.

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2.9.3 Environmentally sensitive areas

'Environmentally sensitive areas' (ESAs) are prescribed under the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004* to protect native vegetation values of areas surrounding significant, threatened or scheduled flora, vegetation communities or ecosystems. Within an ESA none of the exemptions under the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004* apply. However, exemptions under Schedule 6 of the *Environmental Protection Act 1986* (EP Act) still apply, including any clearing in accordance with a subdivision approval under the *Planning and Development Act 2005* (a recognised exemption under the Schedule 6 of the EP Act).

One ESA is located within part of the western side of the site. This ESA is large and extends to the north, south-west and south-east of the site over an area of approximately 598 square kilometers.

2.9.4 Ecological linkages

Ecological linkages are linear landscape elements that allow the movement of fauna, flora and genetic material between areas of remnant habitat. The movement of fauna and the exchange of genetic material between vegetation remnants improves the viability of those remnants by allowing greater access to breeding partners and food sources, refuge from disturbances such as fire and maintenance of genetic diversity of plant communities and populations. Ecological linkages are ideally continuous or near-continuous as the more fractured a linkage is, the less ease flora and fauna have in moving within the corridor (Alan Tingay and Associates 1998).

The Perth Biodiversity Project, supported by the Western Australia Local Government Association (WALGA), have identified and mapped Regional Ecological Linkages within the Perth Metropolitan Region (WALGA and PBP 2007). In order to extend this study outside of the Perth Metropolitan Region, the South West Biodiversity Project was established, resulting in the identification and mapping of the South West Regional Ecological Linkages (Molloy *et al.* 2009).

There are no mapped ecological linkages within the site. However, a regional ecological linkage is identified to the west of the site associated with Paganoni Swamp, Bush Forever Site 395 and connected wetlands, which joins a south-west ecological linkage and continues south.

2.10 Local and regionally significant flora and vegetation

EPA (2004) *Guidance Statement No. 51* states flora species and ecological communities may be significant for a number of reasons irrespective of whether have special protection under policy or legislation. Some of these reasons are outlined in **Appendix A**.

Two key reasons that vegetation within the site may be significant are listed below:

- The close proximity of the site to Paganoni Swamp, which includes conservation category wetland feature UFI 13887, 'Paganoni Swamp South' Peel RSNA and forms part of a regional ecological linkage.
- The vegetation within the site has potential value as habitat for threatened or priority fauna species including, in particular, Carnaby's black cockatoo and the forest red-tailed black cockatoo, which are listed as 'vulnerable' under the EPBC Act and 'endangered' under the WC Act (DoEE 2012).

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2.11 Weed species and declared pests

The term 'weed' can refer to any plant that requires some form of action to reduce its effect on the economy, the environment, human health and amenity. Many non-native flora species and some native species are considered to be weeds.

A particularly invasive or detrimental weed species may be listed as a 'declared pest' pursuant to the Western Australia's *Biosecurity and Agriculture Management Act 2007* (BAM Act), indicating that it warrants special management to limit its spread. Further information on categories of declared pests is provided in **Appendix A**.

2.12 Previous flora surveys

Emerge have previously completed multiple surveys of the site as part of the wider due diligence investigations across Lot 105 stock Road and Lot 101 Mandurah road (which adjoins lot 105 to the west) (Emerge Associates 2014b). As part of this work a reconnaissance survey was undertaken on 21 November 2013, followed by a flora and vegetation assessment on 26 November 2013. During these surveys broad scale mapping of plant communities and vegetation condition was completed and the priority 2 flora species *Acacia benthamii* was recorded in the south-east of the site.

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3 Methods

3.1 Field survey

Two botanists from Emerge visited the site on 9th September 2016 to conduct the flora and vegetation assessment.

The site was traversed on foot and vehicle and the composition and condition of vegetation was recorded. Targeted searches were conducted for threatened and priority flora species with potential to occur in the site, with a particular focus on identifying areas of suitable habitat.

Detailed sampling of the vegetation was undertaken using a combination of non-permanent 10 x 10 m quadrats and relevés. The quadrats were established using fence droppers bound by measuring tape. The relevés were completed over an equivalent ~10 x 10 m area without the use of physical markers and were included to provide a more rapid sample of vegetation in obviously poorer condition. A total of seven sampling points were surveyed, comprised of two quadrats and five relevés. The position of each sampling location was recorded with a hand-held GPS unit, as shown on **Figure 3**.

The data recorded within each sampling point included:

- site details (site name, site number, observers, date, location)
- environmental information (slope, aspect, bare-ground, rock outcropping soil type and colour class, litter layer, topographical position and time since last fire event)
- biological information (vegetation structure and condition, degree of disturbance, species present and 'foliage projective cover' (FPC) (quadrats only)).
- digital photo (oblique angle facing south east).

Plant taxa not observed within sampling locations were recorded opportunistically as the botanists traversed the site. Photographs were also taken throughout the field visit to show particular site conditions.

Transects were walked within areas of suitable habitat for threatened and priority flora species. In particular, the most intact vegetation, located in the south-eastern corner of the site, was searched thoroughly. If observed, the number of individuals was recorded as well as the location using a hand-held GPS unit.

All plant specimens collected during the field survey were dried, pressed and then named in accordance with requirements of the Western Australian Herbarium. Identification of specimens occurred through comparison with named material and through the use of taxonomic keys. Flora species not native to Western Australia are denoted by an asterisk '*' in text and raw data.

Vegetation condition was assigned at each sample point and changes in vegetation condition were also noted and mapped across the site. The condition of the vegetation was assessed using methods from Keighery (1994). For vegetation in the south-eastern corner of the site containing *Banksia* spp.,

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the condition scale provided in the conservation advice for the 'Banksia Woodlands of the Swan Coastal Plain TEC' (DoEE 2016) was applied in addition to the Keighery scale (as shown in **Table 3**).

Table 3: Vegetation condition scale applied during field assessment

Condition category	Definition (Keighery 1994)	Indicator (DoEE 2016)	
		Typical native vegetation composition	Typical weed cover
Pristine	Pristine or nearly so, no obvious signs of disturbance.	Native plant species diversity fully retained or almost so	Zero or close to
Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species.	High native plant species diversity	Less than 10%
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	Moderate native plant species diversity	5-20%
Good	Vegetation structure significantly altered by very obvious signs of multiple disturbances. 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.	Low native plant species diversity	5-50%
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.	Very low native plant species diversity	20-70%
Completely degraded	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often described as 'parkland cleared' with the flora comprising weed or crop species with isolated native trees or shrubs.	Very low to no native species diversity	Greater than 70%

3.2 Mapping and data analysis

3.2.1 Plant community identification and description

The local plant communities within the site were identified from the quadrat data collected during the field survey. A cluster analysis was performed by converting the FPC for each species at each quadrat location to a Domin value (Kent and Coker 1994). Classification was undertaken using hierarchical clustering within the analysis package Primer-6 (Clarke and Gorley 2006), with groups defined using the Bray-Curtis distance measure and further refined using a similarity probability measure (significance level of 0.05).

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Once a group was defined from the cluster analysis, the vegetation was described according to the dominant species present using the structural formation descriptions of the *National Vegetation Inventory System* (NVIS) (ESCAVI 2003). The identified plant community was then mapped on aerial photography (1:15,000) from the quadrat data points and boundaries interpreted from aerial photography. Vegetation condition was mapped on aerial photography (1: 13,000) based on the locations recorded during the field survey to define areas with changes in condition.

3.2.2 Floristic community type assignment

The identified plant community was then compared to the regional 'floristic community type' (FCT) dataset *A Floristic survey of the southern Swan Coastal Plain* by Gibson *et al.* (1994). The quadrat data (presence/absence) was reconciled with Gibson *et al.* (1994) by standardising the names of taxa with those used in the earlier study. This was necessary due to changes in nomenclature in the intervening period. Taxa that were only identified to genus level were excluded, while some infra-species that have been identified since 1994 were reduced to species level. The combined dataset was then imported into the statistical analysis package Primer-6 (Clarke and Gorley 2006).

As data from a localised survey is often spatially correlated, data for each quadrat was compared to Gibson *et al.* (1994) separately. This removed the influence of spatial correlation when assigning a FCT. Classification was then undertaken using a group-average hierarchical clustering technique using the Bray-Curtis distance measure (as described above for plant community determination).

Where the quadrats tended to cluster with a grouping of different FCTs, individual quadrat similarity was assessed separately to differentiate between FCTs. Ultimately the cluster analysis, as well as contextual information relating to the soils, landforms and known locations of FCTs within the region, were considered in the final determination of an FCT for vegetation within the site.

3.2.3 Species accumulation curve

A species accumulation curve was plotted from quadrat data in Excel. A trendline (log) was generated and forecast to locate the asymptote of the curve (the point at which the curve flattens indicating few species remain undetected). Primer-6 also offers a range of estimators to predict minimum species richness (Clarke and Gorley 2006). The non-parametric Jackknife1 estimator was reported, as this is known to perform well in comparison to simulated and real data sets and is also recommended for small sample sizes (Gotelli and Colwell 2011). Comparison between actual and estimated species accumulation curves assists in evaluating the adequacy of sampling effort.

3.3 Survey limitations

It is important to note the specific constraints imposed on surveys and the degree to which these may have limited survey outcomes. An evaluation of the survey methodology against standard constraints outlined in EPA *Guidance Statement No. 51* (2004) is provided in **Table 4**.

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Table 4: Evaluation of survey methodology against standard constraints outlined in EPA Guidance Statement 51

Constraint	Degree of limitation	Details
Availability of contextual information	No limitation	Generally, the broad scale contextual information described in Section 2 is adequate to place the site and vegetation in context.
	Minor limitation	Regarding assignment of FCT the authoritative Gibson <i>et al</i> 1994 dataset was derived from a necessarily limited sample of vegetation from largely publicly owned land which is now more than 20 years out of date. Consequently, it is unknown to what degree official FCTs are an appropriate reference to biodiverse vegetation across the Swan Coastal Plain. Furthermore, Gibson <i>et al.</i> (1994) collected data in the spring main flowering period and in many cases sampled plots multiple times to provide a complete species list. Although only sampled once, the site data was considered comparable given it was also collected in spring and definitive FCTs were not assigned to highly modified vegetation.
Experience level of personnel	No limitation	This flora and vegetation assessment was undertaken by a two qualified botanists with five and 14 years of botanical experience in Western Australia respectively. Technical review was undertaken by a senior environmental consultant with 15 years' experience in environmental science in Western Australia.
Suitability of timing / temporal coverage	No limitation	The survey was conducted in September and thus within the spring main flowering season. Relatively high rainfall was recorded from May to August 2016 in the months preceding the site visit. Therefore it is likely that many plant species would have been in flower and/or visible at the time of survey. Furthermore, a wide range of annual and geophytic plants, including orchids, were recorded (refer Section 4.2) demonstrating that the survey timing was adequate to allow the detection of species for which seasonal timing is critical.
	No limitation	Comprehensive flora and vegetation assessments can require multiple visits, at different times of year, and over a period of a number of years, to enable observation of all species present. The site was visited multiple times in late November 2013 and once in September 2016. The November site visits provided an insight into the vegetation condition and composition out of the main flowering period. Therefore this survey is considered to meet the requirements of a 'level 2' detailed survey.
Spatial coverage / sampling intensity	No limitation	Site coverage was comprehensive (track logged).
	No limitation	A total of 91 species were recorded, of which 85 were recorded from two sample quadrats and five POIs and an additional six were recorded opportunistically. Minimum species richness within site is estimated at approximately 123 (Jackknife1) (refer to species accumulation curve and estimates shown in Plate 5). Therefore an estimated 74% of species were recorded. Considering the small area of 'good' condition vegetation and subsequent intensive searching conducted within this vegetation, combined with the degraded nature of the site, survey effort was considered to be adequate. Only two quadrats were sampled in the 'good' condition vegetation however this area is small (<2ha) with patches of high current disturbance and 'degraded' condition.
Influence of disturbance	Minor limitation	Time since fire is greater than 60 years as interpreted from aerial imagery and therefore short lived species more common after fire may not have been visible.
	No limitation	Historical ground disturbance in differing intensities was evident in the majority of the site including thinning of canopy trees and complete vegetation removal. The disturbance history of the site was considered when undertaking field sampling.
Adequacy of resources	No limitation	All resources required to perform the survey were available.
Access problems	No limitation	All parts of the site could be accessed as required.

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4 Results

4.1 General

The site is undulating with the lowest areas being on the western boundary near Paganoni Swamp and the highest on the southern boundary. Surface soils are yellow brown and sandy with no rock cover. Low shrubby vegetation has spread across much of the central disturbed areas that is dominated by weeds and one native shrub *Acacia pulchella* var. *glaberrima*. Intact vegetation is present in the south-eastern corner of the site and the vegetation near Paganoni Swamp consists of a parkland cleared native canopy over introduced grasses. Planted shrubs and trees are scattered within the central portion of the site.

During the site visit evidence of recent unauthorized human disturbance in the form of firewood cutting in the south-eastern corner of the site, as well as, two and four wheel vehicle use was evident.

4.2 Flora

A total of 63 native and 28 non-native (weed) species were recorded within the site during the field survey, representing 33 families and 72 genera. The dominant families containing native taxa were Fabaceae (nine native taxa and four weed taxa), Asteraceae (four native taxa and five weed taxa) and Orchidaceae (8 native taxa). The most common genera were *Acacia*, *Banksia*, *Caladenia*, and *Trifolium*, each with three taxa. Of the species recorded, 85 were recorded in sample points and six were recorded opportunistically. A complete species list is provided in **Appendix B** and sample data is provided in **Appendix C**.

4.2.1 Threatened and priority flora

One priority 2 (P2) species, *Acacia benthamii*, was recorded within the site. Approximately 10 individuals were recorded within a 25 square metre (m²) area in the south-eastern corner of the site (as shown in **Figure 3**). Note it is hard to verify exactly how many individuals are present in this area due to the spreading habit of *A. benthamii*. No other occurrences of this or any other threatened or priority flora species were recorded within the site.

4.2.2 Declared pests

No species listed as a declared pest pursuant to the BAM Act were recorded within the site.

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4.3 Plant communities

Three native plant communities were identified within the site. Plant community **EmBKg** exists in the south-eastern corner of the site and extends over 3.16 ha. Plant community **EgCcEm** occurs on the eastern side of the site adjoining Paganoni Swamp as well as a linear area on the north eastern boundary of the site. This community extends over 16.24 ha of the site. Plant community **Ap** is located in the central portion of the site and extends over 8.81 ha. The remainder of the site (9.88 ha) contains non-native vegetation with bare soil, weeds or planted vegetation including *Chamelaucium uncinatum* (Geraldton wax) and *Eucalyptus gomphocephala* (tuart).

The plant communities are described in **Table 5** and representative photographs of each are provided in **Plate 1** to **Plate 4**. The location of each plant community is shown on **Figure 3**.

Table 5: Plant communities identified within the site

Plant community	Description	Area (ha)
EmBKg	Open woodland of <i>Eucalyptus marginata</i> (with occasional <i>Corymbia calophylla</i>) over low open woodland of <i>Banksia menziesii</i> , <i>Banksia attenuata</i> and <i>Xylomelum occidentale</i> over low open woodland of <i>Kunzea glabrescens</i> and <i>Hibbertia hypericoides</i> over occasional native forbs and weeds (Plate 1).	3.16
EgCcEm	Woodland of <i>Eucalyptus gomphocephala</i> , <i>Corymbia calophylla</i> and <i>Eucalyptus marginata</i> over sparse shrubland of <i>Hakea prostrata</i> over weeds (Plate 2).	16.24
Ap	Open shrubland of <i>Acacia pulchella</i> var. <i>glaberrima</i> over weeds (Plate 3).	8.81
Non-native vegetation	Heavily disturbed areas comprising weeds with occasional native shrubs and planted vegetation (Plate 4).	9.88



Plate 1: Plant community **EmBKg** in good condition.

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Plate 2: Plant community **EgCcEm** in degraded condition.



Plate 3: Plant community **Ap** in degraded to completely degraded condition.

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Plate 4: Non-native vegetation in completely degraded condition.

4.4 Vegetation condition

The most intact native vegetation was an approximately 1.67 ha portion of the **EmBKg** plant community in the south-eastern corner of the site (refer to **Figure 4**). This vegetation was mapped as being in good condition as it retains the structure expected of a banksia woodland community and has moderate native species diversity. A variety of native species including *Acacia benthamii* (P2) as well as a number of orchids were also recorded in this area. Past disturbance of this area is evident from historical aerial photography and through the presence of dense areas of *Kunzea glabrescens*, which can act as colonizer of disturbed areas. More recent disturbance is also evident from unauthorized felling and lopping of *Eucalyptus marginata* (jarrah) trees for firewood.

EgCcEm vegetation on the western side of the site adjoining Paganoni Swamp consists of trees over scattered native shrubs and dense pasture weeds. This vegetation was mapped as being in degraded condition as it lacks understory structure and has low species diversity. Past disturbance is significant and the lack of understorey suggest this part of the site has been used for stock grazing. Consequently the vegetation is effectively parkland cleared and rehabilitation would require intensive management. A similar patch of vegetation also exists in the north-east of the site.

Areas of **Ap** vegetation in the centre of the site show a high level of disturbance and are dominated by the native species *Acacia pulchella* var. *glaberrima*. The understorey is heavily dominated by weeds with notable patches of sandy open ground. Despite reasonable native cover in parts, this vegetation was mapped as being in 'degraded' to 'completely degraded' condition, as predominantly only one native species is present and rehabilitation would require intensive management.

Remaining areas in the site are in 'completely degraded' condition and consist of non-native species such as pasture grasses, *Asphodelus fistulosus* (onion weed) and planted trees and shrubs. Sandy tracks within the site were also mapped as being in 'completely degraded' condition.

The extent of vegetation by condition category is detailed in **Table 6** and shown on **Figure 4**.

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Table 6: Extent of vegetation condition categories within the site

Condition category	Area (ha)
Pristine	0
Excellent	0
Very Good	0
Good	1.67
Degraded	17.73
Degraded to Completely Degraded	8.81
Completely Degraded	9.88

4.5 Floristic community type assignment

Plant community **EmBKg** was determined to represent FCT 21a 'Central *Banksia attenuata* – *Eucalyptus marginata* woodlands'. This FCT is listed as 'well reserved' and 'low risk' by Gibson *et al.* (1994). Quadrat 1 grouped with FCT 25 in the cluster analysis but was most similar to three Gibson *et al.* (1994) sites representing FCT 21a with 42-44% similarity (Table 7). Quadrat 2 grouped with sites representing FCTs 21a, 21b and 21c in the cluster analysis and was most similar to three Gibson *et al.* (1994) sites representing FCT 21a with 42-44% similarity (Table 7). The relevant portions of the cluster dendrograms showing Quadrat 1 and 2 are provided in Appendix D.

Plant community **EgCcEm** is likely to represent a degraded form of FCT 25 '*Eucalyptus gomphocephala* – *Agonis flexuosa* woodlands' due to the presence of canopy species such as *Eucalyptus gomphocephala*, *Eucalyptus marginata* and *Corymbia calophylla*. The plant community was not compared to the regional FCT dataset due to the low number of species present. This FCT is listed as 'poorly reserved' and 'susceptible' by Gibson *et al.* (1994).

Other plant communities in the site were considered too degraded to assign to a FCT.

Table 7: Plant community and likely FCT represented within the site for each quadrat

Plant Community	Quadrat	Cluster result	Most similar Gibson <i>et al.</i> (1994) sites	Similarity	Floristic community type (FCT)	Reservation and conservation status (Gibson <i>et al.</i> 1994)
EmBKg	1	FCT 25	LOW12B (FCT 21a)	44%	FCT 21a: Central <i>Banksia attenuata</i> – <i>Eucalyptus marginata</i> woodlands	Well reserved Low risk
			WELL-2 (FCT 21a)	44%		
			WELL-1 (FCT 21a)	43%		
	2	FCTs 21a, 21b and 21c	WELL-2 (FCT 21a)	46%		
			PAGA-4 (FCT 21a)	44%		
			CARD7 (FCT 21a)	41%		
EgCcEm	POI3 POI4	N/A	N/A	N/A	FCT 25: <i>Eucalyptus gomphocephala</i> – <i>Agonis flexuosa</i> woodlands	Poorly reserved Susceptible

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4.6 Threatened and priority ecological communities

The structure and composition of plant community **EmBKg** indicates that it represents the 'Banksia Woodlands of the Swan Coastal Plain' TEC. This TEC, herein referred to as the 'banksia woodland TEC', has recently been listed as 'endangered' under the EPBC Act. Whether a patch of vegetation is considered to represent the banksia woodland TEC depends on a number of diagnostic criteria including geographic location, soils, landform, structure, composition, condition and patch size (DoEE 2016). As outlined in **Table 8**, the **EmBKg** vegetation satisfies the criteria to be considered a 3.16 ha patch of the 'banksia woodland TEC'.

Table 8: Criteria for determining presence of Banksia Woodlands of the Swan Coastal Plain TEC adapted from DoEE (2016).

Criteria	Requirements for meeting criteria	Site implications
1. Must meet key diagnostic characteristics	A variety of factors relating to: <ul style="list-style-type: none"> • Location • Soils • Structure • Composition 	<ul style="list-style-type: none"> • Site meets location and soils criteria. • The EmBKg vegetation includes the key diagnostic feature of a tree layer of <i>Banksia attenuata</i> and <i>Banksia menziesii</i>. • The EmBKg vegetation within site also meets structure and composition criterion. FCT 21a identified as one FCT of the banksia woodland TEC.
2. Must meet condition thresholds	<ul style="list-style-type: none"> • A patch should at least meet the 'good' condition category. 	<ul style="list-style-type: none"> • The EmBKg vegetation is present in 'good' and degraded condition, which meets this criterion. The conservation advice indicates that a single patch may include areas of variable condition, meaning parts of the EmBKg vegetation in 'degraded' condition may still be considered the TEC.
3. Must meet minimum patch size	Minimum size of patch: <ul style="list-style-type: none"> • Pristine=no minimum size • Excellent=0.5 ha • Very Good=1 ha • Good=2 ha 	<ul style="list-style-type: none"> • The EmBKg vegetation in 'good' condition comprises 1.67 ha and does <u>not</u> independently meet this criterion. • However, the adjoining EmBKg vegetation in 'degraded' condition would be viewed as contiguous and part of the same patch. Therefore the mapped 3.16 ha of EmBKg vegetation <u>does</u> comprise a patch of the TEC (despite not including more than 2 ha in good condition).
4. Must incorporate surrounding context	<ul style="list-style-type: none"> • Breaks (e.g. tracks) < 30 m do not separate vegetation into separate patches • Buffer zones may apply (20-50 m recommended from patch edge) • The site should be thoroughly sampled (2 surveys in same spring). • Survey timing should be appropriate. • Surrounding environment should be considered (e.g. connectivity, conservation values, fauna habitat) 	<ul style="list-style-type: none"> • No tracks exist within the patch. • Land surrounding the patch is a combination of agricultural and native vegetation. • One survey previously conducted in November and this survey conducted in early spring survey. Results conclusive so two surveys were not required. • Spring survey timing is appropriate. • Intact native vegetation that is likely to meet criteria as banksia woodland exists on the other side of Stock Road.

The plant community **EmBKg** also represents the 'Banksia dominated woodlands of the Swan Coastal Plain IBRA region' PEC (P3).

Although plant community **EgCcEm** is inferred to be FCT 25, in its current state this community could not be considered to represent the 'Southern Swan Coastal Plain *Eucalyptus gomphocephala* - *Agonis*

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flexuosa woodlands' PEC. This is due to the degraded condition and lack of native species structure and diversity in the community.

No other TECs or PECs occur within the site.

The area of the banksia woodland TEC and PEC within the site is outlined in **Figure 5**.

4.7 Other observations

A large number of mature eucalypt trees (diameter at breast height larger than 500 mm) including *Corymbia calophylla* (marri) and *Eucalyptus gomphocephala* (tuart) are present in the site, in particular within areas mapped as containing the **EgCcEm** community. Due to their number and size these trees have the potential to provide foraging, roosting and nesting habitat for black cockatoos (especially Carnaby's black cockatoo), along with other ecological services.

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4.8 Species richness and sampling adequacy

A total of 85 species were recorded from two quadrats and five relevés. A species accumulation curve derived from sample data is presented in **Plate 5**. After seven samples the curve is approaching but has not reached its asymptote. This indicates that a proportion of species likely remain undetected by sampling.

Species richness within the site was estimated in Primer-6 to be approximately 123 (Jackknife 1). Based on the trend of the species accumulation curve, more than 20 quadrats would be required to capture that many species. Including the six additional species recorded opportunistically, a total of 91 species was recorded in the site. This indicates that 74% of the estimated 123 species in the site were recorded.

Considering the small area of 'good' condition vegetation and subsequent intensive searching conducted within this vegetation, combined with the generally degraded to completely degraded condition of vegetation across the remainder of the site, the survey effort was considered to be adequate to prepare a representative species inventory.

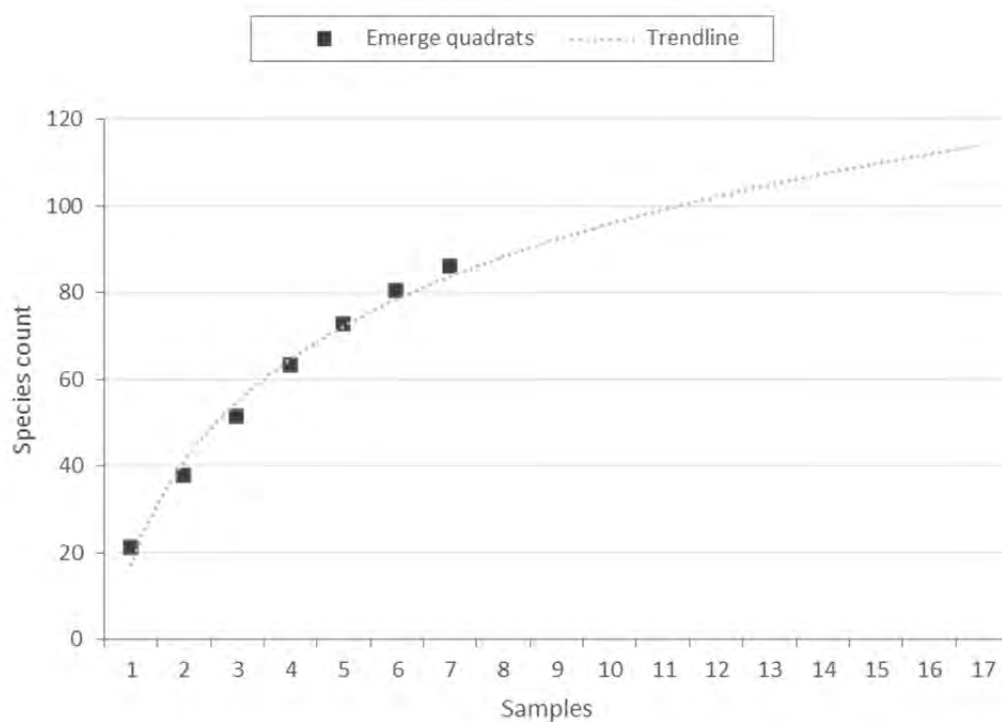


Plate 5: Species accumulation curve derived from sample data ($y = 32.12\ln(x) + 17.389$, $R^2 = 0.9851$)

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5 Discussion

The vegetation within the site has been subject to significant past disturbance and is largely in degraded to completely degraded condition. Approximately one quarter of the site is covered by non-native vegetation. Where native vegetation remains it comprises regrowth from clearing that occurred 20 to 30 years ago (**EmBKg** and **Ap** communities) and a parkland cleared woodland with remnant native canopy and non-native understorey (**EgCcEm** community).

The most intact native vegetation exists in the south-eastern corner of the site where the **EmBKg** plant community is present. This vegetation was determined to represent FCT 21a which is a banksia woodland community. A relatively small area of **EmBKg** vegetation in good condition remains (1.67 ha) which is surrounded by a fringe of degraded vegetation. From aerial photography it was determined that most of this vegetation is regrowth. Despite being mapped as good condition, the **EmBKg** vegetation includes notable weed cover and has been subject to recent physical disturbance. But it also retains a woodland structure and a moderate level of native species diversity. This area of vegetation also contains occurrences of the priority 2 species *Acacia benthamii* and was also found to represent a patch of the EPBC Act listed banksia woodland TEC.

The **EgCcEm** vegetation adjoining Paganoni Swamp on the western side of the site has a relatively intact native canopy and includes some very large marri and tuart trees. Based on its structure and the native species present, this community is inferred to be a degraded form of FCT 25. Historical disturbance has severely impacted the ground layer of this community, which is dominated by introduced pasture grasses, and it would no longer be considered to represent a regional floristic community in its current state. Despite this, the large native trees present in the **EgCcEm** vegetation may be locally or regionally significant in their own right, due to their proximity to Paganoni Swamp and the potential value they have as black cockatoo habitat.

The central areas of the site have been subject to intensive disturbance in the form of sand extraction. The regenerated **Ap** vegetation that is present is not representative of pre-existing native vegetation, comprising one dominant native species (*Acacia pulchella* var. *glaberrima*) over scattered introduced species and bare ground.

5.1 Threatened and priority flora

Other than the approximately 10 individuals of *Acacia benthamii* (P2), no other threatened or priority flora species were recorded within the site. The absence of the larger perennial species such as *Jacksonia sericea* and *Lasiopetalum membranaceum* was relatively easy to confirm. As it was to confirm that *Acacia benthamii* was only present at the one identified location. However, due to their size, smaller geophytic species such as *Caladenia huegelii*, *Drakaea elastica* and *D. micrantha* can be more difficult to detect.

Considerable search effort was applied to locate these species within the site, including within the main flowering period and across multiple years (2014 and 2016). A particular focus was also applied within the area of likely habitat in the **EmBKg** vegetation in the south east corner of the site (refer to **Section 2.7**). As other orchids and geophytes were recorded during the survey, including common species (e.g. *Caladenia flava* subsp. *flava*) and those that occur in similar habitat to *D. elastica* (e.g.

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Pyrorchis sp.), the search effort applied was sufficient to have detected these species if they were present. Therefore it is considered that further threatened and priority flora species are unlikely to occur within the site.

5.2 Vegetation Condition

Rating vegetation condition has the greatest implications (and as is also the most challenging) when the condition of vegetation is close the boundary between 'good' and 'degraded'. This is because good condition is typically accepted as the threshold for conservation significance, while 'degraded' condition implies a low conservation requirement. Separating these two condition categories is further complicated by the fact that good condition is more correctly understood to mean 'average' condition. Applying the Keighery (1994) condition scale good condition vegetation can be expected to be significantly altered, with very obvious disturbance and the presence of aggressive weeds at high density. Therefore good does not literally mean "good" as the label implies.

Additionally, because the condition scales are categorical, assigning condition is always problematic when vegetation qualities are close to the boundary between two categories. This is why, for example, a compound 'degraded to completely degraded' condition category was included in the results of this survey for disturbed **Ap** vegetation which had high native cover (due to *Acacia pulchella* var. *glaberrima*), but was otherwise completely degraded. Categorical schemes will also invariably yield different results when applied by different assessors because of differences in skill levels or personal bias.

In this instance the boundary between areas of good and degraded **EmBKg** vegetation was relatively easy to define. The method applied to assess vegetation condition was also robust, as it combined the standard qualitative, categorical scheme of Keighery (1994), with the additional indicators for diversity and weed cover outlined in DoEE (2016) (refer to **Table 3**). In addition, due to the potential for the presence of the banksia woodland TEC, the condition mapping was conducted at a relatively fine scale. Accordingly small revisions were made from the initial condition mapping prepared during previous surveys by Emerge Associates (2014b). Because of the fine scale at which condition was mapped, the results can be considered to provide a high degree of certainty regarding the condition of vegetation present.

5.3 Threatened and priority ecological communities

Identifying the **EmBKg** plant community as a 'banksia woodland' was relatively straightforward. The **EmBKg** vegetation includes the key diagnostic feature of a tree layer of *Banksia attenuata* and *B. menziesii*. It was also conclusively associated with 'FCT 21a - Central *Banksia attenuata* – *Eucalyptus marginata* woodlands', which is one of the regional FCTs identified in the banksia woodland TEC conservation advice (DoEE 2016). However, to be considered the banksia woodland TEC a patch of banksia vegetation must also meet thresholds for condition and minimum patch size (refer to **Table 8**).

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The DoEE (2016) conservation advice states that a patch of banksia woodland vegetation in good condition must be greater than 2ha in size for it to be considered the TEC. The conservation advice also states that a patch may include areas of variable condition and that the condition that is most representative should be used to assign overall condition of a patch.

For the **EmBKg** community, 1.67 ha was mapped as good, while 1.49 ha was mapped as degraded. As there are no breaks of 30 m or more to separate the areas of good and degraded vegetation, these areas were understood as a single patch. Then, given that the area of **EmBKg** in good condition is close to the 2 ha threshold and comprises the core of the patch, the whole patch was assessed as being in good condition consistent with the conservation advice. A patch of 3.16 ha of the banksia woodland TEC is therefore reported as being present within the site.

However, despite qualifying as a remnant of the TEC, given its small size and relatively disturbed state, the patch is unlikely to be considered a particularly significant remnant of the banksia woodland.

Due to the presence of *Banksia attenuata* and *B. menziesii*, on deep sands, the **EmBKg** community also represents the State listed PEC 'Banksia dominated woodlands of the Swan Coastal Plain IBRA region'. Conservation advice for PECs is less specific, but it is likely that only the area of **EmBKg** vegetation in good condition would be considered to represent this PEC.

5.4 Local and regional significance

Due to their close proximity to Paganoni swamp, the numerous large, mature marri and tuart trees within areas of **EgCcEm** vegetation in the west of the site are likely to be locally and/or regionally significant. These trees provide a buffer to the conservation category wetland (refer to **Section 2.5**), and contribute to the identified Peel RSNA and associated regional ecological linkage (refer to **Section 2.9**). They are also expected to provide potential habitat for endangered black cockatoo species (refer to **Section 2.10**). However, further assessment by a fauna specialist is recommended to confirm these values. Particular note is therefore made of these trees which could be considered the most significant vegetation within the site.

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6 Conclusions

The majority of vegetation within the site is highly disturbed and modified. Approximately 9.88 ha of the site contains completely degraded, non-native vegetation. The remaining 28.2 ha of the site includes native vegetation that is present in predominantly 'degraded-completely degraded' (8.81 ha) or degraded (17.73 ha) condition. However, the site contains approximately 1.67 ha of relatively intact native vegetation in good condition.

Ten individuals of the priority flora species *Acacia benthamii* (P2) were recorded in one location in the south-eastern corner of the site. No other threatened or priority flora species were recorded or are considered likely to occur as intensive targeted searches were conducted in areas of potential habitat and there the remainder of the site does not provide suitable habitat.

The site contains a 3.16 ha patch of the EPBC Act listed banksia woodlands TEC (which also the State listed PEC 'Banksia dominated woodlands of the Swan Coastal Plain IBRA region'). This patch is located in the south-eastern portion of the site and includes the 1.67 ha of **EmBKg** vegetation in good condition and adjacent 1.49 ha of **EmBKg** vegetation in degraded condition.

The degraded **EgCcEm** vegetation near Paganoni Swamp includes numerous large remnant native trees that may be locally or regionally significant due to their proximity to Paganoni Swamp and potential to provide black cockatoo habitat.

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Figures



Figure 1: Location Plan

Figure 2: Environmental Features

Figure 3: Plant Communities

Figure 4: Vegetation Condition

Figure 5: Threatened Ecological Community (TEC)



Figure 1: Location Plan

Project: Flora and Vegetation Survey
Part Lot 105 Stock Road, Lakelands
Client: Lot 105 Lakelands Pty Ltd

Plan Number: EP16-060(03)--F08
Drawn: KNM
Date: 30/03/2017
Checked: RAO
Approved: TAA
Date: 30/03/2017



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Metres
Scale: 1:12,500@A4
GDA 1994 MGA Zone 50



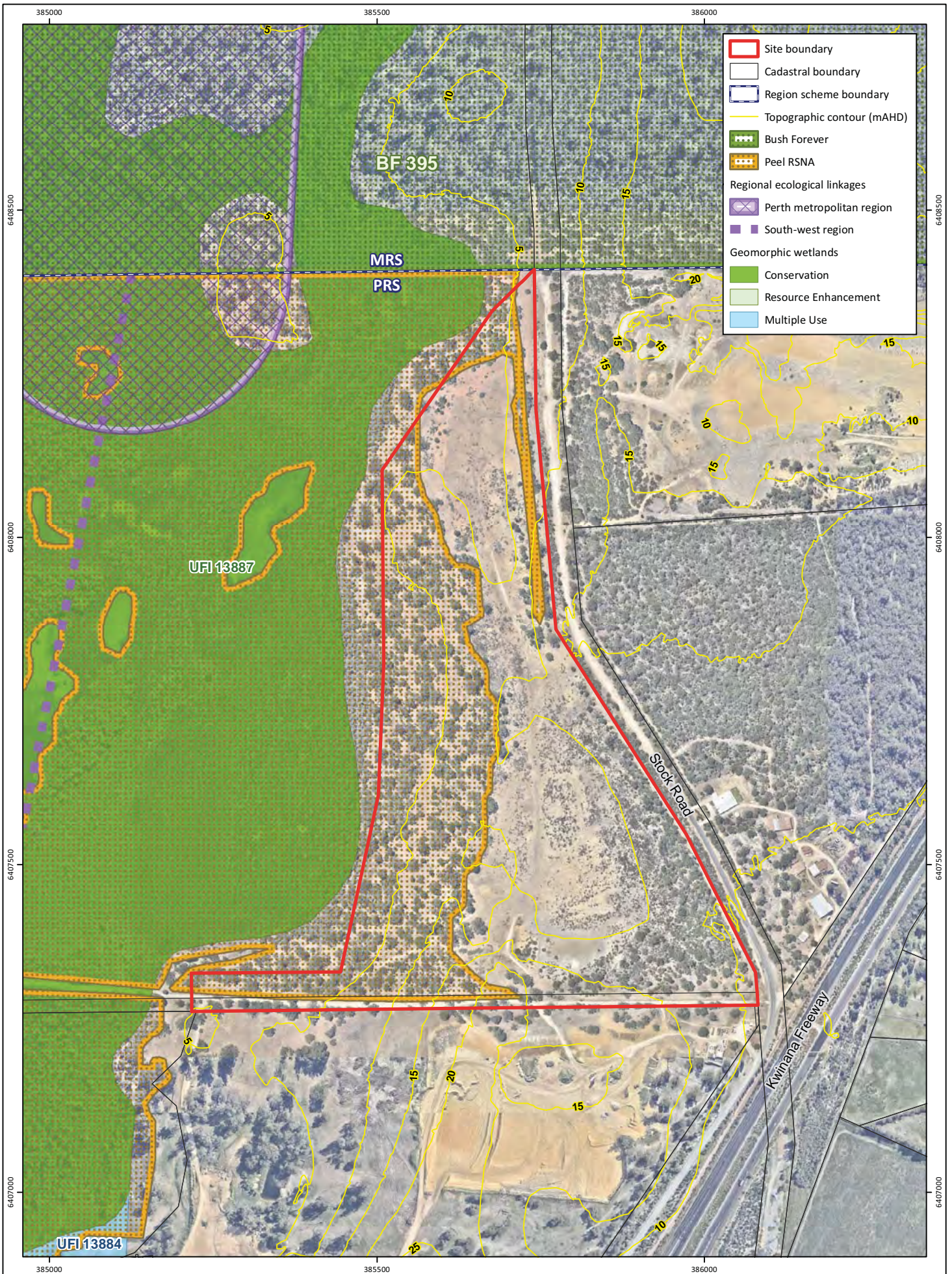


Figure 2: Environmental Features

Plan Number:
EP16-060(03)--F09
Drawn: KNM
Date: 30/03/2017
Checked: RAO
Approved: TAA
Date: 30/03/2017



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GDA 1994 MGA Zone 50



Project: Flora and Vegetation Survey
Part Lot 105 Stock Road, Lakelands

Client: Lot 105 Lakelands Pty Ltd

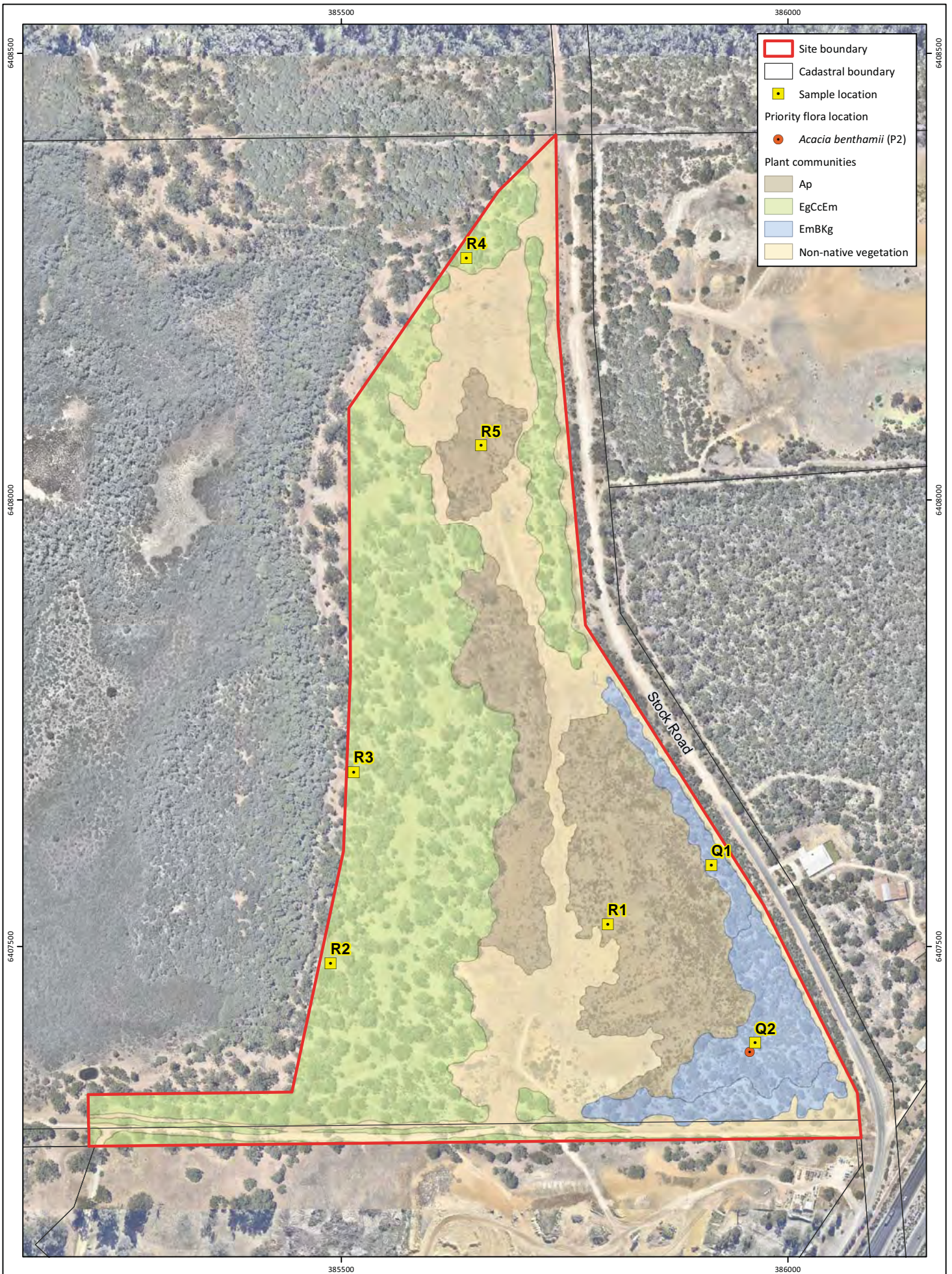


Figure 3: Plant Communities

Project: Flora and Vegetation Survey
Part Lot 105 Stock Road, Lakelands
Client: Lot 105 Lakelands Pty Ltd

Plan Number: EP16-060(03)--F10
Drawn: KNM
Date: 30/03/2017
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Date: 30/03/2017



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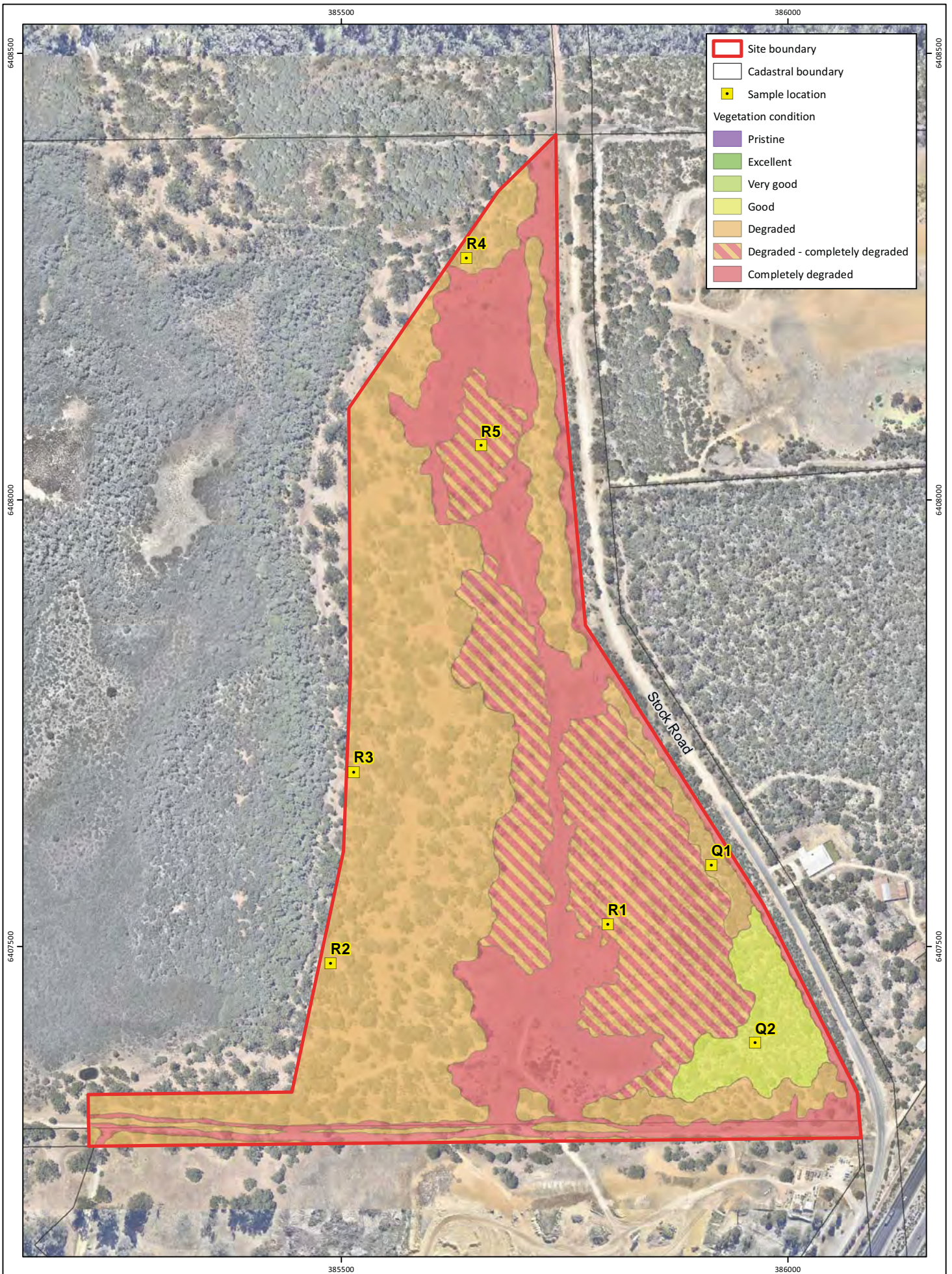


Figure 4: Vegetation Condition

Project: Flora and Vegetation Survey
Part Lot 105 Stock Road, Lakelands
Client: Lot 105 Lakelands Pty Ltd

Plan Number:
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Drawn: KNM
Date: 30/03/2017
Checked: RAO
Approved: TAA
Date: 30/03/2017



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GDA 1994 MGA Zone 50



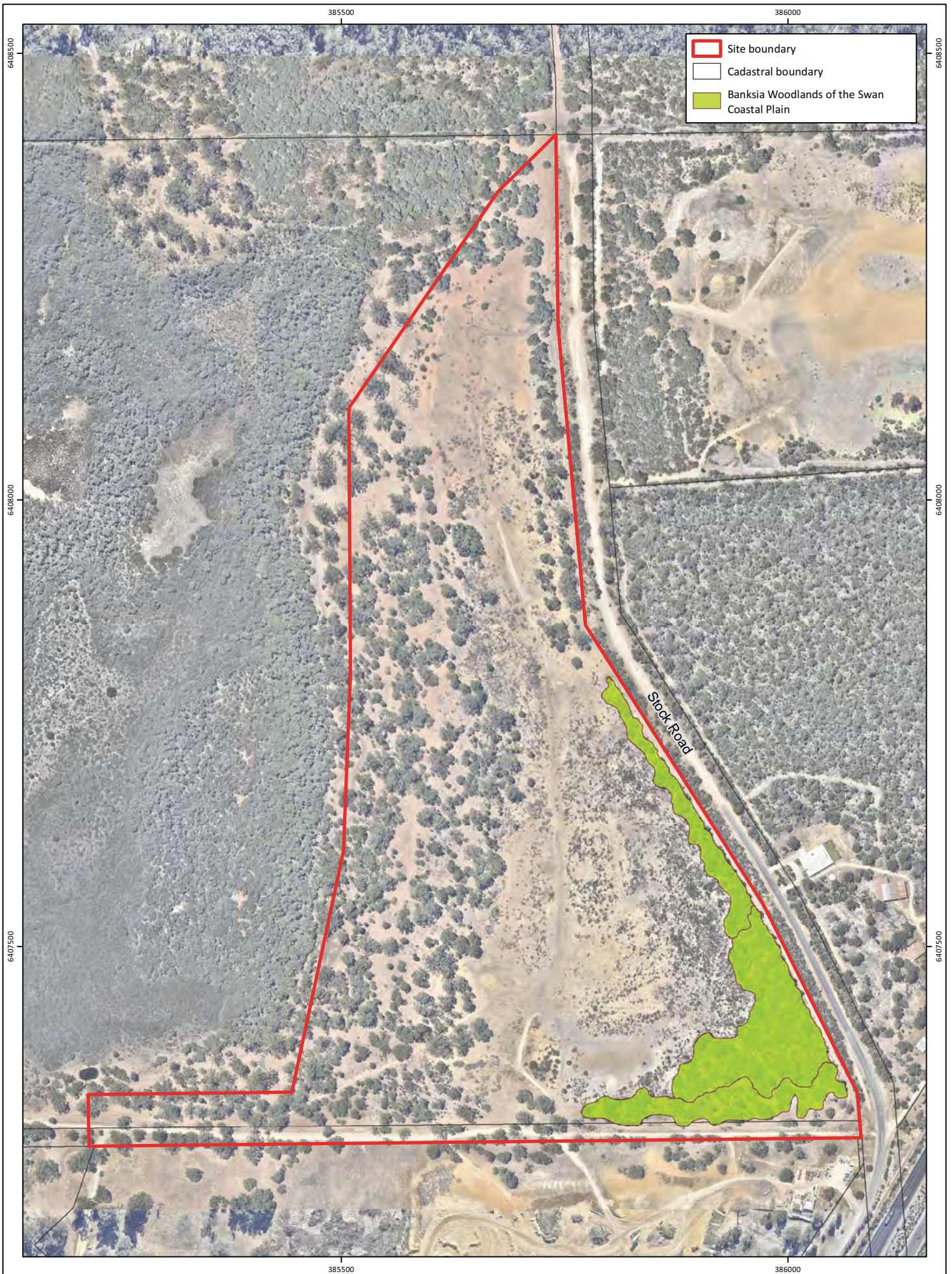


Figure 5: Threatened Ecological Community (TEC)

Plan Number:
 EP16-060(03)--F12
 Drawn: KNM
 Date: 30/03/2017
 Checked: RAO
 Approved: TAA
 Date: 30/03/2017



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 Metres
 Scale: 1:5,500@A4
 GDA 1994 MGA Zone 50

Project: Flora and Vegetation Survey
 Part Lot 105 Stock Road, Lakelands
Client: Lot 105 Lakelands Pty Ltd



Appendix A

Additional Background Information



Conservation Significant Flora and Vegetation

Threatened and priority flora

Flora species considered rare or under threat warrant special protection under Commonwealth and/or State legislation. At the Commonwealth level, flora species can be listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Flora species can be considered 'threatened' pursuant to Schedule 1 of the EPBC Act and listed as either 'critically endangered' (CE), 'endangered' (E) or 'vulnerable' (V).

In Western Australia, plant species may be classed 'threatened' or 'priority' under the *Wildlife Conservation Act 1950* (WC Act), enforced by Department of Parks and Wildlife (DPAW). Priority flora species are potentially rare or threatened and are classified in order of threat. Threatened and priority flora category definitions are listed in **Table 1**. Threatened flora species are gazetted under subsection 2 of section 23F of the WC Act and therefore it is an offence to "take" or damage rare flora without Ministerial approval. Section 23F of the Act defines "to take" as "... to gather, pluck, cut, pull up, destroy, dig up, remove or injure the flora to cause or permit the same to be done by any means".

Table 1: Definition of threatened and priority flora species under the WC Act (Smith 2010).

Conservation Code	Category
T	Threatened Flora – Extant Taxa Taxa which have been adequately searched for and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection, and have been gazetted as such.
X	Threatened Flora – Presumed Extinct Taxa Taxa which have not been collected, or otherwise verified, over the past 50 years despite thorough searching, or of which all known wild populations have been destroyed more recently, and have been gazetted as such.
P1	Priority One – Poorly Known Taxa Taxa which are known from one or a few (generally <5) populations which are under threat, either due to small population size, or being on lands under immediate threat e.g. road verges, urban areas, farmland, active mineral leases etc., or the plants are under threat, e.g. from disease, grazing by feral animals etc. May include taxa with threatened populations on protected lands. Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey.
P2	Priority Two – Poorly Known Taxa Taxa which are known from one or a few (generally <5) populations, at least some of which are not believed to be under immediate threat (i.e. not currently endangered). Such taxa are under consideration for declaration as 'rare flora', but urgently need further survey.
P3	Priority Three – Poorly Known Taxa Taxa which are known from several populations, and the taxa are not believed to be under immediate threat (i.e. not currently endangered), either due to the number of known populations (generally >5), or known populations being large, and either widespread or protected. Such taxa are under consideration for declaration as 'rare flora' but needs further survey.

Conservation Code	Category
P4	Priority Four – Rare Taxa Taxa which are considered to have been adequately surveyed and which, whilst being rare (in Australia), are not currently threatened by any identifiable factors. These taxa require monitoring every 5-10 years.

Note that the WC Act is expected to be repealed some time in 2017 and will be replaced by the *Biodiversity Conservation Act 2016* (BC Act). The BC Act includes updated provisions for the management of threatened flora along with increased penalties and requirements for reporting, management programmes and recovery plans. The BC Act was only recently granted Royal assent on 21 September 2016. Currently, most of the provisions of the BC Act have not come into effect and until they do, the WC Act will continue to guide the management of threatened flora in Western Australia.

Threatened and priority ecological communities

‘Threatened ecological communities’ (TECs) are recognised as ecological communities that are rare or under threat and therefore warrant special protection. Selected TECs are afforded statutory protection at a Commonwealth level under section 181 of the EPBC Act. TECs nominated for listing under the EPBC Act are considered by the Threatened Species Scientific Committee and a final decision is made by the Minister of the Environment. Once listed under the EPBC Act, communities are categorised as either ‘critically endangered’, ‘endangered’ or ‘vulnerable’. Any action likely to have a significant impact on a community listed under the EPBC Act requires approval from the Commonwealth Minister for the Environment.

Within Western Australia TECs are determined by the Western Australian Threatened Ecological Communities Scientific Advisory Committee (WATECSAC) and endorsed by the Minister for the Environment. The WATECSAC is an independent group comprised of representatives from organizations including tertiary institutions, the Western Australian Museum and Department of Parks and Wildlife (DPaW). TECs are assigned to one of the categories outlined in **Table 2** according to their status (in relation to the level of threat). Currently TECs are not afforded direct statutory protection at a state level and their significance is acknowledged through other state environmental approval processes such as ‘environmental impact assessment’ pursuant to Part IV of the *Environmental Protection Act 1986* (EP Act) and the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*.

Table 2: Categories of threatened ecological communities (English and Blyth 1997; DEC 2009a).

Conservation category	Description
PD	Presumably Totally Destroyed An ecological community that has been adequately searched for but for which no representative occurrences have been located.
CE	Critically Endangered An ecological community that has been adequately surveyed and is found to be facing an extremely high risk of total destruction in the immediate future.

E	<p>Endangered</p> <p>An ecological community that has been adequately surveyed and is not critically endangered but is facing a very high risk of total destruction in the near future.</p>
V	<p>Vulnerable</p> <p>An ecological community that has been adequately surveyed and is not critically endangered or endangered but is facing a high risk of total destruction or significant modification in the medium to long-term future.</p>

In addition to listing as a TEC, a plant community may be listed as a ‘priority ecological community’ (PEC). This is an ecological community that is under consideration for listing as a TEC, but does not yet meet survey criteria or has not been adequately defined. PECs are categorised as priority category 1, 2 or 3 (these are described in **Table 3**). Ecological communities that are adequately known and are rare but not threatened, or meet criteria for ‘near threatened’, or that have been recently removed from the threatened list, are placed in ‘priority 4’. These ecological communities require regular monitoring. Conservation dependent ecological communities are placed in ‘priority 5’ (DEC 2009a).

Table 3: Categories of priority ecological communities (DEC 2009a).

Priority categories	Description
Priority 1	Ecological communities with apparently few, small occurrences, all or most not actively managed for conservation (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) and for which current threats exist. Communities may be included if they are comparatively well-known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range.
Priority 2	Communities that are known from few small occurrences, all or most of which are actively managed for conservation (e.g. within national parks, conservation parks, nature reserves, State forest, unallocated Crown land, water reserves, etc.) and not under imminent threat of destruction or degradation. Communities may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under threat from known threatening processes.
Priority 3	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: <ul style="list-style-type: none"> (i) communities known from a few widespread occurrences, which are either large or within significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat, or; (ii) communities made up of large, and/or widespread occurrences, that may or not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, and inappropriate fire regimes. Communities may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and/or are not well defined, and known threatening processes exist that could affect them.
Priority 4	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.
Priority 5	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.

Note the BC Act, previously introduced in **Section 1**, does include provisions for the management of TECs, as well as, penalties for impacting TECS and requirements for reporting, management programmes and recovery plans. The provisions of the BC Act relating to TECs have not yet come

into effect and until they do the management of TECs will continue to be guided by existing environmental approval processes.

Local and regionally significant flora and vegetation

Apart from being listed as either threatened or priority flora, plant species may be significant for a number of other reasons. EPA (2004) *Guidance Statement No. 51* states that significant flora may include taxa that:

- have a keystone role in a particular habitat for threatened species, or supporting large populations representing a significant proportion of the local regional population of a species
- have relic status
- have anomalous features that indicate a potential new discovery
- are representative of the range of a species (particularly, at the extremes of range, recently discovered range extensions, or isolated outliers of the main range)
- have the presence of restricted subspecies, varieties or naturally occurring hybrid
- have local endemism/a restricted distribution
- are poorly reserved.

Similarly, plant communities may be significant for reasons other than a listing as a TEC or PEC. EPA (2004) *Guidance Statement No. 51* indicates that these reasons include:

- scarcity
- the presence of unusual species
- a novel combinations of species
- a role as a refuge
- a role as a key habitat for threatened species
- a role as a key habitat for large populations representing a significant proportion of the local to regional total population of a species
- being representative of the range of a unit (particularly, a good local and/or regional example
- of a unit in 'prime' habitat, at the extremes of range, recently discovered range extensions, or isolated outliers of the main range
- a restricted distribution.

Other Flora

Declared Pests

Declared pests are listed pursuant to the State's *Biosecurity and Agriculture Management Act 2007* (BAM Act). Part 2.3.23 of the BAM Act requires a person must not; "a) keep, breed or cultivate the declared pest; b) keep, breed or cultivate an animal, plant or other thing that is infected or infested with the declared pest; c) release into the environment the declared pest, or an animal, plant or other thing that is infected or infested with the declared pest; or d) intentionally infect or infest, or expose to infection or infestation, a plant, animal or other thing with a declared pest".

Under the BAM Act, all declared pests are placed in one of three categories, namely C1 (exclusion), C2 (eradication) or C3 (management). These categories are described further in **Table 4**. The Western Australian Organism List (WAOL) provides the status of organisms which have been categorised under the BAM Act (DAFWA 2016).

Table 4: Categories of declared pest species under the BAM Act (DAFWA 2016).

Category	Description
C1 (Exclusion)	Not established in Western Australia and control measures are to be taken, including border checks, in order to prevent them entering and establishing in the State.
C2 (Eradication)	Present in Western Australia in low enough numbers or in sufficiently limited areas that their eradication is still a possibility.
C3 (Management)	Established in Western Australia but it is feasible, or desirable, to manage them in order to limit their damage. Control measures can prevent a C3 pest from increasing in population size or density or moving from an area in which it is established into an area which currently is free of that pest.

Wetland Habitat

Geomorphic wetland types

The geomorphic wetland classification system of Semeniuk (1987) is a recognised classification system for the south west of Western Australia. The Semeniuk system uses the landform shape and water permanence (hydro-period) to categorise wetlands.

Table 5: Wetland types defined within the global geomorphic classification system (DEC 2009b).

	BASIN	FLAT	CHANNEL	SLOPE
Permanently inundated	Lake	-	River	-
Seasonally inundated	Sumpland	Floodplain	Creek	-
Seasonally waterlogged	Dampland	Palusplain	-	Paluslope

Wetland management categories

DPaW maintains the *Geomorphic Wetland of the Swan Coastal Plain* dataset, which also categorises individual wetlands into specific management categories as described in **Table 6**.

Table 6: Geomorphic Wetlands of the Swan Coastal Plain management categories (Hill et al. 1996).

MANAGEMENT CATEGORY	DESCRIPTION OF WETLAND	MANAGEMENT OBJECTIVES
Conservation (CCW)	Support high levels of attributes	Preserve wetland attributes and functions through reservation in national parks, crown reserves and state owned land. Protection provided under environmental protection policies.
Resource enhancement (REW)	Partly modified but still supporting substantial functions and attributes	Restore wetland through maintenance and enhancement of wetland functions and attributes. Protection via crown reserves, state or local government owned land, environmental protection policies and sustainable management on private properties.
Multiple use (MUW)	Few wetland attributes but still provide important hydrological functions	Use, development and management considered in the context of water, town and environmental planning through land care.

The management categories of wetlands are determined based on hydrological, biological and human use features. This dynamic dataset is continually updated with site-specific wetland surveys providing new and relevant information. The guidelines for proposing changes to the wetland boundaries and management categories state that relevant information should be obtained in the optimal season for vegetation condition and water levels, which is usually spring (DEC 2009b). Each classified wetland listed in the *Geomorphic Wetland of the Swan Coastal Plain* dataset is given a 'unique feature identifier' (UFI). However in the case of larger wetlands that have undergone a degree of disturbance, a separate management category may be assigned to parts of the wetland in order to reflect the current values.

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Appendix B

Species List



Flora Species List -Lot 105 Stock Rd, Lakelands

Note: * denotes introduced weed species

Family	Species
Araliaceae	<i>Trachymene pilosa</i>
Asparagaceae	<i>Chamaescilla corymbosa</i> <i>Lomandra ?nigricans</i> <i>Lomandra micrantha</i> <i>Sowerbaea laxiflora</i> <i>Thysanotus patersonii</i>
Asphodelaceae	* <i>Asphodelus fistulosus</i>
Asteraceae	* <i>Arctotheca calendula</i> * <i>Hypochaeris glabra</i> * <i>Hypochaeris radicata</i> <i>Lagenophora huegelii</i> <i>Podolepis gracilis</i> <i>Quinetia urvillei</i> <i>Senecio pinnatifidus</i> * <i>Sonchus oleraceus</i> * <i>Ursinia anthemoides</i>
Brassicaceae	* <i>Brassica tournefortii</i>
Campanulaceae	<i>Lobelia tenuior</i>
Caryophyllaceae	* <i>Sagina apetala</i> * <i>Silene gallica</i>
Casuarinaceae	<i>Allocasuarina fraseriana</i>
Crassulaceae	<i>Crassula colorata</i> var. <i>colorata</i>
Cyperaceae	<i>Lepidosperma leptostachyum</i> <i>Lepidosperma longitudinale</i> <i>Tetraria octandra</i>
Dilleniaceae	<i>Hibbertia hypericoides</i>

Flora Species List -Lot 105 Stock Rd, Lakelands

Note: * denotes introduced weed species

Family	Species
Droseraceae	<i>Drosera erythrorhiza</i> <i>Drosera stolonifera</i>
Ericaceae	<i>Brachyloma preisii</i>
Euphorbiaceae	* <i>Euphorbia paralias</i> * <i>Ricinus communis</i>
Fabaceae	<i>Acacia benthamii</i> <i>Acacia pulchella</i> var. <i>glaberrima</i> <i>Acacia stenoptera</i> <i>Bossiaea eriocarpa</i> <i>Gompholobium preisii</i> <i>Hardenbergia comptoniana</i> <i>Hovea trisperma</i> <i>Isotropis cuneifolia</i> <i>Kennedia prostrata</i> * <i>Lupinus cosentinii</i> * <i>Trifolium campestre</i> * <i>Trifolium hirtum</i> * <i>Trifolium repens</i>
Geraniaceae	<i>Erodium botrys</i> <i>Erodium cygnorum</i> <i>Geranium solanderi</i>
Haemodoraceae	<i>Anigozanthus humilis</i> <i>Anigozanthus</i> sp. <i>Conostylis aculeata</i>
Iridaceae	<i>Patersonia occidentalis</i> * <i>Romulea rosea</i>
Lamiaceae	<i>Hemiandra pungens</i>
Myrtaceae	* <i>Chamelaucium uncinatum</i> <i>Corymbia calophylla</i> <i>Eucalyptus gomphocephala</i> <i>Eucalyptus marginata</i>

Flora Species List -Lot 105 Stock Rd, Lakelands

Note: * denotes introduced weed species

Family	Species
	<i>Kunzea glabrescens</i>
Orchidaceae	<i>Caladenia discoidea</i> <i>Caladenia flava</i> subsp. <i>flava</i> <i>Caladenia latifolia</i> <i>Microtis</i> sp. <i>Pheladenia deformis</i> <i>Pterostylis recurva</i> <i>Pterostylis</i> sp. <i>limestone</i> <i>Pyrorchis nigricans</i>
Oxalidaceae	* <i>Oxalis pes-caprae</i>
Phytolaccaceae	* <i>Phytolacca octandra</i>
Poaceae	* <i>Briza maxima</i> * <i>Cynodon dactylon</i> * <i>Ehrharta calycina</i> * <i>Ehrharta longiflora</i> * <i>Vulpia</i> sp. * <i>Lolium rigidum</i> <i>Microlaena stipoides</i> <i>Poaceae</i> sp.
Portulacaceae	<i>Calandrinia liniflora</i>
Primulaceae	* <i>Lysimachia arvensis</i>
Proteaceae	<i>Banksia grandis</i> <i>Banksia attenuata</i> <i>Banksia menziesii</i> <i>Hakea prostrata</i> <i>Synaphea spinulosa</i> subsp. <i>spinulosa</i> <i>Xylomelum occidentale</i>
Restionaceae	<i>Desmocladus flexuosus</i>
Rubiaceae	<i>Opercularia vaginata</i>

Flora Species List -Lot 105 Stock Rd, Lakelands

Note: * denotes introduced weed species

Family	Species
Solanaceae	* <i>Solanum linnaeanum</i> * <i>Solanum nigrans</i>
Violaceae	<i>Hybanthus calycinus</i>
Xanthorrhoeaceae	<i>Xanthorrhoea ?preissii</i>
Zamiaceae	<i>Macrozamia riedlei</i>

Appendix C

Sample Data



Site Details			
Locality	EP16-060	Photo No.	N
Date	9/09/2016	Photo direction	49
Author	RAO	Geographic datum and zone	GDA94 50
Sampling unit	Quadrat	Easting	385914
Sample number	1	Northing	6407591
Geographic and Habitat Data			
Aspect	flat	Hydrology	-
Slope	flat	Adjacent Vegetation	degraded - completely degraded
Topographic position	upper slope	Vegetation Condition	degraded
Altitude (m)	16	Time since fire	>5 yrs
Bare ground %	5	Disturbance	high (tree cutting, tracks)
Soil type/texture	loamy sand	Rock type	N/A
Soil colour	grey - yellow	Rock %	0
Microclimate	-	Litter type and %	leaves, branches, 50%
Vegetation Description			
<p>Woodland <i>Corymbia calophylla</i> over low woodland <i>Banksia attenuata</i> and <i>Allocasuarina fraseriana</i> over open shrubland <i>Macrozamia reidlei</i> , <i>Hibbertia hyericoides</i> over open forbland <i>Sowerbaea laxiflora</i> and <i>Desmocladus flexuosa</i></p>			



Site Details			
Locality	EP16-060	Photo No.	72
Date	9/09/2016	Photo direction	SE
Author	RAO	Geographic datum and zone	GDA94 50
Sampling unit	Quadrat	Easting	385963
Sample number	2	Northing	6407392
Geographic and Habitat Data			
Aspect	flat	Hydrology	-
Slope	flat	Adjacent Vegetation	same
Topographic position	upper slope	Vegetation Condition	good
Altitude (m)	16	Time since fire	>5 yrs
Bare ground %	30	Disturbance	moderate
Soil type/texture	loamy sand	Rock type	N/A
Soil colour	grey	Rock %	0
Microclimate	-	Litter type and %	leaves, twigs, 60%
Vegetation Description			
<p>Open woodland <i>Eucalyptus marginata</i> over low woodland <i>Banksia menziesii</i>, <i>Xylomelum occidentale</i> and <i>Eucalyptus marginata</i> over shrubland <i>Kunzea glabrescens</i> over herbland <i>Conostylis aculeata</i> and <i>Desmocladius flexuosus</i></p>			



Q2 Species Data						
Coll. No.	Species	Layer	Life Form	Height	Habit	% Cover
	<i>Kunzea glabrescens</i>					25
	<i>Eucalyptus marginata</i>					4
	<i>Banksia menziesii</i>					2
	<i>Xylomelum occidentale</i>					1
	<i>Acacia stenoptera</i>					0.5
	<i>Acacia pulchella</i> var. <i>glaberrima</i>					0.5
	<i>Anigozanthus</i> sp.					0.5
	<i>Banksia attenuata</i>					0.5
	<i>Bossiaea eriocarpa</i>					0.5
13	<i>Brachyloma preisii</i>					0.5
	* <i>Briza maxima</i>					0.5
	<i>Caladenia discoidea</i>					0.5
	<i>Caladenia flava</i> subsp. <i>flava</i>					0.5
	<i>Chamaescilla corymbosa</i>					0.5
	<i>Conostylis aculeata</i>					0.5
	<i>Crassula colorata</i>					0.5
	<i>Desmocladus flexuosus</i>					0.5
	<i>Drosera stolonifera</i>					0.5
	<i>Drosera erythrorhiza</i>					0.5
9	<i>Gompholobium preisii</i>					0.5
7	<i>Hemiandra pungens</i>					0.5
	<i>Hibbertia hypericoides</i>					0.5
8	<i>Hovea trisperma</i>					0.5
	<i>Hybanthus calycinus</i>					0.5
	* <i>Hypochaeris glabra</i>					0.5
	<i>Kennedia prostrata</i>					0.5
5	<i>Lomandra ?nigricans</i>					0.5
	<i>Lomandra micrantha</i>					0.5
	<i>Microtis</i> sp.					0.5
	<i>Poaceae</i> sp.					0.5
14	<i>Podolepis gracilis</i>					0.5
10	<i>Quinetia urvillei</i>					0.5
11	* <i>Silene gallica</i>					0.5
6	<i>Synaphea spinulosa</i> subsp. <i>spinulosa</i>					0.5
	<i>Tetraria octandra</i>					0.5
	<i>Trachymene pilosa</i>					0.5
12	* Unknown					0.5
	* <i>Ursinia anthemoides</i>					0.5
opp	<i>Pyrorchis nigricans</i>					opp
opp	<i>Microlaena stipoides</i>					opp
opp	<i>Acacia benthamii</i>					opp
opp	<i>Pheladenia deformis</i>					opp
opp	<i>Macrozamia riedlei</i>					opp
opp	<i>Lobelia tenuior</i>					opp
opp	<i>Patersonia occidentalis</i>					opp
opp	<i>Sowerbaea laxiflora</i>					opp

Site Details			
Locality	EP16-060	Photo No.	92
Date	9/09/2016	Photo direction	NE
Author	RAO	Geographic datum and zone	GDA94 50
Sampling unit	POI	Easting	385798
Sample number	1	Northing	6407525
Geographic and Habitat Data			
Aspect	N	Hydrology	-
Slope	minor	Adjacent Vegetation	same
Topographic position	lower slope	Vegetation Condition	degraded - completely degraded
Altitude (m)	12	Time since fire	>5 yrs
Bare ground %	95	Disturbance	high
Soil type/texture	sand	Rock type	N/A
Soil colour	grey	Rock %	0
Microclimate	-	Litter type and %	leaves, twigs, 1%
Vegetation Description			
<p>Low open shrubland <i>Acacia pulchella</i> var. <i>glaberrima</i> over open forbland <i>Asphodelus fistulosus</i> and <i>Romulea rosea</i></p>			



Site Details			
Locality	EP16-060	Photo No.	102
Date	9/09/2016	Photo direction	NW
Author	RAO	Geographic datum and zone	GDA94 50
Sampling unit	POI	Easting	385488
Sample number	2	Northing	6407481
Geographic and Habitat Data			
Aspect	W	Hydrology	-
Slope	0-5	Adjacent Vegetation	wetland/same
Topographic position	lower slope	Vegetation Condition	degraded
Altitude (m)	8	Time since fire	> 5yrs
Bare ground %	10	Disturbance	high (historic)
Soil type/texture	loamy sand	Rock type	N/A
Soil colour	brown grey	Rock %	0
Microclimate	-	Litter type and %	leaves, 2%
Vegetation Description			
<p>Sedgeland <i>Lepidosperma leptostachyum</i> over forbland <i>Arctotheca calendula</i> and <i>Trifolium campestre</i></p>			



Site Details			
Locality	EP16-060	Photo No.	103
Date	9/09/2016	Photo direction	N
Author	RAO	Geographic datum and zone	GDA94 50
Sampling unit	POI	Easting	385514
Sample number	3	Northing	6407695
Geographic and Habitat Data			
Aspect	W	Hydrology	NA
Slope	0-5	Adjacent Vegetation	same
Topographic position	Lower slope	Vegetation Condition	degraded
Altitude (m)	10	Time since fire	>5 yrs
Bare ground %	2	Disturbance	high
Soil type/texture	sand	Rock type	N/A
Soil colour	grey brown	Rock %	0
Microclimate	-	Litter type and %	leaves, twigs, logs, 5%
Vegetation Description			
<p>Woodland <i>Eucalyptus gomphocephala</i> and <i>Corymbia calophylla</i> over open shrubland <i>Hakea prostrata</i> and <i>Solanum linnaeanum</i> over closed forbland <i>Asphodelus fistulosus</i> and introduced pasture grasses</p>			



Site Details			
Locality	EP16-060	Photo No.	105
Date	9/09/2016	Photo direction	NE
Author	RAO	Geographic datum and zone	GDA94 50
Sampling unit	POI	Easting	385640
Sample number	4	Northing	6408271
Geographic and Habitat Data			
Aspect	W	Hydrology	-
Slope	0-5	Adjacent Vegetation	wetland/shrubland
Topographic position	upper slope	Vegetation Condition	degraded
Altitude (m)	9	Time since fire	>5 yrs
Bare ground %	1	Disturbance	high
Soil type/texture	sand	Rock type	N/A
Soil colour	grey brown	Rock %	0
Microclimate	-	Litter type and %	leaves, twigs, 20%
Vegetation Description			
<p>Woodland <i>Corymbia calophylla</i> over open tall shrubland <i>Banksia grandis</i> over closed forbland <i>Asphodelus fistulosus</i> and introduced pasture grasses</p>			



Site Details			
Locality	EP16-060	Photo No.	108
Date	9/09/2016	Photo direction	W
Author	RAO	Geographic datum and zone	GDA94 50
Sampling unit	POI	Easting	385656
Sample number	5	Northing	6408061
Geographic and Habitat Data			
Aspect	E	Hydrology	-
Slope	15-20	Adjacent Vegetation	same
Topographic position	mid-slope	Vegetation Condition	degraded - completely degraded
Altitude (m)	7	Time since fire	>5 yrs
Bare ground %	95	Disturbance	high
Soil type/texture	sand	Rock type	N/A
Soil colour	grey	Rock %	0
Microclimate	-	Litter type and %	leaves 1%
Vegetation Description			
<p>Low open shrubland <i>Acacia pulchella</i> var. <i>glaberrima</i> over open forbland <i>Asphodelus fistulosus</i> and <i>Romulea rosea</i></p>			



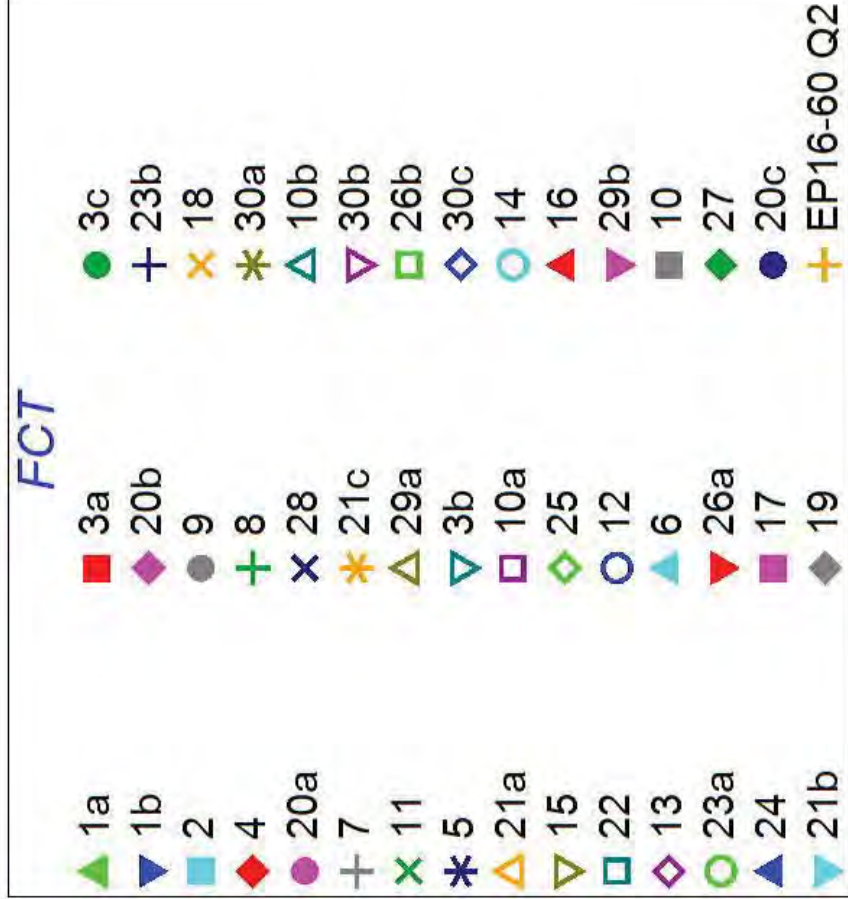
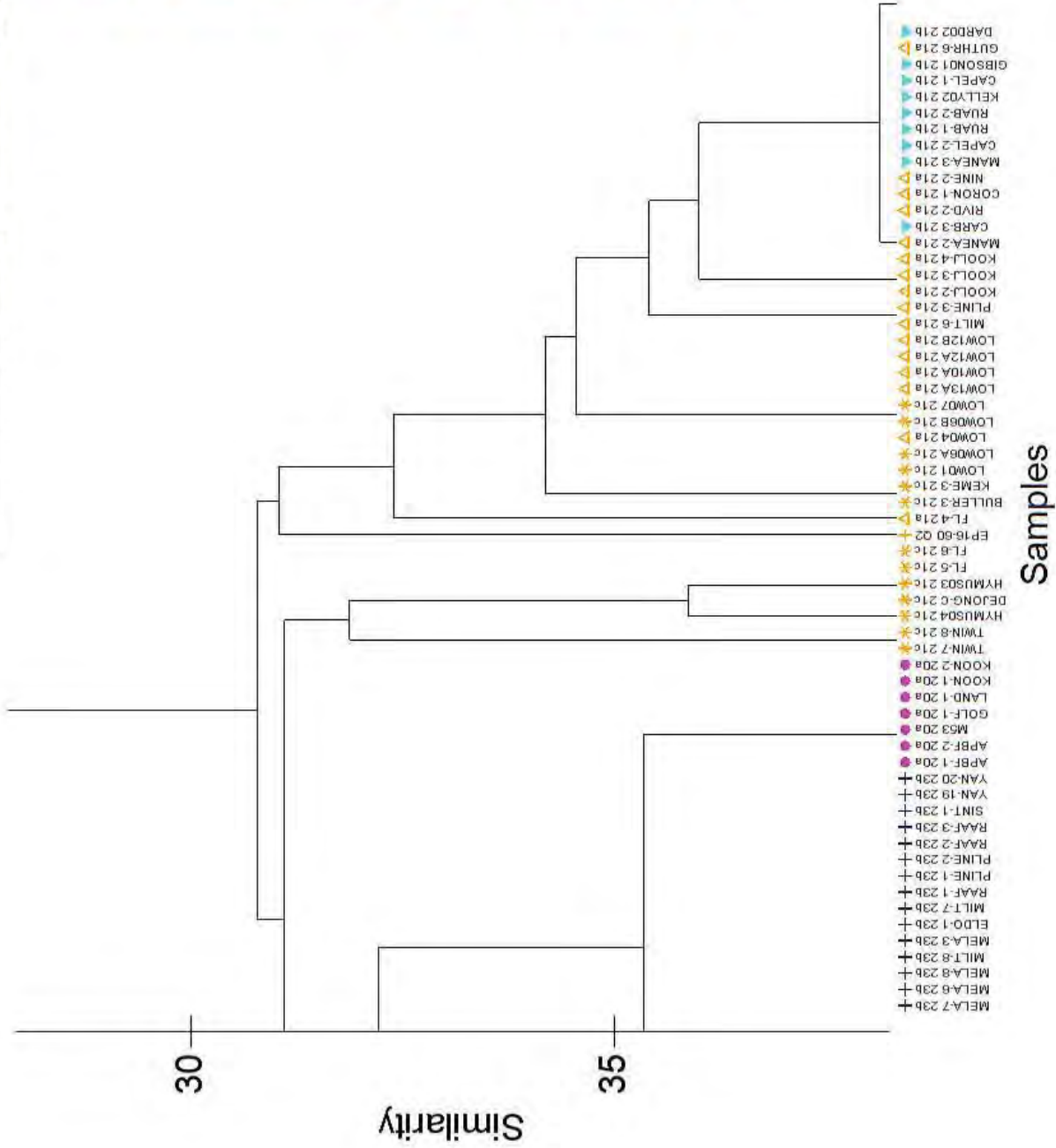
Appendix D

Cluster Dendrograms



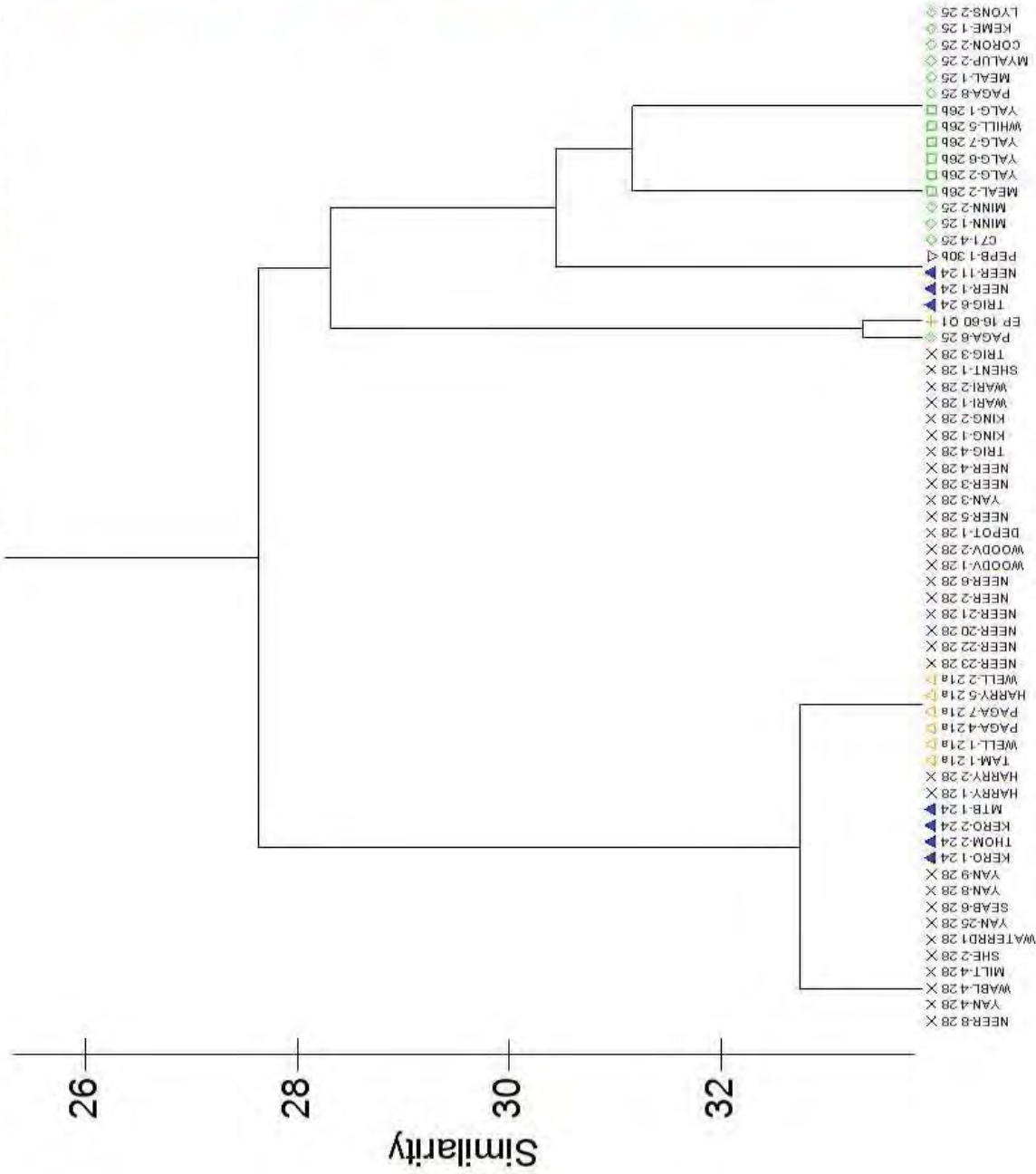
Group average

Resemblance: S17 Bray Curtis similarity



Group average

Resemblance: S17 Bray Curtis similarity



Attachment 4

Fauna Assessment (Harewood 2016)



Fauna Assessment



Lot 105 Stock Road (part)

Lakelands

APRIL 2017

Version 3

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FIGURES

FIGURE 1:	Subject Site & Surrounds
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APPENDICES

APPENDIX A:	Conservation Categories
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Acronyms/Abbreviations:

ALA: Atlas of Living Australia www.ala.org.au

BA: Birdlife Australia (Formerly RAOU, Birds Australia).

BC Bill: Biodiversity Conservation Bill (2015). WA Government.

°C: Degrees Celsius.

CALM: Department of Conservation and Land Management (now DPaW), WA Government.

CAMBA: China Australia Migratory Bird Agreement 1998.

CBD: Central Business District.

DBH: Diametre at Breast Height – tree measurement.

DEC: Department of Environment and Conservation (now DPaW), WA Government.

DEH: Department of Environment and Heritage (now DotEE), Australian Government.

DEP: Department of Environment Protection (now DER), WA Government.

DER: Department of Environment Regulation (formerly DEC, DoE), WA Government.

DEWHA: Department of the Environment, Water, Heritage and the Arts (now DotEE), Australian Government

DMP: Department of Mines and Petroleum (formerly DoIR), WA Government.

DoE: Department of Environment (now DER/DPaW), WA Government.

DotE: Department of the Environment (now DotEE), Australian Government.

DotEE: Department of the Environment and Energy (formerly SEWPaC, DWEHA, DEH & DotE), Australian Government.

DoIR: Department of Industry and Resources (now DMP), WA Government.

DPaW: Department of Parks and Wildlife (formerly DEC, CALM, DoE), WA Government.

EP Act: *Environmental Protection Act 1986*, WA Government.

EPA: Environmental Protection Authority, WA Government.

EPBC Act: *Environment Protection and Biodiversity Conservation Act 1999*, Australian Government.

ha: Hectare (10,000 square metres).

IBRA: Interim Biogeographic Regionalisation for Australia.

IUCN: International Union for the Conservation of Nature and Natural Resources – commonly known as the World Conservation Union.

JAMBA: Japan Australia Migratory Bird Agreement 1981.

km: Kilometre.

m: Metre.

mm: Millimetre.

RAOU: Royal Australia Ornithologist Union.

ROKAMBA: Republic of Korea-Australia Migratory Bird Agreement 2007.

SEWPaC: Department of Sustainability, Environment, Water, Population and Communities (now DotEE), Australian Government

SSC: Species Survival Commission, International.

WA: Western Australia.

WAM: Western Australian Museum, WA Government.

WC Act: *Wildlife Conservation Act 1950*, WA Government.

SUMMARY

This report details the results of a fauna assessment of a section of Lot 105 Stock Road, North Lakelands, located in the City of Mandurah (Figure 1). The assessment has been confined to the eastern section of Lot 105 (the subject site) which is zoned 'Urban' under the Peel Region Scheme and has an area of about 38.1 ha (Figure 2).

It is understood that a residential development is proposed for the site. The fauna assessment reported on here represents one of several technical reports that will be used to inform, guide and support ongoing planning by providing an understanding of the suite of environmental values present.

The scope of works was to conduct a level 1 fauna survey as defined by the EPA (EPA 2004). Because some listed threatened species (i.e. several species of black cockatoo) are known to occur in the general area, the scope of the survey work was expanded to include a targeted assessment (Level 2 survey – EPA 2004) of the site's significance to these species. The assessment has included a literature review ("desktop study") and several daytime surveys, including intensive black cockatoo assessments incorporating tree hollow inspections and dusk roost surveys.

Almost all of the subject site can be regarded as being cleared or parkland cleared. Cleared areas mostly coincide with a now decommissioned sand/limestone extraction operation. The extraction area contains some natural regeneration but this is limited to occasional trees and shrubs over a variety of introduced weeds. Adjoining the extraction area mainly to the west are areas of parkland cleared woodlands containing wide spaced tuart, marri and jarrah trees over a sparse shrubland of native shrubs and weeds. The south east corner of the subject site contains a small area of jarrah and sheoak woodland over a native shrubland. The location and extent of the identified habitat elements is shown in Figure 3 (courtesy Emerge Associates 2016).

Overall fauna habitat values at the subject site have been compromised to varying degrees by the removal of a large percentage of the original native vegetation and the degradation of remnant patches. As a consequence, the fauna diversity of the subject site is well below levels present prior to historical disturbances having occurred. Much of the area lacks natural attributes and therefore is now only likely to be utilised by generally common and widespread fauna species with non-specific requirements which allow them to persist in disturbed/highly disturbed habitats.

Nonetheless the remaining vegetation still retains value as habitat for some species, in particular black cockatoos, given the dominance of tuart, marri, jarrah, banksia and sheoak within the main vegetation units. This vegetation provides (depending on tree species) potential breeding, foraging and roosting opportunities for the various black cockatoo species known to frequent the area, in what is otherwise a largely cleared landscape.

Opportunistic fauna observations are listed in Appendix B. A total of 36 native fauna species were observed (or positively identified from foraging evidence, scats, tracks, skeletons or

calls) within the subject site during the various surveys and from camera trap images. Three introduced species were also confirmed as being present. Most of the fauna species recorded are common, widespread bird species.

Evidence of two listed threatened black cockatoo species was observed (forest red-tailed black cockatoo – numerous individuals and foraging evidence (chewed marri and jarrah fruits) and Carnaby's black-cockatoo – foraging evidence (chewed jarrah fruits and banksia cones)).

A summary of the potential black cockatoo habitat trees (i.e. eucalypts with a DBH \geq 50cm) observed within the subject site is provided in Table 3 and their location shown in Figure 4. Additional details on each habitat tree observed can be found in Appendix D.

Of the 263 habitat trees recorded, the majority (199, ~76%) were not observed to contain hollows of any size. Forty-eight (48, ~18%) of the trees contained one or more hollows considered by the Author not to be suitable for black cockatoos to use for nesting purposes.

Sixteen trees (16, ~6%) were identified as containing hollows that appeared possibly big enough to allow the entry of a black cockatoo into a suitably sized and orientated branch/trunk. Five of these trees (tree tag ID's 287, 299, 329, 374 and 494 - see Appendix D) were found to have evidence (various degrees of chewing around hollow entrances) that specialist consultant Tony Kirkby considered likely to be due to black cockatoos, though conclusions on actual breeding taking place in the hollows were tentative as no actual activity was seen. A subsequent examination of these particular trees using a telescopic pole with an attached high-definition camera found no evidence of any historical or existing black cockatoo nesting activity, such as fledglings, egg shells, feathers or general nest debris and to date no confirmed black cockatoo breeding habitat has been located within the subject site.

Notwithstanding this, the site does contain 263 potential black cockatoo habitat trees (i.e. a suitable tree with a DBH of >50cm) which could potentially be utilised in the future (subject to a suitable hollow forming and a range of other factors).

Foraging evidence (fresh and old) left on marri fruits, jarrah fruits and banksia cones was found at numerous locations, scattered across woodland areas within the subject site. This activity was attributed to the forest red-tailed black cockatoo or Carnaby's black cockatoo depending on the nature of the evidence present.

Black cockatoo foraging habitat within the site is represented by *banksia*, marri, jarrah and sheoak is primarily located within the EmBKg and EgCcEm plant communities. The total area of these plant communities is however likely to be a significant overstatement of the actual extent of black cockatoo habitat within the site, given this also incorporates tree species which black cockatoos do not forage on to any significant degree (for example, tuart trees) in addition to extensive areas of cleared understorey with no canopy cover which do not provide any habitat value to black cockatoos.

Notwithstanding the above, foraging habitat within the site represents only a very small portion of available cockatoo habitat located in proximity to the site and across the wider locality. Areas of remnant bushland and remnant mature trees to the south, east, north and west all provide black cockatoo habitat, with the majority contained within the Rockingham Lakes Regional Park.

Within the subject site, large mature tuart, marri and jarrah represent potential black cockatoo roosting habitat, all of which are generally distributed across and contained within the EmBKg and EgCcEm plant communities.

No black cockatoo roosting activity was observed during the first two dusk surveys. During the third dusk survey on 21 February 2017 three FRTBCs were observed foraging and grooming in the far south-western section of the site. The cockatoos were observed to intermittently switch between adjacent trees, before settling and roosting together in one tree.

No other evidence of roosting activity was observed within the site, such as branch clippings, droppings or moulted feathers, which are normally associated with black cockatoo roost sites. This suggests that the site is unlikely to contain any permanent or established roosting areas which are frequently used by large flocks of cockatoos, which represents the most important roosting habitat for each of the species. On this basis, the roosting activity by the three forest red-tailed black cockatoos observed during the third dusk survey is considered likely to have been an opportunistic occurrence and no evidence was observed to suggest large flocks of cockatoos utilise any section of the subject site for regular roosting activities.

With respect to native vertebrate fauna, 11 mammal (including eight bat species), 82 bird, 28 reptile and two frog species have previously been recorded in the general area, some of which have the potential to occur in or utilise sections of the subject site at times, a conclusion largely based on the presence of apparently suitable habitat.

Two vertebrate fauna species of conservation significance were positively identified as utilising the subject site for some purpose during the survey period, these being Carnaby's black-cockatoo (Endangered) and the forest red-tailed black cockatoo (Vulnerable). An additional five species of conservation significance may also utilise the subject site, though, as no evidence of these species presence was identified during the field survey, the status of some in the area remains uncertain. These are the Perth lined Ierista (Priority 3), Baudin's black cockatoo (Endangered), the peregrine falcon (S7), the rainbow bee-eater (Migratory) and the southern brush-tailed phascogale (S6).

The primary fauna related issue identified during the assessment which will require consideration during ongoing planning and development of the subject site relates to the presence of black cockatoo habitat. Future planning for the proposed development should aim to minimise the loss of this vegetation as much as reasonable and practicable to reduce potential impacts so as to simplify the approval process.

1. INTRODUCTION

This report details the results of a fauna assessment of a section of Lot 105 Stock Road, North Lakelands, located in the City of Mandurah. Lot 105 is situated about 57 kilometres south of the Perth central business district in south west Western Australia and is centred at approximately 32.462895°S and 115.784208°E (Figure 1).

Lot 105 has a total area of about 132 ha. The assessment has been confined to the eastern section of Lot 105 (the subject site) which is zoned 'Urban' under the Peel Region Scheme and has an area of about 38.1 ha (Figure 2).

2. DEVELOPMENT PROPOSAL

It is understood that a residential development is proposed for the subject site. The fauna assessment reported on here represents one of several technical reports that will be used to inform, guide and support ongoing planning by providing an understanding of the suite of environmental values present.

It is also anticipated that the information presented will be used by regulatory authorities to assess the potential impact of the proposal on fauna and fauna habitats.

3. SCOPE OF WORKS

The scope of works was to conduct a level 1 fauna survey as defined by the EPA (EPA 2004). Because some listed threatened species (i.e. several species of black cockatoo) are known to occur in the general area, the scope of the survey work was expanded to include a targeted assessment (Level 2 survey – EPA 2004) of the site's significance to these species.

The fauna assessment has therefore included:

1. Level 1 Fauna Survey (to EPA standard);
2. Black Cockatoo Habitat Assessment ("habitat trees" = DBH \geq 50cm, existing and potential nest hollows, foraging and roosting habitat) (Level 2 survey to EPA standard); and
3. Report summarising methods, results and discussion on likely constraints on development within the subject site.

This survey report has been prepared for use in the EPA's EIA process (if required) and is considered suitable for this purpose.

The scope of work has been restricted to a general fauna survey (Level 1 assessment) and a targeted black cockatoo habitat survey (Level 2 assessment). It is anticipated that this level of survey will provide sufficient information to allow decisions on potential impacts and management to be made.

It is considered unlikely that additional detailed Level 2 surveys within the subject site would provide information that would alter any decision making processes required to allow an informed assessment of the impact of the proposal to be made.

Note: For the purposes of this report the term black cockatoo is in reference to Baudin's black-cockatoo *Calyptorhynchus baudinii*, Carnaby's black-cockatoo *Calyptorhynchus latirostris* and the forest red-tailed black-cockatoo *Calyptorhynchus banksii naso*.

4. METHODS

4.1 POTENTIAL FAUNA INVENTORY – LITERATURE REVIEW

4.1.1 Database Searches

Searches of the following databases were undertaken to aid in the compilation of a list of vertebrate fauna potentially occurring within the subject site:

- DPaW's NatureMap Database Search (combined data from DPaW, ALA, WAM, BA and consultant's reports) (DPaW 2017b); and
- Protected matters search tool (DotEE 2017).

It should be noted that lists produced during the abovementioned database searches contain observations/inferred distributions from a broader area than the subject site and therefore may include species that would only ever occur as vagrants due to a lack of suitable habitat or the presence of only marginal habitat within the subject site itself. The databases also often included or are based on very old records and in some cases the species in question have become locally or regionally extinct.

Information from these sources should therefore be taken as indicative only and local knowledge and information also needs to be taken into consideration when determining what actual species may be present within the specific area being investigated.

4.1.2 Previous Fauna Surveys in the Area

Fauna surveys, assessments and reviews have been undertaken in nearby areas in the past, though not all are publicly available and could not be referenced. The most significant of those available have been used as the primary reference material for compiling the potential fauna assemblage for the general area.

Those reports referred to included, but were not limited to:

- Biota Environmental Sciences (2008). Mandurah Entrance Road Targeted Fauna Survey. Unpublished report prepared for GHD Pty Ltd.
- Coffey Environments Pty Ltd (2009). Fauna Risk Assessment, Lakelands. Unpublished report for Peet Mandurah Syndicate Ltd.
- Chambers, B. K. (2010). Paganoni Swamp Preliminary Underpass Monitoring and Trapping Report: Report to the Department of Main Roads Western Australia. The University of Western Australia, Crawley.
- Chambers, B. K. (2011). Paganoni Swamp, Trapping Report #2: Report to the Department of Main Roads Western Australia. The University of Western Australia, Crawley.
- ENV Australia (2010). Cape Peron Fauna Assessment. Unpublished report for Strategen.
- GHD Pty Ltd (2008). Environmental Impact Assessment Report for Mandurah Entrance Road. Unpublished report for MRWA.
- Harewood, G. (2008). Fauna Survey (Level 1), Lot 5001 Fremantle Road. Unpublished report for ERM.
- Harewood, G. (2009). Fauna Survey (Level 2) East Rockingham WWTP Site & Pipeline Corridors. Unpublished report for ERM.
- Harewood, G. (2011a). Fauna Underpass Monitoring Spring 2010 – Perth Mandurah Rail Line. Unpublished report for the Public Transport Authority of Western Australia.
- Harewood, G. (2011b). Fauna Assessment, Lots 3, 805, 806 and 807 Mandurah Road, Karnup. Unpublished report for Emerge Associates.
- Harewood, G. (2014). Fauna Assessment, Lot 101 Mandurah Road, Lakelands. Unpublished report for Emerge Associates.
- How R.A., Harvey M.S., Dell J. and Waldock J. (1996). Ground Fauna of Urban Bushland Remnants in Perth. Report N93/04 to the Australian Heritage Commission (Woodman Point Results).

As with the databases searches some reports refer to species that would not occur in the subject site due to a lack of suitable habitat (extent and/or quality) and this fact was taken into consideration when compiling the potential fauna species list. It should also be noted that the NatureMap database is likely to include some records from previous fauna surveys in the area including some of those listed above.

4.1.3 Existing Publications

The following represent the main publications used to identify and refine the potential fauna species list for the subject site:

- Anstis, M. (2013). Tadpoles and Frogs of Australia. New Holland Publishers, Sydney.
- Barrett, G., Silcocks, A., Barry, S., Cunningham, R. and Poulter, R. (2003). The New Atlas of Australian Birds. Royal Australasian Ornithologists Union, Victoria.
- Bush, B., Maryan, B., Browne-Cooper, R. & Robinson, D. (2007). Reptiles and Frogs in the Bush: Southwestern Australia. UWA Press, Nedlands.
- Bush, B., Maryan, B., Browne-Cooper, R. & Robinson, D. (2010). Field Guide to Reptiles and Frogs of the Perth Region. UWA Press, Nedlands.
- Churchill, S. (2008). Australian Bats. Second Edition, Allen & Unwin.
- Cogger, H.G. (2014). Reptiles and Amphibians of Australia. 7th Edition. CSIRO Publishing.
- Johnstone, R.E. and Storr, G.M. (1998). Handbook of Western Australian Birds: Volume 1 – Non-passerines (Emu to Dollarbird). Western Australian Museum, Perth Western Australia.
- Johnstone, R.E. and Storr, G.M. (2004). Handbook of Western Australian Birds: Volume 2 – Passerines (Blue-winged Pitta to Goldfinch). Western Australian Museum, Perth Western Australia.
- Menkhorst, P. and Knight, F. (2011). A Field Guide to the Mammals of Australia. Oxford University Press, Melbourne.
- Morgan, D.L., Beatty, S.J., Klunzinger, M.W, Allen, M.G. and Burnham, Q.E (2011). Field Guide to the Freshwater Fishes, Crayfishes and Mussels of South Western Australia. Published by SERCUL.
- Storr, G.M., Smith, L.A. and Johnstone R.E. (1983). Lizards of Western Australia II: Dragons and Monitors. WA Museum, Perth.
- Storr, G.M., Smith, L.A. and Johnstone R.E. (1990). Lizards of Western Australia III: Geckos and Pygopods. WA Museum, Perth.
- Storr, G.M., Smith, L.A. and Johnstone R.E. (1999). Lizards of Western Australia I: Skinks. Revised Edition, WA Museum, Perth.
- Storr, G.M., Smith, L.A. and Johnstone R.E. (2002). Snakes of Western Australia. Revised Edition, WA Museum, Perth.

- Tyler M.J. & Doughty P. (2009). Field Guide to Frogs of Western Australia, Fourth Edition, WA Museum, Perth.
- Van Dyck, S., Gynther, I. & Baker, A. Eds (2013). Field Companion to The Mammals of Australia. Queensland Museum.
- Wilson, S. and Swan, G. (2013). A Complete Guide to Reptiles of Australia. Reed, New Holland, Sydney.
- Woinarski, J., Burbidge, A. & Harrison, P. (2014). The Action Plan for Australian Mammals 2012. CSIRO Publishing.

4.1.4 Fauna of Conservation Significance

The conservation significance of fauna species has been assessed using data from the following sources:

- *Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)*. Administered by the Australian Government DoEE;
- *Wildlife Conservation Act 1950 (WC Act)*. Administered by the Western Australian DPaW (Govt. of WA 2017);
- Red List produced by the Species Survival Commission (SSC) of the World Conservation Union (also known as the IUCN Red List - the acronym derived from its former name of the International Union for Conservation of Nature and Natural Resources). The Red List has no legislative power in Australia but is used as a framework for State and Commonwealth categories and criteria; and the
- DPaW Priority Fauna list. A non-statutory list maintained by the DPaW for management purposes (DPaW 2017a).

The *EPBC Act* also requires the compilation of a list of migratory species that are recognised under international treaties including the:

- Japan Australia Migratory Bird Agreement 1981 (JAMBA);
- China Australia Migratory Bird Agreement 1998 (CAMBA);
- Republic of Korea-Australia Migratory Bird Agreement 2007 (ROKAMBA); and
- Bonn Convention 1979 (The Convention on the Conservation of Migratory Species of Wild Animals).

(Note - Species listed under JAMBA are also protected under Schedule 5 of the *WC Act*.)

All migratory bird species listed in the annexes to these bilateral agreements are protected in Australia as matters of national environmental significance (NES) under the *EPBC Act*.

The conservation status of all vertebrate fauna species listed as occurring or possibly occurring near the subject site has been assessed using the most recent lists published in accordance with the above-mentioned instruments and is indicated as such in the fauna listings of this report. A full listing of conservation codes is provided in Appendix A.

A number of other species not listed in official lists can also be considered of local or regional conservation significance. These include species that have a restricted range, those that occur in breeding colonies and those at the limit of their range.

While not classified as rare, threatened or vulnerable under any State or Commonwealth legislation, a number of birds have been listed as species of significance on the Swan Coastal portion of the Perth Metropolitan Region (Bush Forever - Government of Western Australia 1998, 2000a & 2000b). The bird species are often referred to as Bush Forever Decreaser Species. The three categories used for birds within the Bush Forever documents are:

- Habitat specialists with reduced distribution on the Swan Coastal Plain (code Bh);
- Wide ranging Species with reduced population's on the Swan Coastal Plain. (code Bp); and
- Extinct in the Perth region (code Be).

The presence of Bush Forever species should be taken into some consideration when determining the fauna values of an area. Bush Forever decreaser species are indicated as such within the species list held in Appendix B.

4.1.5 Invertebrate Fauna of Conservation Significance

It can be difficult to identify significant invertebrate species (e.g. short range endemics (SREs) as there are uncertainties in determining the range-restrictions of many species due to lack of surveys, lack of taxonomic resolutions within target taxa and problems in identifying certain life stages. Where invertebrates are collected during surveys, a high percentage are likely to be unknown, or for known species there can be limited knowledge or information on their distribution (Harvey 2002).

For this project, the assessment for conservation significant invertebrates has been limited to those listed by the DPaW and *EPBC Act* database searches (which rely on distribution records and known habitat preferences). No assessment of the potential for SREs to be present has been made.

4.1.6 Likelihood of Occurrence – Vertebrate Fauna of Conservation Significance

Fauna of conservation significance identified during the literature review as previously being recorded in the general area were assessed and ranked for their likelihood of occurrence within the study area itself. The rankings and criteria used were:

- **Would Not Occur:** There is no suitable habitat for the species in the subject site and/or there is no documented record of the species in the general area since records have been kept and/or the species is generally accepted as being locally/regionally extinct (supported by a lack of recent records).
 - **Locally Extinct:** Populations no longer occur within a small part of the species natural range, in this case within 10 or 20km of the study area. Populations do however persist outside of this area.
 - **Regionally Extinct:** Populations no longer occur in a large part of the species natural range, in this case within the southern forest regions. Populations do however persist outside of this area.
- **Unlikely to Occur:** The subject site is outside of the currently documented distribution for the species in question, or no suitable habitat (type, quality and extent) was identified as being present during the field assessment. Individuals of some species may occur occasionally as vagrants/transients especially if suitable habitat is located nearby but the subject site itself would not support a population or part population of the species.
- **Possibly Occurs:** The study area is within the known distribution of the species in question and habitat of at least marginal quality was identified as being present during the field assessment, supported in some cases by recent records being documented in literature from within or near the subject site. In some cases, while a species may be classified as possibly being present at times, habitat may be marginal (e.g. poor quality, fragmented, limited in extent) and therefore the frequency of occurrence and/or population levels may be low.
- **Known to Occur:** The species in question was positively identified as being present (for sedentary species) or as using the subject site as habitat for some other purpose (for non-sedentary/mobile species) during the field survey. This information may have been obtained by direct observation of individuals or by way of secondary evidence (e.g. foraging debris, tracks and scats). In some cases, while a species may be classified as known to occur, habitat may be marginal (e.g. poor quality, fragmented, limited in extent) and therefore the frequency of occurrence and/or population levels may be low.

4.1.7 Taxonomy and Nomenclature

Taxonomy and nomenclature for fauna species used in this report is generally taken from the DPaW's WA Fauna Census Database which is assumed to follow Aplin and Smith (2001) for amphibians and reptiles and Johnstone (2001) for birds. Jackson and Groves (2015) has been used for mammals.

Common names are taken from the Western Australia Museum (WAM) recognised primary common name listings when specified, though where common names are not

provided they have been acquired from other publications. Sources include Cogger (2014), Wilson and Swan (2013), Van Dyck & Strahan (2013), Christidis and Boles (2008), Bush *et al.* (2010), Bush *et al.* (2007), Tyler *et al.* (2009), and Glauret (1961). Not all common names are generally accepted.

4.2 SITE SURVEYS

Several field surveys were completed to inform the assessment, as summarised in Table 1. The intensity of survey work carried out can be regarded as being higher than that normally undertaken for an assessment of this kind so as to enable a comprehensive and robust understanding of fauna occurrences and habitats present within the subject site.

Table 1: Timeline of field surveys.

Date	Attendee(s)	Purpose
30 September 2016	Greg Harewood	• Initial fauna and black cockatoo habitat assessment (part 1)
2 October 2016	Greg Harewood	• Initial fauna and black cockatoo habitat assessment (part 2)
20 January 2017	Greg Harewood Tony Kirkby	• Ground-level visual inspection of hollows identified as being of a suitable size to potentially support black cockatoo usage.
23 January 2017	Greg Harewood Emerge Associates	• Black cockatoo dusk roost survey (1 st)
6 February 2017	Emerge Associates	• Black cockatoo dusk roost survey (2 nd)
21 February 2017	Greg Harewood Emerge Associates	• Telescopic-pole inspection of hollows identified as being potentially suitable to support black cockatoo nesting. • Black cockatoo dusk roost survey (3 rd)

4.2.1 Fauna Habitat Assessment

The vegetation communities identified during the botanical survey of the site carried out by Emerge Associates (Emerge Associates 2016) have been used as the basis for a classification of areas into broad fauna habitat types. This information has been supplemented with observations made during the fauna assessment.

The main aim of the habitat assessment was to determine if it was likely that any species of conservation significance would be utilising the areas that may be impacted on as a consequence of development at the subject site. The habitat information obtained was also used to aid in finalising the overall potential fauna list.

As part of the literature review, available information on the habitat requirements of the species of conservation significance listed as possibly occurring in the area was researched. During the field survey the habitats within the subject site were assessed and specific elements identified, if present, to determine the likelihood of listed threatened species utilising the area and its significance to them.

4.2.2 Opportunistic Fauna Observations

Opportunistic observations of fauna species were made during the field survey. Methods involved traversing a series of transects across the subject site during the day while searching microhabitats such as logs, rocks, leaf litter and observations of bird species with binoculars. Secondary evidence of a species presence such as tracks, scats, skeletal remains, foraging evidence or calls were also noted if observed/heard.

Seven motion sensing cameras were deployed on site on the 5th September 2016. Five of the cameras were stolen prior to those remaining (two) being retrieved on the 30 September 2016.

4.2.3 Black Cockatoo Habitat Assessment

The following methods were employed during the black cockatoo habitat assessment to comply with the defined scope of works and are based on guidelines published by the Commonwealth DotEE (SEWPaC 2012) which states that surveys for Carnaby's, Baudin's and forest red-tailed black cockatoo habitat should:

- be done by a suitably qualified person with experience in vegetation or cockatoo surveys, depending on the type of survey being undertaken;
- maximise the chance of detecting the species' habitat and/or signs of use;
- determine the context of the site within the broader landscape, for example, the amount and quality of habitat nearby and in the local region (for example, within 10 km);
- account for uncertainty and error (false presence and absences); and
- include collation of existing data on known locations of breeding and feeding birds and night roost locations.

Habitat used by black cockatoos have been placed into three categories by the DotEE (SEWPaC 2012) these being:

- Breeding Habitat;
- Foraging Habitat; and
- Night Roosting Habitat.

So as to comply with the requested scope of works and in line with the published guidelines the following was carried out.

4.2.3.1 Black Cockatoo Breeding Habitat

The black cockatoo breeding habitat assessment involved the identification of all suitable breeding trees species (native, endemic species only) within the subject site that had a Diameter at Breast Height (DBH) of equal to or over 50cm. The DBH of each tree was estimated using a pre-made 50 cm “caliper”.

Target tree species included marri and jarrah or any other *Corymbia/Eucalyptus* species of a suitable size that may have been present. Peppermints, *banksia*, sheoak and *melaleuca* tree species (for example) were not assessed as they typically do not develop hollows that are used by black cockatoos.

The location of each tree identified as being over the threshold DBH was recorded with a GPS and details on tree species, number and size of hollows (if any) noted.

Based on this assessment trees present within the subject site have been placed into one of four categories:

- Tree < 50cm DBH or an unsuitable species (not recorded);
- Tree \geq 50cm DBH, no hollows seen;
- Tree \geq 50cm DBH, one or more hollows seen, none of which were considered suitable for black cockatoos to use for nesting; or
- Tree \geq 50cm DBH, one or more hollows seen, with at least one considered suitable for black cockatoos to use for nesting.

For the purposes of this assessment a tree containing a potential cockatoo nest hollow was defined as:

Generally, any tree which is alive or dead that contains one or more visible hollows (cavities within the trunk or branches) suitable for occupation by a black cockatoo for the purpose of nesting/breeding. Hollows that had an entrance greater than about 10cm in diameter and would allow the entry of a black cockatoo into a suitably orientated and sized branch/trunk were recorded as a “potential black cockatoo nest hollow”.

Identified hollows were examined using binoculars for evidence of actual use by black cockatoos (e.g. chewing around hollow entrance, scarring and scratch marks on trunks and branches). Trees with possible nest hollows were also scratched and raked with a large stick/pole in attempt to flush any sitting birds from hollows and calls of chicks were also listened for. It should be noted that the survey may have been conducted outside of the main breeding season of one or more of the three species of black cockatoo.

All trees identified during the initial assessment as having hollows potentially suitable for black cockatoos were then subject to additional assessment with Tony Kirkby.

In order to further assist in determining if any of the hollows with chew marks were currently occupied by or had historically been used for nesting by black cockatoos, an additional survey was subsequently undertaken by Greg Harewood and staff from Emerge Associates. A telescopic pole with an attached high-definition camera was extended and maneuvered adjacent to and inside each of the hollows, enabling direct observation of each hollow's entrance and internal characteristics.

4.2.3.2 Black Cockatoo Foraging Habitat

The location and nature of black cockatoo foraging evidence (e.g. chewed fruits around base of trees) observed during the field survey was recorded. The nature and extent of potential foraging habitat present was also documented irrespective of the presence of any actual foraging evidence.

A review of available literature was also carried out to determine the location/extent of any known/likely black cockatoo foraging habitat areas in the vicinity of the subject site.

4.2.3.3 Black Cockatoo Roosting Habitat

Direct and indirect evidence of black cockatoos roosting within trees was with the subject site was noted if observed (e.g. branch clippings, droppings or moulted feathers). Three separate black cockatoo roost surveys were also completed (see Table 1). This involved two or three people surveying the subject site from wide spaced strategic locations an hour either side of dusk to observe any cockatoo roosting activity.

A review of available literature was also carried out to determine the location/extent of any known/likely black cockatoo roosting habitat areas in the vicinity of the subject site.

5. SURVEY CONSTRAINTS

No seasonal sampling has been carried out as part of this fauna assessment. The conclusions presented are based upon field data and the environmental monitoring and/or testing carried out over a limited period of time and are therefore merely indicative of the environmental condition of the subject site at the time of the field assessments. It should also be recognised that site conditions can change with time.

Some fauna species are reported as potentially occurring within the subject site based on there being suitable habitat (quality and extent) within the subject site or immediately adjacent. With respect to opportunistic observations, the possibility exists that certain species may not have been detected during field investigations due to:

- seasonal inactivity during the field survey;

- species present within micro habitats not surveyed;
- cryptic species able to avoid detection; and
- transient wide-ranging species not present during the survey period.

Lack of observational data on some species should therefore not necessarily be taken as an indication that a species is absent from the subject site.

The habitat requirements and ecology of many of the species known to occur in the wider area are often not well understood or documented. It can therefore be difficult to exclude species from the potential list based on a lack of a specific habitat or microhabitat within the subject site. As a consequence of this limitation the potential fauna list produced is most likely an overestimation of those species that actually utilise the subject site for some purpose. Some species may be present in the general area but may only use the subject site itself on rare occasions or as vagrants/transients.

In recognition of survey limitations, a precautionary approach has been adopted for this assessment. Any fauna species that would possibly occur within the subject site (or immediately adjacent), as identified through ecological databases, publications, discussions with local experts/residents and the habitat knowledge of the Author, has been assumed to potentially occur in the subject site.

During the black cockatoo habitat survey a search for trees containing hollows was completed. It should be noted that identifying hollows suitable for fauna species from ground level has limitations. Generally the full characteristics of any hollow seen are not fully evident (e.g. internal dimensions). It is also difficult to locate all hollows within all trees as some are not observable from ground level.

The location of observations was recorded using a handheld GPS. The accuracy of the GPS cannot be guaranteed above a level of about 5 to 10 metres, though it should be noted that in some circumstance the accuracy can increase or decrease beyond this range.

6. RESULTS

6.1 POTENTIAL FAUNA INVENTORY – LITERATURE REVIEW

A list of fauna species considered most likely to occur in the subject site has been compiled from information obtained during the desktop study and is presented in Appendix B. This listing was refined after information gathered during the site reconnaissance survey was assessed. The results of some previous fauna surveys carried out in the general area are summarised in this species listing as are the DPaW NatureMap database search results. The raw database search results from NatureMap

(DPaW 2017b) and the Protected Matters Search Tool (DotEE 2017) are contained within Appendix C.

The list of potential fauna takes into consideration that firstly the species in question is not known to be locally extinct and secondly that suitable habitat for each species, as identified during the habitat assessment, is present within the subject site. Compiling an accurate fauna list has limitations (see Section 5 above) and therefore, as discussed, the listing is likely to be an overestimation of the fauna species actually present within the subject site at any one time.

6.2 SITE SURVEYS

6.2.1 Fauna Habitat Assessment

Almost all of the subject site can be regarded as being cleared or parkland cleared. Cleared areas mostly coincide with a now decommissioned sand/limestone extraction operation. The extraction area contains some natural regeneration but this is limited to occasional trees and shrubs over a variety of introduced weeds. Adjoining the extraction area mainly to the west are areas of parkland cleared woodlands containing wide spaced tuart, marri and jarrah trees over a sparse shrubland of native shrubs and weeds. The south-east corner of the subject site contains a small area of jarrah and sheoak woodland over a native shrubland.





Outside of the subject site but bordering it to the west are various wetland habitats associated with Paganoni Swamp.

The site contains many large native and endemic trees with observable hollows of various sizes, with 64 examples being recorded (see Section 6.2.3). These were primarily located within parkland cleared and woodland areas.

Topography of the subject site is irregular, a consequence of the previous extraction activities but in general rises from the west from about 5 mAHD to a maximum of about 15 mAHD in the east. All the study area falls within a section of the Spearwood Dune System which at this location consists of a pale yellowish-brown residual sand derived from the Tamala Limestone (Gozzard 1983).

Descriptions and examples images of the main fauna habitats/dominant vegetation present within the subject site are provided in Table 2. The location and extent of the identified habitat elements is shown in Figure 3 (courtesy Emerge Associates 2016).

Table 2: Main Fauna Habitats within the Subject Site

Code	Fauna Habitat Description	Example Image
EgCcEm	<p>Woodland of <i>Eucalyptus gomphocephala</i>, <i>Corymbia calophylla</i> and <i>Eucalyptus marginata</i> over sparse shrubland of <i>Hakea prostrata</i> over weeds.</p> <p>Area ~16.24 ha (~43%)</p>	
Non-native vegetation	<p>Heavily disturbed areas comprising weeds with occasional native shrubs and planted vegetation.</p> <p>Total Area ~9.88 ha (~26%)</p>	
EmBKg	<p>Open woodland of <i>Eucalyptus marginata</i> (with occasional <i>Corymbia calophylla</i>) over low open woodland of <i>Banksia menziesii</i>, <i>B. attenuata</i> and <i>Xylomelum occidentale</i> over low open woodland of <i>Kunzea glabrescens</i> and <i>Hibbertia hypericoides</i> over occasional native forbs and weeds.</p> <p>Total Area ~3.16 ha (~8%)</p>	
Ap	<p>Open shrubland to shrubland of <i>Acacia pulchella</i> over weeds.</p> <p>Total Area ~8.81 ha (~23%)</p>	

Almost half (~49%) of the subject site consists of totally cleared areas, a regrowth of non-native vegetation or regrowth of *Acacia* shrubland. All the remnant vegetation present has been subject to considerable historical disturbance (e.g. partial clearing, logging, prior grazing and dieback), and is largely in a 'degraded' or 'completely degraded' condition based on the Keighery (1994) vegetation condition scale.

Overall fauna habitat values at the subject site have been compromised to varying degrees by the removal of a large percentage of the original native vegetation and the degradation of remnant patches. As a consequence the fauna diversity of the subject site is well below levels present prior to historical disturbances having occurred. Much of the area lacks natural attributes and as a consequence is now only likely to be utilised by generally common and widespread fauna species with non-specific requirements which allow them to persist in disturbed/highly disturbed habitats.

Biodiversity values of the native remnants would also have been reduced a certain degree from original pre-disturbance levels due to the overall fragmentation of vegetation in the wider area, the likelihood of more frequent fires and the presence of feral predators such as cats and foxes.

Nonetheless the remaining vegetation still retains value as habitat for some species, in particular black cockatoos, given the dominance of tuart, marri, jarrah, *banksia* and sheoak within the main vegetation units. This vegetation provides (depending on tree species) potential breeding, foraging and roosting opportunities for the various black cockatoo species known to frequent the area, in what is otherwise a largely cleared landscape.

6.2.2 Opportunistic Fauna Observations

Opportunistic fauna observations are listed in Appendix B. A total of 36 native fauna species were observed (or positively identified from foraging evidence, scats, tracks, skeletons or calls) within the subject site during the two day time surveys and from the camera trap results. Three introduced species were also confirmed as being present. Most of the fauna species recorded are common, widespread bird species.

Evidence of two listed threatened black cockatoo species was observed (forest red-tailed black cockatoo – numerous individuals and foraging evidence (chewed marri and jarrah fruits) and Carnaby's black-cockatoo – foraging evidence (chewed jarrah fruits and *banksia* cones)).

6.2.3 Black Cockatoo Habitat Assessment

6.2.3.1 Black Cockatoo Breeding Habitat

Trees considered potentially suitable for black cockatoos to use as nesting habitat (using DotEE criteria - SEWPaC 2012), but ultimately subject to a suitable hollow being present

or developing and a range of other factors) which were found within the subject site comprised the following species:

- Marri – *Corymbia calophylla*;
- Tuart - *Eucalyptus gomphocephala*; and
- Jarrah – *Eucalyptus marginata*.

Most of the identified habitat trees are located within the EmBKg and EgCcEm plant communities (Figure 3). It should be noted that the propensity to develop hollows suitable for black cockatoo varies greatly between tree species. For example, relative to marri, jarrah trees rarely develop hollows that are then used by black cockatoos for breeding (Kirkby 2009).

A summary of the potential black cockatoo habitat trees observed within the subject site is provided in Table 3 below and their location shown in Figure 4. Additional details on each habitat tree observed can be found in Appendix D.

Table 3: Summary of Potential Black Cockatoo Habitat Trees (DBH \geq 50cm) within the Subject Site

Total Number of Habitat Trees	Number of Trees with <u>No Hollows Observed</u>	Number of Trees with Hollows Considered <u>Unsuitable</u> for Nesting Black Cockatoos	Number of Trees with Hollows Considered <u>Possibly Suitable</u> for Nesting Black Cockatoos	Tree Species			
				Marri	Tuart	Jarrah	Dead - Unknown
263	199	48	16	132	71	55	5

Of the 263 habitat trees recorded, the majority (199, ~76%) were not observed to contain hollows of any size. Forty-eight (48, ~18%) of the trees contained one or more hollows considered by the Author not to be suitable for black cockatoos to use for nesting purposes.

Sixteen trees (16, ~6%) were identified as containing hollows that appeared possibly big enough to allow the entry of a black cockatoo into a suitably sized and orientated branch/trunk. Most of these hollows showed no evidence of actual use by black cockatoos. However, several hollows did exhibit some signs of use possibly caused by black cockatoos in the form of varying amounts of “chew” marks around the hollow entrance and it was concluded at the time that some of these may have been used for breeding in the recent past.

All trees identified as having what appeared to be large hollows possibly suitable for black cockatoos within the subject site (16 in total), including those which showed some signs of apparent use (chew marks) were resurveyed by Greg Harewood and black cockatoo specialist Tony Kirkby. This assessment was done from ground level using binoculars.

Five trees (tree tag ID's 287, 299, 329, 374 and 404 - see Appendix D) were found to have evidence (various degrees of chewing (or possible chewing) around hollow entrances) that Tony Kirkby considered likely to be due to black cockatoos, though conclusions on actual breeding taking place in the hollows were tentative as no actual activity was seen.

The hollows in these particular trees were examined using a telescopic pole with an attached high-definition camera in order to further assist in determining if any of the hollows with chew marks were currently occupied by or had historically been used for nesting by black cockatoos. The camera-pole inspection found no evidence of any historical or existing black cockatoo nesting activity, such as fledglings, egg shells, feathers or general nest debris and to date no confirmed black cockatoo breeding habitat has been located within the subject site. A summary of observations are provided below:

- 287: The hollow inspection could not be completed due to safety concerns (dead tree with multiple limb failures, with debris scattered around base of tree) and height of hollow entrance. Further inspection of the hollow opening using binoculars could not identify any chew markings and as such this tree was ruled out.
- 299: The hollow inspection did not observe any chew marks, these are likely to have been mistakenly assigned in the first instance due to confusion with a fresh branch limb failure directly underneath the hollow. The hollow has suitable characteristics to potentially support nesting, however no evidence in this regard was observed.
- 329: The hollow inspection did identify chew marks around the hollow opening, however no evidence of nesting was observed.
- 374: The hollow inspection determined the hollow was too shallow to support nesting activity.
- 404: The hollow inspection did identify chew marks around the hollow opening, however no evidence of nesting was observed.

Notwithstanding this, the site does contain 263 potential black cockatoo habitat trees (i.e. a suitable tree with a DBH of ≥ 50 cm) which could potentially be utilised in the future (subject to a suitable hollow forming and a range of other factors).

A review of available data showed one previous record of black cockatoo's breeding in the immediate vicinity, this being a record of forest red-tailed black-cockatoo's nesting about 2 km to the south of the subject site (Johnstone *et al.* 2006). During a subsequent survey

in a nearby area a pair of red-tailed black-cockatoos were observed at a hollow in a tuart tree at a location about 3 km south of the subject site (Biota 2009) though no actual breeding was confirmed at the time. The next closest documented breeding site (for Carnaby's black-cockatoo) is near Karnup/Baldivis approximately 7 km to the north east (Johnstone *et al.* 2011) though the date of the observation is not provided.

6.2.3.2 Black Cockatoo Foraging Habitat

Following is a list of the flora species recorded within the subject site during the fauna assessment that are known to be used as a direct food source (i.e. fruits or flowers) by one or more species of black cockatoo:

- Marri - *Corymbia calophylla*;
- Jarrah - *Eucalyptus marginata*;
- Sheoak - *Allocasuarina fraseriana*;
- Candelstick Banksia - *Banksia attenuata*; and
- Firewood Banksia - *Banksia menziesii*.

Fresh foraging evidence left on marri fruits by forest red-tailed black-cockatoos was found at numerous locations, scattered across woodland areas within the subject site. Several generally old (several months at least) evidence of banksia cones (*B. attenuata* & *B. menziesii*) being foraged upon was also found in the south-east section of the subject site. Both Carnaby's and Baudin's black cockatoo forage on *banksia* and so either species could be responsible, however in this instance all the evidence observed has been attributed to Carnaby's black cockatoo as they are more commonly recorded in this general area.

Several examples of jarrah fruits being foraged on by black cockatoos were also observed. This was attributed to either the forest red-tailed black-cockatoos or Carnaby's black-cockatoo.

Black cockatoo foraging habitat within the site is primarily located within the EmBKg and EgCcEm plant communities. The total area of these plant communities is however likely to be a significant overstatement of the actual extent of black cockatoo habitat within the site, given this also incorporates tree species which black cockatoos do not forage on to any significant degree (for example, tuart trees).

In addition, the mapped extent of these communities also incorporates extensive areas of cleared understorey with no canopy cover which do not provide any habitat value to black cockatoos.

Notwithstanding the above, foraging habitat within the site represents only a very small portion of available cockatoo habitat located in proximity to the site and across the wider

locality. Areas of remnant bushland and remnant mature trees to the south, east, north and west all provide black cockatoo habitat, with the majority contained within the Rockingham Lakes Regional Park.

Based on regional habitat mapping prepared by the DoP (2011), it is estimated that approximately 1,874 ha of potential foraging habitat for Carnaby's black cockatoo occurs within 5 km of the site, and 3,628 ha within 10 km of the site. Whilst this total area includes private property, approximately half occurs in areas afforded some form of protection from clearing, including Bush Forever sites, 'Parks and Recreation' and 'Regional Open Space' reserves and lands managed by DPaW.

Furthermore, available foraging habitat in nearby reserves such as Bush Forever site 395 and the wider Rockingham Lakes Regional Parks is known to contain extensive areas of intact remnant vegetation, which provides much higher quality habitat values for black cockatoos compared to the habitat within the site. As such, it is considered possible that this is preferentially used by cockatoo species instead of habitat within the site, given its adjacent location and extensive availability.

Overall, the site is known to contain black cockatoo foraging habitat and is used by both Carnaby's black cockatoo and forest red-tailed black cockatoos to forage. However, the site is unlikely to represent a significant foraging resource for either species, given the high availability of other suitable habitat in the locality and wider region. The site may also support Baudin's black cockatoo foraging activity intermittently, however this is unlikely to be of any significance given the location of the site in the far north-western extent of this species documented distribution.

6.2.3.3 Black Cockatoo Roosting Habitat

Black cockatoo roosting habitat is typically characterised by groves of large endemic trees, sometimes on high points and/or close to a fresh water source. Within the subject site, large mature tuart, marri and jarrah represent potential black cockatoo roosting habitat, all of which are generally distributed across and contained within the EmBKg and EgCcEm plant communities.

No black cockatoo roosting activity was observed during the first two dusk surveys. During the third dusk survey on 21 February 2017 three FRTBCs were observed foraging and grooming in the far south-western section of the site. The cockatoos were observed to intermittently switch between adjacent trees, before settling and roosting together in one tree.

No other evidence of roosting activity was observed within the site, such as branch clippings, droppings or moulted feathers, which are normally associated with black cockatoo roost sites. This suggests that the site is unlikely to contain any permanent or established roosting areas which are frequently used by large flocks of cockatoos, which represents the most important roosting habitat for each of the species. On this basis, the

roosting activity by the three forest red-tailed black cockatoos observed during the third dusk survey is considered likely to have been an opportunistic occurrence.

Given the presence of large numbers of mature eucalypts, habitat within the site appears superficially to represent black cockatoo roosting habitat. However, the results of the surveys carried out to date suggest it is only used opportunistically by small groups of cockatoos, with no evidence observed to suggest large flocks of cockatoos utilise any section of the subject site for regular roosting activities.

A review of available data showed some previous records of black cockatoo’s roosting at several locations about 1km south west of the subject site, either side of Mandjoogoordap Drive (Johnstone *et al.* 2011) and several others within 10km (Burnham *et al.* 2010). The most recent report on the “Great Cocky Count” (Peck *et al.* 2016) identifies a red-tail black cockatoo roost about 3 km south of the subject site in or near Marlee Reserve. Thirteen other roosts sites were surveyed with the City of Mandurah with only three being in use on the day of the count (3 April 2016).

6.3 FAUNA INVENTORY – SUMMARY

6.3.1 Vertebrate Fauna

Table 4 summarises the number of vertebrate fauna species potentially occurring within or utilising at times the subject site, based on results from the desktop study and observations made during the field assessment. A complete list of vertebrate fauna possibly inhabiting or frequenting the subject site is held in Appendix B.

Table 4: Summary of Potential Vertebrate Fauna Species (as listed in Appendix B)

Group	Total number of potential species	Potential number of specially protected species	Potential number of migratory species	Potential number of priority species	Number of species recorded during field surveys
Amphibians	2	0	0	0	0
Reptiles	28	0	0	1	3
Birds	87 ⁵	4	1	0	32 ¹
Non-Volant Mammals	9 ⁶	1	0	0	4 ²
Volant Mammals (Bats)	8	0	0	0	0
Total	134¹¹	5	1	1	39³

Superscript = number of introduced species included in total.

Not all species listed as potentially occurring within the subject site in existing databases and publications (i.e. *EPBC Act* Threatened Fauna and Migratory species lists, DPaW's NatureMap database, various reports and publications) are shown in the expected listing in Appendix B. Some species have been excluded from this list based largely on the lack of suitable habitat within the subject site and in the general area or known local extinction, even if suitable habitat is present.

Despite the omission of some species it should be noted that the list provided is still very likely an over estimation of the fauna species utilising the subject site (either on a regular or infrequent basis) as a result of the precautionary approach adopted for the assessment. At any one time only a subset of the listed potential species are likely to be present within the bounds of the subject site.

As a large proportion of the subject site is cleared the majority represents unsuitable habitat for many of the potential species listed. Most, if present, would be confined to the area of remnant native bushland in the west or south east corner and even in these areas only a subset of the species listed are likely to be present at any one time.

6.3.2 Vertebrate Fauna of Conservation Significance

A review of the *EPBC Act* threatened fauna list, DPaW's Threatened Fauna Database and Priority List, unpublished reports and scientific publications identified a number of specially protected, priority or migratory vertebrate fauna species as potentially occurring in the general vicinity of the subject site. Of these species, most that have no potential whatsoever to utilise the subject site for any purpose have been omitted from the potential list (Appendix B), principally due to lack of suitable habitat (including extent and/or quality) or known local extinction.

The following vertebrate fauna species of conservation significance were positively identified as utilising the subject site for some purpose during the survey period, these being:

- Carnaby's Black-Cockatoo *Calyptorhynchus latirostris* – S2 (*WC Act*), Endangered (*EPBC Act*)

Some foraging evidence attributed to this species found during the field survey (chewed jarrah fruits and *banksia* cones). Most of the remnant native vegetation present (i.e. marri, jarrah and *banksia* trees) within the subject site represents foraging habitat for this species.

Larger native endemic trees (≥ 50 cm DBH) present within the subject site can be considered potential breeding habitat, a number of which appeared to contain large hollows possibly suitable for actual nesting, though no confirmed nesting activity has been found to date despite an intensive assessment of potential hollows. No roosting activity observed.

- Forest Red-tailed Black-Cockatoo *Calyptorhynchus banksii naso* – S3 (WC Act), Vulnerable (EPBC Act)

Individuals of this species were recorded within the subject site during the field reconnaissance survey. Numerous examples of foraging evidence attributed to this species was also found (mainly chewed marri fruits). Most of the remnant native vegetation present (i.e. marri, jarrah and sheoak trees) within the subject site represents foraging habitat for this species.

Larger native endemic trees (≥ 50 cm DBH) present within the subject site can be considered potential breeding habitat, a number of which appeared to contain large hollows possibly suitable for actual nesting, though no confirmed nesting activity has been found to date despite an intensive assessment of potential hollows. One instance of apparent opportunistic roosting activity observed.

Based on the habitats present and current documented distributions it is considered possible that the following additional species of conservation significance may use the subject site for some purpose at times, though, as no evidence of any using the subject site at the time of the field survey was found, the status of some in the area remains uncertain.

These species are:

- Perth Lined Lerista *Lerista lineata* – P3 (DPaW Priority Species)
Status within the subject site difficult to determine. The area is however within the documented range of this species and some areas of habitat appear suitable, so it may occur
- Peregrine Falcon *Falco peregrinus* – S7 (WC Act)
This species potentially utilises some sections of the subject site as part of a much larger home range. No evidence of nesting was observed and the probability of this species breeding within the subject site can be considered to be low.
- Baudin's Black-Cockatoo *Calyptorhynchus baudinii* – S2 (WC Act), Vulnerable (EPBC Act)
This species is only recorded in this area of its documented range on infrequent occasions. It is listed as a potential species but probably only occurs in small groups and on rare occasions.
- Rainbow Bee-eater *Merops ornatus* – S5 (WC Act), Migratory (EPBC Act)
This species is a common seasonal visitor to south west. It possibly breeds in some sections of the subject site where ground conditions permit (e.g. firm sandy areas) though population levels would not be significant as it usually breeds in pairs, rarely in small colonies (Johnstone and Storr 1998).
- South-western Brush-tailed Phascogale *Phascogale tapoatafa wambenger* – S6 (WC Act)
Several individuals of this species have been captured in Paganoni Swamp reserve and east of the Kwinana Freeway at Keralup in the past though foxes and

drying weather conditions appear to be affecting population levels (Chambers 2010, 2011). While the current status within the subject site itself is difficult to ascertain, it does contain suitable habitat with numerous trees containing hollows so a population may persist.

Habitat for some of these species on-site, while considered possibly suitable, may be marginal in extent/quality and species listed may only visit the area for short periods, or as rare/uncommon vagrants/transients.

A number of other species of conservation significance, while possibly present in the wider area (e.g. Paganoni Swamp to the west and north (forming part of Bush Forever Site 356), are not listed as potential species due to known localised extinction (and no subsequent recruitment from adjoining areas) and/or lack of suitable habitat and/or the presence of feral predators. Details on conservation significant species and reasons for the omission of some from the potential listing are provided in Appendix E and Table 5.

Thirty bird species that potentially frequent or occur in the study area are noted as Bush Forever Decreaser Species in the Perth Metropolitan Region (seven species were recorded during the field survey). Decreaser species are a significant issue in biodiversity conservation in the Perth section of the coastal plain as there have been marked reductions in range and population levels of many sedentary bird species as a consequence of disturbance and land clearing (Dell & Hyder-Griffiths 2002).

6.3.3 Invertebrate Fauna of Conservation Significance

Only one invertebrate species of conservation significance appeared in the DPaW database search (DPaW 2017b), this being the graceful sun moth (*Synemon gratiosa*). The protected matter database search returned no invertebrate results (DotEE 2017).

The graceful sun moth is listed as Priority 4 by DPaW. It is however considered unlikely to persist within the subject site due to an absence of suitable habitat i.e. low vegetation containing *Lomandra hermaphrodita* and *L. maritima*). Additional information on this species can be found in Appendix E.

7. FAUNA VALUES

7.1 CONSERVATION SIGNIFICANCE OF THE SUBJECT SITE

The conservation significance of the subject site has been determined by applying site specific criteria such as:

- Fauna species and/or habitat present within the subject site that is poorly represented in the general vicinity;

- Fauna habitat within the subject site supporting species of conservation or other significance; and
- Fauna habitat within the subject site in better condition than other similar locations in the general vicinity.

A high percentage of the subject site has been subject to a high degree of historical disturbance and therefore the diversity of fauna species has been significantly reduced from its original natural levels. Habitat degradation as a result of partial clearing, altered fire regimes and the presence of introduced predators is also likely to have had a significant effect on species diversity in the remnants that remain.

Because of these factors most of the site has very little conservation significance to fauna in general. The assessment does however suggest that the site has some local conservation value principally as habitat for black cockatoos in what is otherwise a largely cleared landscape.

7.2 VALUE OF THE SUBJECT SITE AS AN ECOLOGICAL LINKAGE/WILDLIFE CORRIDOR

Corridors of native vegetation can be very important for the dispersal of species in otherwise cleared landscapes. Any areas of remnant vegetation making up part of a linkage is therefore of great value by facilitating the movement of species that cannot fly great distances or utilise cleared/developed land. Linkage with adjacent bushland areas has been identified as a natural attribute of high priority in the assessment of an areas regional significance.

The site itself is not shown as being directly within a previously identified regionally significant ecological linkage. Bush Forever Site Sites 395 (Paganoni Swamp and adjacent bushland) does however contribute to Greenways 89 and 123 (Tingay, Alan & Associates 1998) which are part of a recognised regionally significant, contiguous bushland/wetland linkage (see Figure 6 - Government of Western Australia 2000a). As a consequence of the proximity of this vegetation, the site could be seen as contributing to the overall value of the linkage, though its value to most of fauna species known to frequent the wider area would be low when compared to the better quality vegetation protected in nearby reserves to the west and north.

8. POTENTIAL IMPACTS AND DEVELOPMENT CONSIDERATIONS

8.1 POTENTIAL IMPACTS OF DEVELOPMENT

In general the most significant potential impacts to fauna of any development include:

- Loss of vegetation/fauna habitat that may be used for foraging, breeding, roosting, or dispersal (includes loss of hollow bearing trees);
- Fragmentation of vegetation/fauna habitat which may restrict the movement of some fauna species;
- Modifications to surface hydrology, siltation of creek lines;
- Changes to fire regimes;
- Pollution (e.g. oil spills);
- Noise/light/dust;
- Spread of plant pathogens (e.g. dieback) and weeds;
- Increase in the number of predatory introduced species (e.g. foxes, cats);
- Death or injury of fauna during clearing and construction; and
- An increase in fauna road kills subsequent to development.

The location and extent of clearing that may take place has yet to be finalised, however based on the habitats present and the current concept layout plan the possible impacts on species of conservation significance previously recorded in the general area has been assessed, a summary of which is provided in Table 5 below. Additional information on specific fauna species is provided in Appendix E.

Additional information on those species listed is provided in Appendix E.

Table 5: Likelihood of Occurrence and Possible Impacts – Fauna Species of Conservation Significance (continues on following pages).

Common Name	Genus & Species	Conservation Status (See Appendix A for codes)	Habitat Present	Likelihood of Occurrence	Possible Impacts
Graceful Sun Moth	<i>Synemon gratiosa</i>	P4	No/Marginal	Unlikely.	No impact.
Perth Lined Lerista	<i>Lerista lineata</i>	P3	Yes	Possible.	Loss/modification of small areas of generally degraded habitat.

Common Name	Genus & Species	Conservation Status (See Appendix A for codes)	Habitat Present	Likelihood of Occurrence	Possible Impacts
Black-striped Snake	<i>Neelaps calonotos</i>	P3	No/Marginal	Unlikely.	No impact.
Malleefowl	<i>Leipoa ocellata</i>	S3, VU	No	Would Not Occur - species locally extinct.	No Impact.
Great Egret	<i>Ardea alba</i>	S5, Mig	No	Would Not Occur.	No Impact.
Cattle Egret	<i>Ardea ibis</i>	S5, Mig	No	Would Not Occur.	No Impact.
Painted Snipe	<i>Rostratula benghalensis</i>	S2, Mig, EN	No	Would Not Occur.	No Impact.
Australasian Bittern	<i>Botaurus poiciloptilus</i>	S2, EN	No	Would Not Occur.	No Impact.
Migratory Shorebirds/Wetland Species	Various	S5, Mig, Various	No	Would Not Occur.	No Impact.
Hooded Plover	<i>Thinornis rubricollis tregellasi</i>	P4	No	Would Not Occur.	No Impact.
White-bellied Sea-Eagle	<i>Haliaeetus leucogaster</i>	Ma	No/Marginal	Unlikely	No Impact.
Osprey	<i>Pandion haliaetus</i>	S5, Mig	No	Would Not Occur.	No Impact.
Peregrine Falcon	<i>Falco peregrinus</i>	S7	Yes	Possible but only rarely.	Loss/modification of small areas of degraded habitat.
Masked Owl	<i>Tyto novaehollandae novaehollandae</i>	P3	No/Marginal	Unlikely.	No impact.
Fork-tailed Swift	<i>Apus pacificus</i>	S5, Mig	Yes	Unlikely, Flyover only on very rare occasions.	No impact.
Rainbow Bee-eater	<i>Merops ornatus</i>	S5, Mig	Yes	Possible.	Loss/modification of small areas of generally degraded habitat.
Grey Wagtail	<i>Motacilla cinerea</i>	S5, Mig	No	Would Not Occur.	No Impact.
Carnaby's Black Cockatoo	<i>Calyptorhynchus latirostris</i>	S2, EN	Yes	Known to Occur.	Loss/modification of small areas of potential habitat.
Baudin's Black Cockatoo	<i>Calyptorhynchus baudinii</i>	S2, VU	Yes	Possible (on rare occasions only).	No Impact.
Forest Red-tailed Black Cockatoo	<i>Calyptorhynchus banksii naso</i>	S3, VU	Yes	Known to Occur.	Loss/modification of small areas of potential habitat.
Chuditch	<i>Dasyurus geoffroii</i>	S3, VU	No	Unlikely.	No impact.
South-western Brush-tailed Phascogale	<i>Phascogale tapoatafa wambenger</i>	S6	Yes	Possible.	Loss/modification of small areas of generally degraded habitat.
Southern Brown Bandicoot	<i>Isodon obesulus fusciventer</i>	P4	No/Marginal	Unlikely	No Impact.

Common Name	Genus & Species	Conservation Status (See Appendix A for codes)	Habitat Present	Likelihood of Occurrence	Possible Impacts
Western Ringtail Possum	<i>Pseudocheirus occidentalis</i>	S1, VU	No	Would Not Occur - species locally extinct.	No Impact.
Western Brush Wallaby	<i>Macropus irma</i>	P4	No/Marginal	Unlikely	No Impact.
Woylie	<i>Bettongia penicillata ogiby</i>	S2, EN	No	Would Not Occur - species locally extinct.	No Impact.
Western False Pipistrelle	<i>Falsistrellus mackenziei</i>	P4	Yes/Marginal	Unlikely - species locally extinct.	No Impact.
Water Rat	<i>Hydromys chrysogaster</i>	P4	No	Unlikely.	No impact.

8.2 CONSIDERATIONS FOR PLANNING AND DEVELOPMENT

The fauna assessment results indicate that the primary considerations required during ongoing development planning should be focussed on the identified presence of habitat used or potentially used by some threatened fauna species in particular those listed under the *EPBC Act*, namely the three species of black cockatoo.

The assessment identified the presence of black cockatoo breeding, foraging and possible roosting habitat within the subject site. Commonwealth referral guidelines for black cockatoos, published by the DotEE (SEWPaC 2012), indicate that clearing of any actual or potential breeding habitat trees, over 1 ha of foraging habitat or any roost trees would be considered as having a high risk of “significant impact” on one or more of the black cockatoo species and therefore potentially in breach of the *EPBC Act*.

This fact will need to be taken into consideration during the course of ongoing planning and once progressed to a point where areas to be impacted on are defined, the actual need to refer the proposal to the DotEE, can then be reviewed.

9. CONCLUSION

The fauna assessment within the subject site was undertaken for the purposes of categorising the fauna assemblages and identifying fauna habitats present. A targeted assessment of black cockatoo habitat within the area was also carried out.

With respect to native vertebrate fauna, 11 mammal (including eight bat species), 82 bird, 28 reptile and two frog species have previously been recorded in the general area, some of which have the potential to occur in or utilise sections of the subject site at times, a conclusion largely based on the presence of apparently suitable habitat.

Two vertebrate fauna species of conservation significance were positively identified as utilising the subject site for some purpose during the survey period, these being Carnaby’s

black-cockatoo (Endangered) and the forest red-tailed black cockatoo (Vulnerable). An additional five species of conservation significance may also utilise the subject site, though, as no evidence of these species presence was identified during the field survey, the status of some in the area remains uncertain. These are the Perth lined lorista (Priority 3), Baudin's black cockatoo (Endangered), the peregrine falcon (S7), the rainbow bee-eater (Migratory) and the south-western brush-tailed phascogale (S6).

The primary fauna related issue identified during the assessment which will require consideration during ongoing planning and development of the subject site relates to the presence of black cockatoo habitat. Future planning for the proposed development should aim to minimise the loss of this vegetation as much as reasonable and practicable to reduce potential impacts so as to simplify the approval process.

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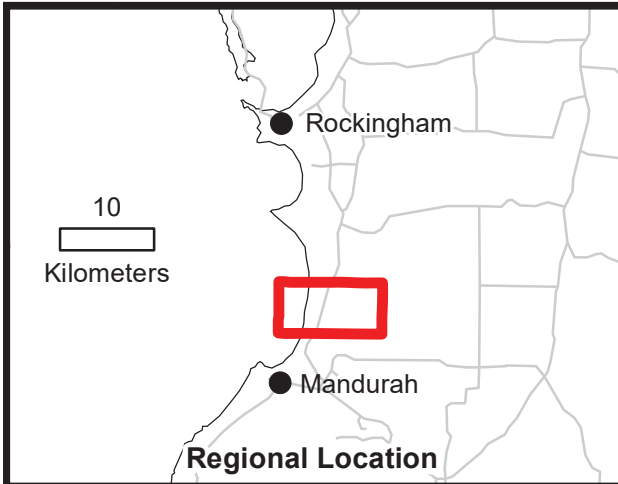
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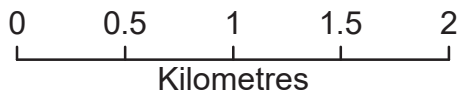
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FIGURES



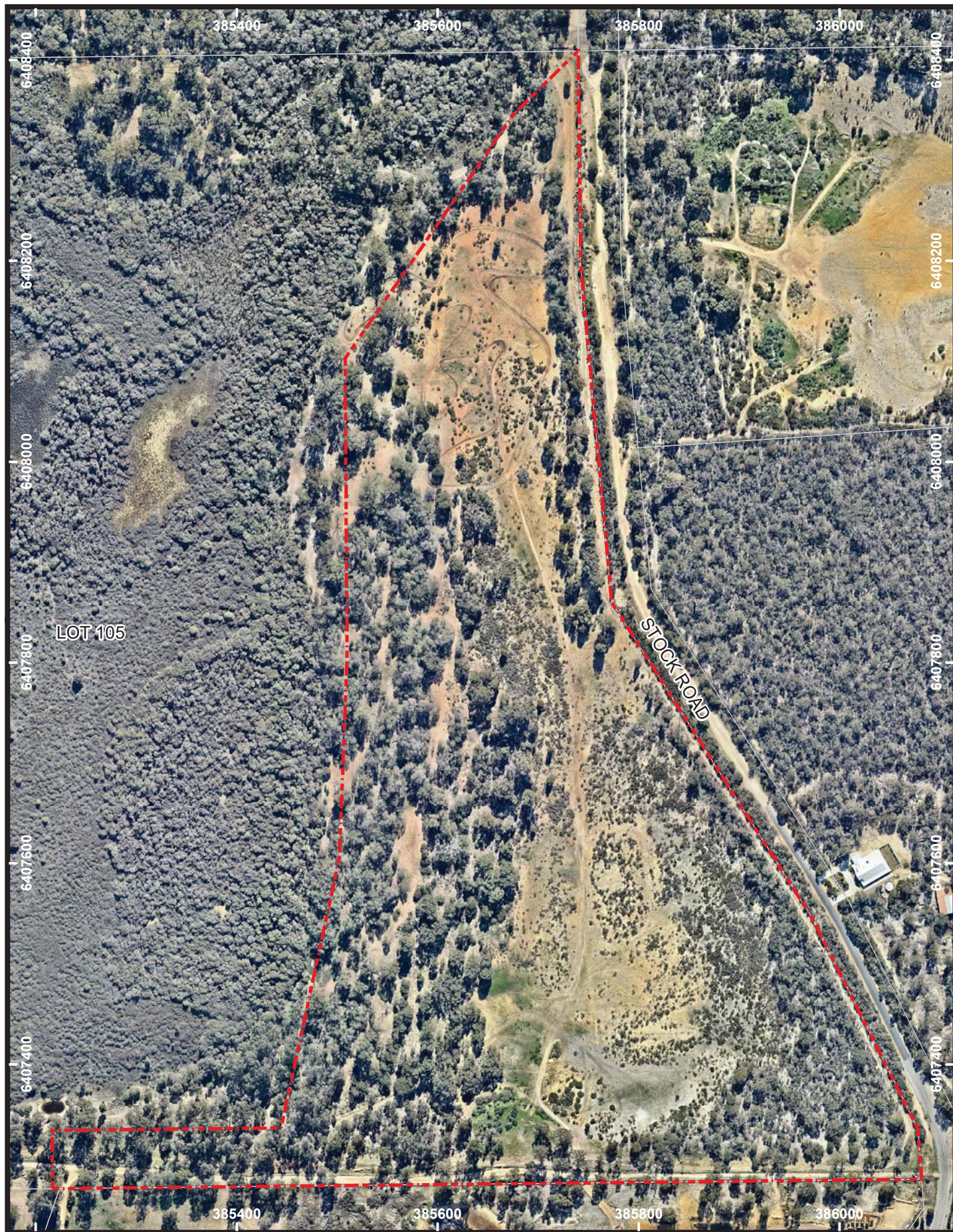
Legend

 Subject Site



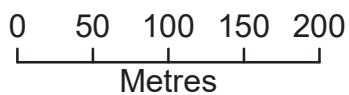
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Date: March 2017
Scale: 1:35,000

**Lot 105 Stock Road
Lakelands
Subject Site
and
Surrounds**



Legend

 Subject Site



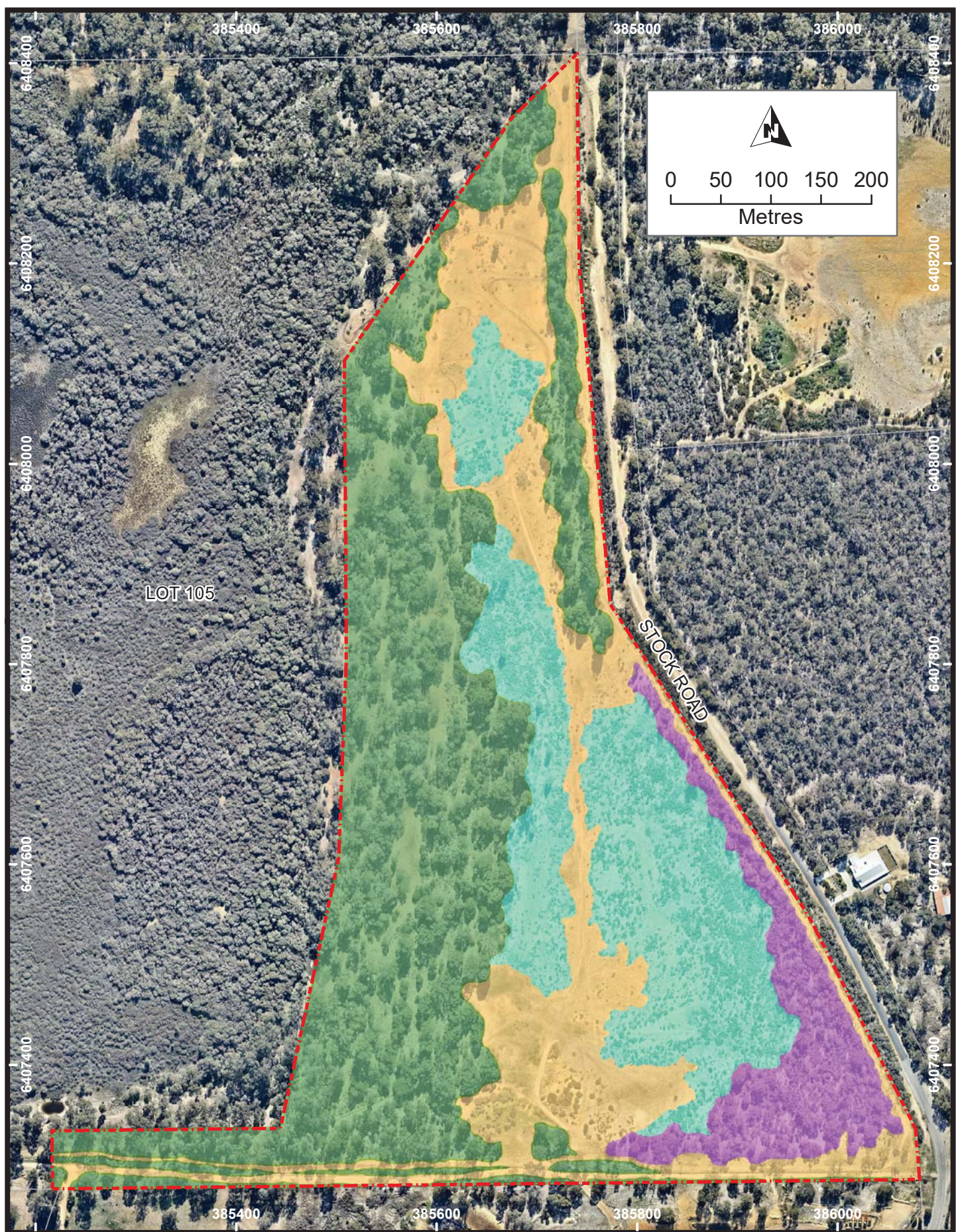
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Date: March 2017
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**Lot 105 Stock Road
Lakelands**


**Subject Site
Air Photo**





Projection/Coordinate System: UTM/MGA Zone 50

Figure: 2



Legend

 Subject Site

-  Open Shrubland/Shrubland over Weeds
-  Woodland of Tuart, Marri & Jarrah over Sparse Shrubland
-  Open Woodland of Jarrah over Low Open Woodland of Banksia
-  Non-native vegetation



Drawn: G Harewood
Date: April 2017
Scale: 1:5,000

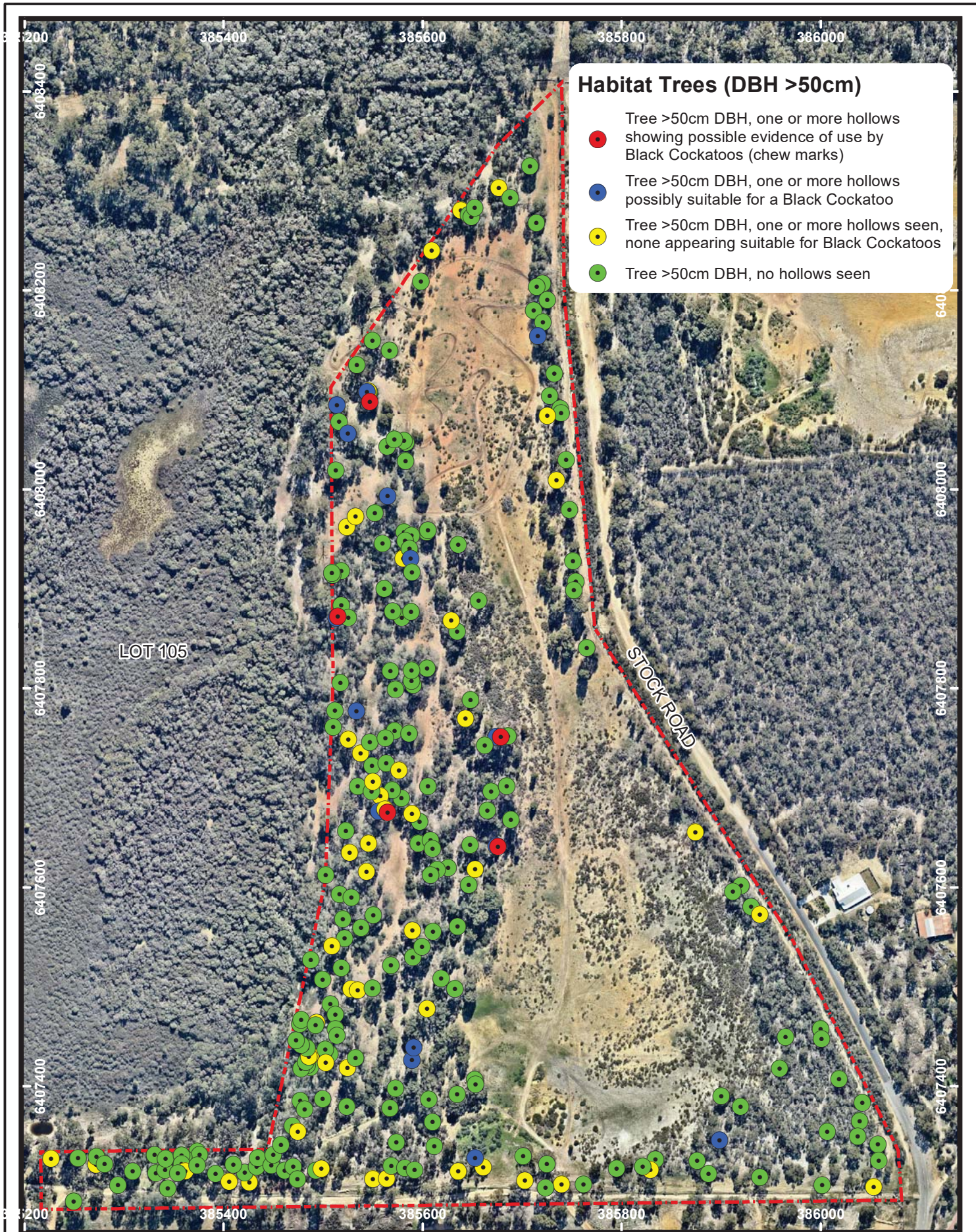
**Lot 105 Stock Road
Lakelands**

**Plant
Communities**

(Courtesy Emerge Associates)

Projection/Coordinate System: UTM/MGA Zone 50

Figure: 3

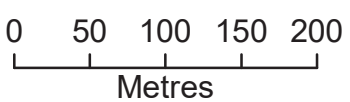


Habitat Trees (DBH >50cm)

- Tree >50cm DBH, one or more hollows showing possible evidence of use by Black Cockatoos (chew marks)
- Tree >50cm DBH, one or more hollows possibly suitable for a Black Cockatoo
- Tree >50cm DBH, one or more hollows seen, none appearing suitable for Black Cockatoos
- Tree >50cm DBH, no hollows seen

Legend

 Subject Site



Drawn: G Harewood
Date: March 2017
Scale: 1:5,000

Lot 105 Stock Road
Lakelands

**Habitat Trees
(DBH >50cm)**

APPENDIX A

CONSERVATION CATEGORIES

EPBC Act (1999) Threatened Fauna Categories

Threatened fauna may be listed under Section 178 of the *Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)* in any one of the following categories:

Category	Code	Description
Extinct	E	There is no reasonable doubt that the last member of the species has died.
*Extinct in the wild	EW	A species (a) is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; or (b) 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 species is facing an extremely high risk of extinction in the wild in the immediate future.
*Endangered	EN	A species: (a) is not critically endangered; and (b) is facing a very high risk of extinction in the wild in the near future.
*Vulnerable	VU	A species (a) is not critically endangered or endangered; and (b) is facing a high risk of extinction in the wild in the medium-term future.
Conservation Dependent	CD	A species is the focus of a specific conservation program the cessation of which would result in the species becoming vulnerable, endangered or critically endangered
*Migratory	Migratory	(a) all migratory species that are: (i) native species; and (ii) from time to time included in the appendices to the Bonn Convention; and (b) all migratory species from time to time included in annexes established under JAMBA, CAMBA and ROKAMBA; and (c) all native species from time to time identified in a list established under, or an instrument made under, an international agreement approved by the Minister.
Marine	Ma	Species in the list established under s248 of the <i>EPBC Act</i>

Note: Only species in those categories marked with an asterisk are matters of national environmental significance (NES) under the *EPBC Act*.

Wildlife Conservation (Specially Protected Fauna) Notice 2015 Categories

Published as Specially Protected under the *Wildlife Conservation Act 1950*, and listed under Schedules 1 to 7 of the Wildlife Conservation (Specially Protected Fauna) Notice.

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

Category	Code	Description
Schedule 1 Critically Endangered species	CR	Threatened species considered to be facing an extremely high risk of extinction in the wild.
Schedule 2 Endangered species	EN	Threatened species considered to be facing a very high risk of extinction in the wild.
Schedule 3 Vulnerable species	VU	Threatened species considered to be facing a high risk of extinction in the wild.
Schedule 4 Presumed extinct species	EX	Species which have been adequately searched for and there is no reasonable doubt that the last individual has died.
Schedule 5 Migratory birds protected under an international agreement	IA	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 the Bonn Convention, relating to the protection of migratory birds.
Schedule 6 Fauna that is of special conservation need as conservation dependent fauna	CD	Fauna of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as threatened.
Schedule 7 Other specially protected fauna.	OS	Fauna otherwise in need of special protection to ensure their conservation.

Western Australian DPaW Priority Fauna Categories

Possibly threatened species that do not meet survey criteria, or are otherwise data deficient, are added to the Priority Fauna 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 flora or fauna.

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

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

Category	Code	Description
Priority 1 Poorly Known Species.	P1	Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.
Priority 2 Poorly Known Species.	P2	Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.
Priority 3 Poorly Known Species.	P3	Species that are known from several locations and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.
Priority 4 Rare, Near Threatened and other species in need of monitoring.	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 do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable.</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>

*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).

IUCN Red List Threatened Species Categories

The *IUCN Red List of Threatened Species*[™] is a checklist of taxa that have undergone an extinction risk assessment using the *IUCN Red List Categories and Criteria*.

Categories are summarized below.

Category	Code	Description
Extinct	EX	Taxa for which there is no reasonable doubt that the last individual has died.
Extinct in the Wild	EW	Taxa which is known only to survive in cultivation, in captivity or and as a naturalised population well outside its past range and it has not been recorded in known or expected habitat despite exhaustive survey over a time frame appropriate to its life cycle and form.
Critically Endangered	CR	Taxa facing an extremely high risk of extinction in the wild.
Endangered	EN	Taxa facing a very high risk of extinction in the wild.
Vulnerable	VU	Taxa facing a high risk of extinction in the wild.
Near Threatened	NT	Taxa which has been evaluated but does not qualify for CR, EN or VU now but is close to qualifying or likely to qualify in the near future.
Least Concern	LC	Taxa which has been evaluated but does not qualify for CR, EN, VU, or NT but is likely to qualify for NT in the near future.
Data Deficient	DD	Taxa for which there is inadequate information to make a direct or indirect assessment of its risk of extinction based on its distribution and/or population status.
Not Evaluated	NE	Taxa which has not been evaluated.

A full list of categories and their meanings are available at:

<http://www.iucnredlist.org/technical-documents/categories-and-criteria/2001-categories-criteria>

APPENDIX B

FAUNA OBSERVED OR POTENTIALLY PRESENT WITHIN SUBJECT SITE

Fauna Observed or Potentially Present Within Subject Site

Lot 105 Stock Road Lakelands, W.A.

Compiled by Greg Harewood - March 2016
 Approximate centroid = 32.4622°S and 115.78385°E
 Recorded (Sighted/Heard/Signs/Captured) = X

- A: Harewood, G. (2017). Fauna Assessment of Lot 105, Stock Road, Lakelands. Unpublished report for Emerge Associates.
 B: Harewood, G. (2011). Fauna Assessment, Lots 3, 805, 806 and 807 Mandurah Road, Karnup. Unpublished report for Emerge Associates.
 C: Harewood, G. (2009). Fauna Survey (Level 2) East Rockingham WWTP Site and Pipeline Corridors. Unpublished report for ERM.
 D: Harewood, G. (2008). Fauna Survey (Level 1) Lot 5001 Fremantle Road Mandurah. Unpublished report for ERM.
 E: ENV Australia (2010). Cape Peron Fauna Assessment. Unpublished report for Strategen.
 F: How, et al. (1996). Ground Fauna of Urban Bushland Remnants in Perth. Report N93/04 to the Australian Heritage Commission (Woodman Point Results).
 G: DPaW (2017). NatureMap Database search. "By Circle"1115° 47' 02" E, 32° 27' 44" S – Study area (plus 5km buffer), 30/03/2017.

Class Family Species	Common Name	Conservation Status	A	B	C	D	E	F	G
Amphibia									
Myobatrachidae Ground or Burrowing Frogs									
<i>Heleioporus eyrei</i>	Moaning Frog	LC					X		X
<i>Limnodynastes dorsalis</i>	Western Banjo Frog	LC					X	X	X
Reptilia									
Diplodactylidae Geckoes									
<i>Strophurus spinigerus</i>	Soft Spiny-tailed Gecko				X		X		X
Gekkonidae Geckoes									
<i>Christinus marmoratus</i>	Marbled Gecko				X		X		X

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Class Family Species	Common Name	Conservation Status	A	B	C	D	E	F	G
Pygopodidae Legless Lizards									
<i>Aprasia repens</i>	Sandplain Worm Lizard						X	X	X
<i>Delma fraseri</i>	Fraser's Legless Lizard				X				X
<i>Delma grayii</i>	Side-barred Delma						X		
<i>Lialis burtonis</i>	Burton's Legless Lizard				X		X	X	X
Agamidae Dragon Lizards									
<i>Pogona minor</i>	Western Bearded Dragon		X		X	X	X		X
Varanidae Monitor's or Goanna's									
<i>Varanus gouldii</i>	Gould's Sand Monitor								X
<i>Varanus rosenbergi</i>	Heath Monitor								X
<i>Varanus tristis</i>	Racehorse Monitor				X			X	X

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Class Family Species	Common Name	Conservation Status	A	B	C	D	E	F	G
Scincidae									
Skinks									
<i>Acritoscincus trilineatum</i>	Southwestern Cool Skink						X		
<i>Cryptoblepharus buchananii</i>	Fence Skink		X	X	X		X	X	X
<i>Ctenotus australis</i>	Western Ctenotus				X				X
<i>Ctenotus fallens</i>	West Coast Ctenotus				X		X	X	X
<i>Ctenotus impar</i>	Odd-striped Ctenotus								
<i>Egernia kingii</i>	King's Skink								X
<i>Egernia napoleonis</i>	Salmon-bellied Skink								X
<i>Hemiergis quadrilineata</i>	Two-toed Mulch Skink				X		X	X	X
<i>Lerista elegans</i>	West Coast Four-toed Lerista				X		X		X
<i>Lerista lineata</i>	Perth Lined Lerista	P3					X	X	X
<i>Menetia greyii</i>	Dwarf Skink				X		X	X	X
<i>Morethia lineocellata</i>	West Coast Pale-flecked Morethia				X		X		X
<i>Morethia obscura</i>	Shrubland Pale-flecked Morethia				X				
<i>Tiliqua rugosa</i>	Bobtail		X		X	X	X	X	X

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Class Family Species	Common Name	Conservation Status	A	B	C	D	E	F	G
Typhlopidae Blind Snakes									
<i>Ramphotyphlops australis</i>	Southern Blind Snake						X		
Elapidae Elapid Snakes									
<i>Notechis scutatus</i>	Tiger Snake								X
<i>Pseudonaja affinis</i>	Dugite				X	X	X		X
<i>Simoselaps bertholdi</i>	Jan's Banded Snake								X
Aves									
Phasianidae Quails, Pheasants									
<i>Coturnix pectoralis</i>	Stubble Quail	LC							X
Anatidae Geese, Swans, Ducks									
<i>Anas superciliosa</i>	Pacific Black Duck	LC					X		X
<i>Chenonetta jubata</i>	Australian Wood Duck	LC	X						X
<i>Tadorna tadornoides</i>	Australian Shelduck	LC							X

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Class Family Species	Common Name	Conservation Status	A	B	C	D	E	F	G
Accipitridae									
Kites, Goshawks, Eagles, Harriers									
<i>Accipiter cirrocephalus</i>	Collared Sparrowhawk	Bp LC			X				X
<i>Accipiter fasciatus</i>	Brown Goshawk	Bp LC			X	X		X	X
<i>Aquila audax</i>	Wedge-tailed Eagle	Bp LC							X
<i>Aquila morphnoides</i>	Little Eagle	Bp LC			X			X	X
<i>Circus approximans</i>	Swamp Harrier	LC					X		X
<i>Circus assimilis</i>	Spotted Harrier	LC							X
<i>Elanus caeruleus</i>	Black-shouldered Kite	LC		X	X		X		X
<i>Haliastur sphenurus</i>	Whistling Kite	Bp LC	X		X		X		X
<i>Hamirostra isura</i>	Square-tailed Kite	Bp LC							

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Class Family Species	Common Name	Conservation Status	A	B	C	D	E	F	G
Falconidae									
Falcon									
<i>Falco berigora</i>	Brown Falcon	Bp LC							X
<i>Falco cenchroides</i>	Australian Kestrel	LC	X		X	X	X		X
<i>Falco longipennis</i>	Australian Hobby	LC			X		X		X
<i>Falco peregrinus</i>	Peregrine Falcon	S7 Bp LC		X	X				X
Turnicidae									
Button-quails									
<i>Turnix varia</i>	Painted Button-quail	Bp LC							
Columbidae									
Pigeons, Doves									
<i>Columba livia</i>	Domestic Pigeon	Introduced				X	X		X
<i>Ocyphaps lophotes</i>	Crested Pigeon	LC	X						X
<i>Phaps chalcoptera</i>	Common Bronzewing	Bh LC	X	X	X	X		X	X
<i>Streptopelia senegalensis</i>	Laughing Turtle-Dove	Introduced			X	X	X		X

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Class Family Species	Common Name	Conservation Status	A	B	C	D	E	F	G
Psittacidae									
Parrots									
<i>Cacatua roseicapilla</i>	Galah	LC	X	X	X	X	X	X	X
<i>Cacatua sanguinea</i>	Little Corella	LC	X			X			X
<i>Cacatua tenuirostris</i>	Eastern Long-billed Corella	Introduced					X		X
<i>Calyptorhynchus banksii naso</i>	Forest Red-tailed Black-Cockatoo	S3 VU Be VU VU A2c+3c+	X						
<i>Calyptorhynchus baudinii</i>	Baudin's Black-Cockatoo	S2 EN Bp VU C2a(ii)							X
<i>Calyptorhynchus latirostris</i>	Carnaby's Black-Cockatoo	S2 EN Bp EN A2bcde+3bc	X	X	X	X			X
<i>Glossopsitta porphyrocephala</i>	Purple-crowned Lorikeet	LC							
<i>Neophema elegans</i>	Elegant Parrot	LC							X
<i>Platycercus icterotis icterotis</i>	Western Rosella (western ssp)	Bp LC					X		
<i>Platycercus spurius</i>	Red-capped Parrot	LC	X	X	X	X		X	X
<i>Platycercus zonarius</i>	Australian Ringneck Parrot	LC	X	X	X	X	X	X	X
<i>Polytelis anthopeplus</i>	Regent Parrot	LC	X			X			X
<i>Trichoglossus haematodus</i>	Rainbow Lorikeet	Introduced							X

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Class Family Species	Common Name	Conservation Status	A	B	C	D	E	F	G
Cuculidae Parasitic Cuckoos									
<i>Cacomantis flabelliformis</i>	Fan-tailed Cuckoo	LC						X	X
<i>Chrysococcyx basalis</i>	Horsfield's Bronze Cuckoo	LC			X			X	
<i>Chrysococcyx lucidus</i>	Shining Bronze Cuckoo	LC						X	
<i>Cuculus pallidus</i>	Pallid Cuckoo	LC							
Strigidae Hawk Owls									
<i>Ninox novaeseelandiae</i>	Boobook Owl	LC	X						X
Tytonidae Barn Owls									
<i>Tyto alba</i>	Barn Owl	LC			X				X
Podargidae Frogmouths									
<i>Podargus strigoides</i>	Tawny Frogmouth	LC							X
Caprimulgidae Nightjars									
<i>Eurostopodus argus</i>	Spotted Nightjar	LC							

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Class Family Species	Common Name	Conservation Status	A	B	C	D	E	F	G
Aegothelidae Owlet-nightjars									
<i>Aegotheles cristatus</i>	Australian Owlet-nightjar	LC							
Halcyonidae Tree Kingfishers									
<i>Dacelo novaeguineae</i>	Laughing Kookaburra	Introduced	X		X	X	X	X	X
<i>Todiramphus sanctus</i>	Sacred Kingfisher	LC						X	X
Meropidae Bee-eaters									
<i>Merops ornatus</i>	Rainbow Bee-eater	S5 Mig JA LC			X		X	X	X
Maluridae Fairy Wrens, GrassWrens									
<i>Malurus splendens</i>	Splendid Fairy-wren	Bh LC		X	X	X	X	X	X

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Class Family Species	Common Name	Conservation Status	A	B	C	D	E	F	G
Acanthizidae									
Thornbills, Geryones, Fieldwrens & Whitefaces									
<i>Acanthiza apicalis</i>	Broad-tailed Thornbill	Bh LC	X	X	X		X	X	X
<i>Acanthiza chrysorrhoa</i>	Yellow-rumped Thornbill	Bh LC	X					X	X
<i>Acanthiza inornata</i>	Western Thornbill	Bh LC			X		X		X
<i>Gerygone fusca</i>	Western Gerygone	LC	X		X	X	X	X	X
<i>Sericornis frontalis</i>	White-browed Scrubwren	Bh LC		X	X	X	X	X	X
<i>Smicrornis brevirostris</i>	Weebill	Bh LC	X	X	X	X	X	X	X
Pardalotidae									
Pardalotes									
<i>Pardalotus punctatus</i>	Spotted Pardalote	LC							X
<i>Pardalotus striatus</i>	Striated Pardalote	LC	X		X	X	X	X	X

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Class Family Species	Common Name	Conservation Status	A	B	C	D	E	F	G
Meliphagidae									
Honeyeaters, Chats									
<i>Acanthorhynchus superciliosus</i>	Western Spinebill	LC							X
<i>Anthochaera carunculata</i>	Red Wattlebird	LC	X		X	X	X	X	X
<i>Anthochaera lunulata</i>	Western Little Wattlebird	Bp LC							X
<i>Epthianura albifrons</i>	White-fronted Chat	LC							X
<i>Lichenostomus virescens</i>	Singing Honeyeater	LC	X		X	X	X	X	
<i>Lichmera indistincta</i>	Brown Honeyeater	LC			X	X	X	X	X
<i>Phylidonyris nigra</i>	White-cheeked Honeyeater	Bp LC					X		X
<i>Phylidonyris novaehollandiae</i>	New Holland Honeyeater	Bp LC			X	X	X		X
Petroicidae									
Australian Robins									
<i>Petroica multicolor</i>	Scarlet Robin	Bh LC		X	X				
Neosittidae									
Sitellas									
<i>Daphoenositta chrysoptera</i>	Varied Sittella	Bh LC			X				X

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Class Family Species	Common Name	Conservation Status	A	B	C	D	E	F	G
Pachycephalidae									
Crested Shrike-tit, Crested Bellbird, Shrike Thrushes, Whistlers									
<i>Colluricincla harmonica</i>	Grey Shrike-thrush	Bh LC			X			X	X
<i>Pachycephala pectoralis</i>	Golden Whistler	Bh LC	X					X	X
<i>Pachycephala rufiventris</i>	Rufous Whistler	LC	X	X	X	X	X	X	X
Dicruridae									
Monarchs, Magpie Lark, Flycatchers, Fantails, Drongo									
<i>Grallina cyanoleuca</i>	Magpie-lark	LC			X	X	X	X	X
<i>Rhipidura fuliginosa</i>	Grey Fantail	LC	X	X	X	X	X	X	X
<i>Rhipidura leucophrys</i>	Willie Wagtail	LC	X		X		X	X	X
Campephagidae									
Cuckoo-shrikes, Trillers									
<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike	LC	X	X	X			X	X
<i>Lalage tricolor</i>	White-winged Triller	LC							
Artamidae									
Woodswallows, Butcherbirds, Currawongs									
<i>Artamus cinereus</i>	Black-faced Woodswallow	Bp LC					X		X
<i>Artamus cyanopterus</i>	Dusky Woodswallow	Bp LC							X

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Class Family Species	Common Name	Conservation Status	A	B	C	D	E	F	G
Cracticidae									
Currawongs, Magpies & Butcherbirds									
<i>Cracticus tibicen</i>	Australian Magpie	LC	X	X	X	X	X	X	X
<i>Cracticus torquatus</i>	Grey Butcherbird	LC	X	X	X	X	X	X	X
<i>Strepera versicolor</i>	Grey Currawong	Bp LC		X					X
Corvidae									
Ravens, Crows									
<i>Corvus coronoides</i>	Australian Raven	LC	X	X	X	X	X	X	X
Motacillidae									
Old World Pipits, Wagtails									
<i>Anthus australis</i>	Australian Pipit	LC			X				X
Dicaeidae									
Flowerpeckers									
<i>Dicaeum hirundinaceum</i>	Mistletoebird	LC							X
Hirundinidae									
Swallows, Martins									
<i>Hirundo neoxena</i>	Welcome Swallow	LC	X		X		X	X	X
<i>Hirundo nigricans</i>	Tree Martin	LC	X		X			X	X

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Class Family Species	Common Name	Conservation Status	A	B	C	D	E	F	G
Sylviidae Old World Warblers									
<i>Cincloramphus cruralis</i>	Brown Songlark	LC							X
<i>Cincloramphus mathewsi</i>	Rufous Songlark	LC							
Zosteropidae White-eyes									
<i>Zosterops lateralis</i>	Silvereeye	LC	X		X	X	X	X	X
Mammalia									
Dasyuridae Carnivorous Marsupials									
<i>Phascogale tapoatafa wambenger</i>	South-western Brush-tailed Phascogale	EN NT							
Phalangeridae Brush-tail Possums, Cuscuses									
<i>Trichosurus vulpecula</i>	Common Brushtail Possum	LC	X						X
Macropodidae Kangaroos, Wallabies									
<i>Macropus fuliginosus</i>	Western Grey Kangaroo	LC	X	X	X				X

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Class Family Species	Common Name	Conservation Status	A	B	C	D	E	F	G
Molossidae									
Freetail Bats									
<i>Austronomus australis</i>	White-striped Freetail-bat	LC					X		X
<i>Ozimops kitcheneri</i>	Southern Freetail-bat	LC			X				
Vespertilionidae									
Ordinary Bats									
<i>Chalinolobus gouldii</i>	Gould's Wattled Bat	LC			X		X		X
<i>Chalinolobus morio</i>	Chocolate Wattled Bat	LC							
<i>Nyctophilus geoffroyi</i>	Lesser Long-eared Bat	LC							
<i>Nyctophilus gouldi</i>	Gould's Long-eared Bat	LC							
<i>Nyctophilus major</i>	Western Long-eared Bat	LC			X				
<i>Vespadelus regulus</i>	Southern Forest Bat	LC			X				
Muridae									
Rats, Mice									
<i>Mus musculus</i>	House Mouse	Introduced		X	X		X	X	X
<i>Rattus rattus</i>	Black Rat	Introduced		X	X			X	X

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Class Family Species	Common Name	Conservation Status	A	B	C	D	E	F	G
Canidae Dogs, Foxes									
<i>Canis lupus familiaris</i>	Dog	Introduced			X	X			
<i>Vulpes vulpes</i>	Red Fox	Introduced	X		X		X	X	X
Felidae Cats									
<i>Felis catus</i>	Cat	Introduced		X	X			X	X
Leporidae Rabbits, Hares									
<i>Oryctolagus cuniculus</i>	Rabbit	Introduced	X	X	X	X	X	X	X

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APPENDIX C

DPaW & EPBC DATABASE SEARCH RESULTS

NatureMap - Lakelands

Created By Greg Harewood on 30/03/2017

Kingdom Animalia
Current Names Only Yes
Core Datasets Only Yes
Method 'By Circle'
Centre 115° 47' 02" E, 32° 27' 44" S
Buffer 5km
Group By Species Group

Species Group	Species	Records
Amphibian	6	79
Bird	102	919
Fish	6	8
Invertebrate	5	28
Mammal	13	718
Reptile	32	691
TOTAL	164	2443

Name ID	Species Name	Naturalised	Conservation Code	Endemic To Query Area
Amphibian				
1.	25399 <i>Crinia glauerti</i> (Clicking Frog)			
2.	25400 <i>Crinia insignifera</i> (Squelching Froglet)			
3.	25410 <i>Heleioporus eyrei</i> (Moaning Frog)			
4.	25412 <i>Heleioporus psammophilus</i> (Sand Frog)			
5.	25378 <i>Litoria adelaidensis</i> (Slender Tree Frog)			
6.	25388 <i>Litoria moorei</i> (Motorbike Frog)			
Bird				
7.	24260 <i>Acanthiza apicalis</i> (Broad-tailed Thornbill, Inland Thornbill)			
8.	24261 <i>Acanthiza chrysorrhoa</i> (Yellow-rumped Thornbill)			
9.	24262 <i>Acanthiza inornata</i> (Western Thornbill)			
10.	24560 <i>Acanthorhynchus superciliosus</i> (Western Spinebill)			
11.	24312 <i>Anas gracilis</i> (Grey Teal)			
12.	24316 <i>Anas superciliosa</i> (Pacific Black Duck)			
13.	47414 <i>Anhinga novaehollandiae</i> (Australasian Darter)			
14.	24561 <i>Anthochaera carunculata</i> (Red Wattlebird)			
15.	24562 <i>Anthochaera lunulata</i> (Western Little Wattlebird)			
16.	41324 <i>Ardea modesta</i> (Eastern Great Egret)		IA	
17.	<i>Barnardius zonarius</i>			
18.	24319 <i>Biziura lobata</i> (Musk Duck)			
19.	25714 <i>Cacatua pastinator</i> (Western Long-billed Corella)			
20.	25715 <i>Cacatua roseicapilla</i> (Galah)			
21.	25716 <i>Cacatua sanguinea</i> (Little Corella)			
22.	25598 <i>Cacomantis flabelliformis</i> (Fan-tailed Cuckoo)			
23.	25717 <i>Calyptorhynchus banksii</i> (Red-tailed Black-Cockatoo)			
24.	24731 <i>Calyptorhynchus banksii</i> subsp. <i>naso</i> (Forest Red-tailed Black-Cockatoo)		T	
25.	24734 <i>Calyptorhynchus latirostris</i> (Carnaby's Cockatoo (short-billed black-cockatoo), Carnaby's Cockatoo)		T	
26.	<i>Calyptorhynchus latirostris?</i>			Y
27.	24321 <i>Chenonetta jubata</i> (Australian Wood Duck, Wood Duck)			
28.	<i>Chroicocephalus novaehollandiae</i>			
29.	24288 <i>Circus approximans</i> (Swamp Harrier)			
30.	25675 <i>Colluricincla harmonica</i> (Grey Shrike-thrush)			
31.	24399 <i>Columba livia</i> (Domestic Pigeon)	Y		
32.	25568 <i>Coracina novaehollandiae</i> (Black-faced Cuckoo-shrike)			
33.	25592 <i>Corvus coronoides</i> (Australian Raven)			
34.	24671 <i>Coturnix pectoralis</i> (Stubble Quail)			
35.	25595 <i>Cracticus tibicen</i> (Australian Magpie)			
36.	25596 <i>Cracticus torquatus</i> (Grey Butcherbird)			
37.	24322 <i>Cygnus atratus</i> (Black Swan)			
38.	30901 <i>Dacelo novaeguineae</i> (Laughing Kookaburra)			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
		Y		
39.	25673 <i>Daphoenositta chrysoptera</i> (Varied Sittella)			
40.	25607 <i>Dicaeum hirundinaceum</i> (Mistletoebird)			
41.	24470 <i>Dromaius novaehollandiae</i> (Emu)			
42.	<i>Egretta garzetta</i>			
43.	<i>Egretta novaehollandiae</i>			
44.	<i>Elanus axillaris</i>			
45.	24290 <i>Elanus caeruleus</i> subsp. <i>axillaris</i> (Australian Black-shouldered Kite)			
46.	47937 <i>Elseoyornis melanops</i> (Black-fronted Dotterel)			
47.	<i>Eolophus roseicapillus</i>			
48.	24379 <i>Erythronyctes cinctus</i> (Red-kneed Dotterel)			
49.	25623 <i>Falco longipennis</i> (Australian Hobby)			
50.	25624 <i>Falco peregrinus</i> (Peregrine Falcon)		S	
51.	25727 <i>Fulica atra</i> (Eurasian Coot)			
52.	25729 <i>Gallinula tenebrosa</i> (Dusky Moorhen)			
53.	25530 <i>Gerygone fusca</i> (Western Gerygone)			
54.	24443 <i>Grallina cyanoleuca</i> (Magpie-lark)			
55.	24295 <i>Haliastur sphenurus</i> (Whistling Kite)			
56.	47965 <i>Hieraaetus morphnoides</i> (Little Eagle)			
57.	24491 <i>Hirundo neoxena</i> (Welcome Swallow)			
58.	25637 <i>Larus novaehollandiae</i> (Silver Gull)			
59.	25661 <i>Lichmera indistincta</i> (Brown Honeyeater)			
60.	<i>Lophoictinia isura</i>			
61.	24690 <i>Macronectes giganteus</i> (Southern Giant Petrel)		IA	
62.	24326 <i>Malacorhynchus membranaceus</i> (Pink-eared Duck)			
63.	25654 <i>Malurus splendens</i> (Splendid Fairy-wren)			
64.	24598 <i>Merops ornatus</i> (Rainbow Bee-eater)		IA	
65.	<i>Microcarbo melanoleucos</i>			
66.	25693 <i>Microeca fascians</i> (Jacky Winter)			
67.	48008 <i>Morus serrator</i> (Australasian Gannet)			
68.	24738 <i>Neophema elegans</i> (Elegant Parrot)			
69.	24407 <i>Ocyphaps lophotes</i> (Crested Pigeon)			
70.	25680 <i>Pachycephala rufiventris</i> (Rufous Whistler)			
71.	<i>Pandion cristatus</i>			
72.	25681 <i>Pardalotus punctatus</i> (Spotted Pardalote)			
73.	25682 <i>Pardalotus striatus</i> (Striated Pardalote)			
74.	24648 <i>Pelecanus conspicillatus</i> (Australian Pelican)			
75.	48061 <i>Petrochelidon nigricans</i> (Tree Martin)			
76.	48066 <i>Petroica boodang</i> (Scarlet Robin)			
77.	24667 <i>Phalacrocorax sulcirostris</i> (Little Black Cormorant)			
78.	24409 <i>Phaps chalcoptera</i> (Common Bronzewing)			
79.	48071 <i>Phylidonyris niger</i> (White-cheeked Honeyeater)			
80.	24596 <i>Phylidonyris novaehollandiae</i> (New Holland Honeyeater)			
81.	24841 <i>Platalea flavipes</i> (Yellow-billed Spoonbill)			
82.	24747 <i>Platycercus spurius</i> (Red-capped Parrot)			
83.	25721 <i>Platycercus zonarius</i> (Australian Ringneck, Ring-necked Parrot)			
84.	24750 <i>Platycercus zonarius</i> subsp. <i>semitorquatus</i> (Twenty-eight Parrot)			
85.	25722 <i>Polytelis anthopeplus</i> (Regent Parrot)			
86.	25731 <i>Porphyrio porphyrio</i> (Purple Swamphen)			
87.	24702 <i>Pterodroma brevirostris</i> (Kerguelen Petrel)			
88.	24716 <i>Puffinus pacificus</i> (Wedge-tailed Shearwater)		IA	
89.	<i>Purpureicephalus spurius</i>			
90.	24776 <i>Recurvirostra novaehollandiae</i> (Red-necked Avocet)			
91.	48096 <i>Rhipidura albiscapa</i> (Grey Fantail)			
92.	25614 <i>Rhipidura leucophrys</i> (Willie Wagtail)			
93.	25534 <i>Sericornis frontalis</i> (White-browed Scrubwren)			
94.	24279 <i>Sericornis frontalis</i> subsp. <i>maculatus</i> (White-browed Scrubwren)			
95.	30948 <i>Smicronis brevirostris</i> (Weebill)			
96.	24533 <i>Sterna paradisaea</i> (Arctic Tern)			
97.	25597 <i>Strepera versicolor</i> (Grey Currawong)			
98.	25590 <i>Streptopelia senegalensis</i> (Laughing Turtle-Dove)	Y		
99.	25705 <i>Tachybaptus novaehollandiae</i> (Australasian Grebe, Black-throated Grebe)			
100.	25552 <i>Tadorna radjah</i> (Radjah Shelduck)			
101.	24331 <i>Tadorna tadornoides</i> (Australian Shelduck, Mountain Duck)			
102.	<i>Thalasseus bergii</i>			
103.	24845 <i>Threskiornis spinicollis</i> (Straw-necked Ibis)			
104.	25549 <i>Todiramphus sanctus</i> (Sacred Kingfisher)			
105.	25723 <i>Trichoglossus haematodus</i> (Rainbow Lorikeet)			
106.	24808 <i>Tringa nebularia</i> (Common Greenshank)		IA	
107.	24386 <i>Vanellus tricolor</i> (Banded Lapwing)			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
108.	25765 <i>Zosterops lateralis</i> (Grey-breasted White-eye, Silveryeye)			
Fish				
109.	<i>Crapatalus</i> sp.			Y
110.	<i>Phyllichthys punctatus</i>			
111.	<i>Sphyraena obtusata</i>			
112.	<i>Trygonoptera mucosa</i>			
113.	<i>Trygonoptera personata</i>			
114.	<i>Urolophus lobatus</i>			
Invertebrate				
115.	<i>Aname mainae</i>			
116.	<i>Isopeda leishmanni</i>			
117.	<i>Missulena granulosa</i>			
118.	<i>Missulena hoggi</i>			
119.	33992 <i>Synemon gratiosa</i> (Graceful Sunmoth)		P4	
Mammal				
120.	24186 <i>Chalinolobus gouldii</i> (Gould's Wattle Bat)			
121.	24092 <i>Dasyurus geoffroii</i> (Chuditch, Western Quoll)		T	
122.	24041 <i>Felis catus</i> (Cat)	Y		
123.	24054 <i>Globicephala macrorhynchus</i> (Short-finned Pilot Whale)			
124.	25478 <i>Isoodon obesulus</i> (Southern Brown Bandicoot)		P4	
125.	24153 <i>Isoodon obesulus subsp. fusciventer</i> (Quenda, Southern Brown Bandicoot)		P4	
126.	24132 <i>Macropus fuliginosus</i> (Western Grey Kangaroo)			
127.	24223 <i>Mus musculus</i> (House Mouse)	Y		
128.	24085 <i>Oryctolagus cuniculus</i> (Rabbit)	Y		
129.	24243 <i>Rattus fuscipes</i> (Western Bush Rat)			
130.	24245 <i>Rattus rattus</i> (Black Rat)	Y		
131.	25521 <i>Trichosurus vulpecula</i> (Common Brushtail Possum)			
132.	24158 <i>Trichosurus vulpecula subsp. vulpecula</i> (Common Brushtail Possum)			
Reptile				
133.	24991 <i>Aprasia repens</i> (Sand-plain Worm-lizard)			
134.	25335 <i>Caretta caretta</i> (Loggerhead Turtle)		T	
135.	24980 <i>Christinus marmoratus</i> (Marbled Gecko)			
136.	30893 <i>Cryptoblepharus buchananii</i>			
137.	25027 <i>Ctenotus australis</i>			
138.	25039 <i>Ctenotus fallens</i>			
139.	25766 <i>Delma fraseri</i> (Fraser's Legless Lizard)			
140.	25468 <i>Demansia psammophis</i> (Yellow-faced Whipsnake)			
141.	25296 <i>Demansia psammophis subsp. reticulata</i> (Yellow-faced Whipsnake)			
142.	25096 <i>Egernia kingii</i> (King's Skink)			
143.	25119 <i>Hemiergis quadrilineata</i>			
144.	25133 <i>Lerista elegans</i>			
145.	25147 <i>Lerista lineata</i> (Perth Slider, Lined Skink)		P3	
146.	25005 <i>Lialis burtonis</i>			
147.	25184 <i>Menetia greyii</i>			
148.	25191 <i>Morethia lineocellata</i>			
149.	25249 <i>Neelaps calonotos</i> (Black-striped Snake)		P3	
150.	25252 <i>Notechis scutatus</i> (Tiger Snake)			
151.	25253 <i>Parasuta gouldii</i>			
152.	25510 <i>Pogona minor</i> (Dwarf Bearded Dragon)			
153.	25511 <i>Pseudonaja affinis</i> (Dugite)			
154.	25259 <i>Pseudonaja affinis subsp. affinis</i> (Dugite)			
155.	25264 <i>Pseudonaja nuchalis</i> (Gwardar, Northern Brown Snake)			
156.	25266 <i>Simoselaps bertholdi</i> (Jan's Banded Snake)			
157.	25518 <i>Strophurus spinigerus</i>			
158.	25203 <i>Tiliqua occipitalis</i> (Western Bluetongue)			
159.	25519 <i>Tiliqua rugosa</i>			
160.	25207 <i>Tiliqua rugosa subsp. rugosa</i>			
161.	25218 <i>Varanus gouldii</i> (Bungarra or Sand Monitor)			
162.	25225 <i>Varanus rosenbergi</i> (Heath Monitor)			
163.	25526 <i>Varanus tristis</i> (Racehorse Monitor)			
164.	25227 <i>Varanus tristis subsp. tristis</i> (Racehorse Monitor)			

Conservation Codes
T - Rare or likely to become extinct
X - Presumed extinct
IA - Protected under international agreement
S - Other specially protected fauna
¹ - Priority 1
2 - Priority 2
3 - Priority 3
4 - Priority 4
5 - Priority 5



EPBC Act Protected Matters Report

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

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

Information is available about [Environment Assessments](#) and the EPBC Act including significance guidelines, forms and application process details.

Report created: 30/03/17 14:00:43

[Summary](#)

[Details](#)

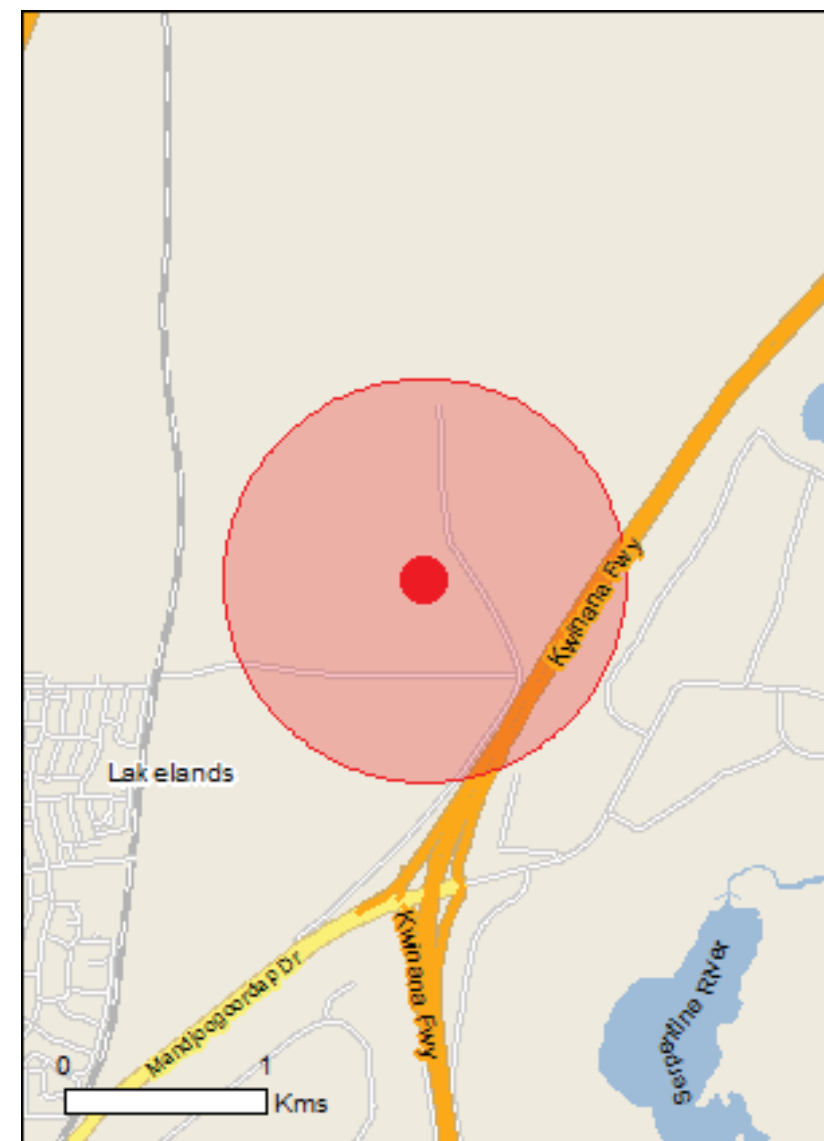
[Matters of NES](#)

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

[Extra Information](#)

[Caveat](#)

[Acknowledgements](#)



This map may contain data which are
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[Coordinates](#)

Buffer: 1.0Km



Summary

Matters of National Environmental Significance

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

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	2
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	1
Listed Threatened Species:	18
Listed Migratory Species:	7

Other Matters Protected by the EPBC Act

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

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

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

Commonwealth Land:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	13
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Commonwealth Reserves Marine:	None

Extra Information

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

State and Territory Reserves:	None
Regional Forest Agreements:	None
Invasive Species:	33
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Wetlands of International Importance (Ramsar)	[Resource Information]
Name	Proximity
Becher point wetlands	Within 10km of Ramsar
Peel-yalgorup system	Within 10km of Ramsar

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

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

Listed Threatened Species	[Resource Information]
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Name	Status	Type of Presence
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Birds

Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat may occur within area
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Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat likely to occur within area
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Calyptorhynchus banksii naso Forest Red-tailed Black-Cockatoo, Karrak [67034]	Vulnerable	Species or species habitat known to occur within area
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Calyptorhynchus baudinii Baudin's Cockatoo, Long-billed Black-Cockatoo [769]	Vulnerable	Species or species habitat likely to occur within area
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Calyptorhynchus latirostris Carnaby's Cockatoo, Short-billed Black-Cockatoo [59523]	Endangered	Species or species habitat known to occur within area
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Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat likely to occur within area
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Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
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Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area
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Mammals

Bettongia penicillata Brush-tailed Bettong, Woylie [213]	Endangered	Species or species habitat may occur within area
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Dasyurus geoffroii Chuditch, Western Quoll [330]	Vulnerable	Species or species
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Name	Status	Type of Presence
Pseudocheirus occidentalis Western Ringtail Possum, Ngwayir, Womp, Woder, Ngoor, Ngoolangit [25911]	Vulnerable	habitat known to occur within area Species or species habitat likely to occur within area
Plants		
Andersonia gracilis Slender Andersonia [14470]	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 may 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-leaved Hammer Orchid, Glossy-leaved 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 likely to occur within area
Lepidosperma rostratum Beaked Lepidosperma [14152]	Endangered	Species or species habitat likely to occur within area
Listed Migratory Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Sterna dougallii Roseate Tern [817]		Foraging, feeding or related behaviour likely to occur within area
Migratory Terrestrial Species		
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Migratory Wetlands Species		
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat likely to 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 likely to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Breeding known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat likely to occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
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 likely to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat may occur within area
Sterna dougallii Roseate Tern [817]		Foraging, feeding or related behaviour likely to occur within area
Thinornis rubricollis Hooded Plover [59510]		Species or species habitat may occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Extra Information

Invasive Species

[[Resource Information](#)]

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

Name	Status	Type of Presence
Birds		
<i>Acridotheres tristis</i> Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
<i>Anas platyrhynchos</i> Mallard [974]		Species or species habitat likely to occur within area
<i>Carduelis carduelis</i> European Goldfinch [403]		Species or species habitat likely to occur within area
<i>Columba livia</i> Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
<i>Passer domesticus</i> House Sparrow [405]		Species or species habitat likely to occur within area
<i>Passer montanus</i> Eurasian Tree Sparrow [406]		Species or species habitat likely to occur within area
<i>Streptopelia chinensis</i> Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
<i>Streptopelia senegalensis</i> Laughing Turtle-dove, Laughing Dove [781]		Species or species habitat likely to occur within area
<i>Sturnus vulgaris</i> Common Starling [389]		Species or species habitat likely to occur within area
<i>Turdus merula</i> Common Blackbird, Eurasian Blackbird [596]		Species or species habitat likely to occur within area
Mammals		
<i>Bos taurus</i> Domestic Cattle [16]		Species or species habitat likely to occur within area
<i>Canis lupus familiaris</i> Domestic Dog [82654]		Species or species habitat likely to occur within area
<i>Felis catus</i> Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
<i>Funambulus pennantii</i> Northern Palm Squirrel, Five-striped Palm Squirrel [129]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus norvegicus Brown Rat, Norway Rat [83]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Brachiaria mutica Para Grass [5879]		Species or species habitat may occur within area
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species habitat may occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat may occur within area
Chrysanthemoides monilifera subsp. monilifera Boneseed [16905]		Species or species habitat likely to occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat likely to occur within area
Olea europaea Olive, Common Olive [9160]		Species or species habitat may occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Salvinia molesta Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area
Tamarix aphylla Athel Pine, Athel Tree, Tamarisk, Athel Tamarisk, Athel Tamarix, Desert Tamarisk, Flowering		Species or species habitat likely to occur

Name	Status	Type of Presence
Cypress, Salt Cedar [16018]		within area
Reptiles		
Hemidactylus frenatus		
Asian House Gecko [1708]		Species or species habitat likely to occur within area

Caveat

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

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

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

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

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

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

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

- migratory and
- marine

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

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

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

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

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

Coordinates

-32.4622 115.78385

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.

APPENDIX D

BLACK COCKATOO HABITAT TREE DETAILS

Habitat Trees (DBH >50cm)
 Datum = GDA94

Tag Number	Zone	mE	mN	Tree Species	Tree Height (m)	DBH (cm)	Number of Hollows	Hollow Type 1	Hollow Size 1 (cm)	Hollow Type 2	Hollow Size 2 (cm)	Hollow Type 3	Hollow Size 3 (cm)	Hollow Type 4	Hollow Size 4 (cm)	Hollow Type 5	Hollow Size 5 (cm)	Occupancy	Chew Marks	Potential Cockatoo Nest Hollow	Comments
2	50	385227	6206549	Tuart	20+	>50	5+	Knot Hole	<5	Knot Hole	5-10	Knot Hole	<5	Knot Hole	5-10	Branch	5-10	No Signs	No Signs	No	Internal dimensions of hollows unknown
6	50	385254	6206549	Tuart	20+	>50	0											No Signs	No Signs	No	
7	50	385272	6206543	Marri	20+	>50	1	Branch	5-10									No Signs	No Signs	No	Internal dimensions of hollows unknown
8	50	385272	6206551	Marri	20+	>50	0											No Signs	No Signs	No	
9	50	385280	6206543	Marri	20+	>50	0											No Signs	No Signs	No	
11	50	385294	6206522	Marri	20+	>50	0											No Signs	No Signs	No	
12	50	385309	6206536	Marri	20+	>50	0											No Signs	No Signs	No	
19	50	385331	6206552	Marri	20+	>50	0											No Signs	No Signs	No	
21	50	385332	6206534	Marri	20+	>50	0											No Signs	No Signs	No	
23	50	385344	6206518	Marri	20+	>50	0											No Signs	No Signs	No	
25	50	385342	6206536	Marri	20+	>50	0											No Signs	No Signs	No	
26	50	385342	6206548	Jarra	20+	>50	0											No Signs	No Signs	No	
31	50	385374	6206555	Marri	20+	>50	0											No Signs	No Signs	No	
32	50	385376	6206552	Tuart	20+	>50	0											No Signs	No Signs	No	
33	50	385360	6206549	Marri	20+	>50	0											No Signs	No Signs	No	
34	50	385358	6206551	Marri	20+	>50	0											No Signs	No Signs	No	
35	50	385358	6206543	Marri	20+	>50	0											No Signs	No Signs	No	
36	50	385362	6206535	Marri	20+	>50	3	Knot Hole	<5	Branch	5-10	Branch	5-10					No Signs	No Signs	No	Internal dimensions of hollows unknown
37	50	385354	6206533	Marri	20+	>50	0											No Signs	No Signs	No	
39	50	385373	6206541	Marri	15-20	>50	0											No Signs	No Signs	No	
40	50	385392	6206532	Marri	20+	>50	0											No Signs	No Signs	No	
41	50	385406	6206524	Tuart	20+	>50	5+	Knot Hole	<5	Knot Hole	<5	Branch	<5	Branch	5-10	Branch	<5	No Signs	No Signs	No	Internal dimensions of hollows unknown
43	50	385426	6206523	Tuart	20+	>50	1	Knot Hole	5-10									No Signs	No Signs	No	Internal dimensions of hollows unknown
44	50	385421	6206533	Marri	15-20	>50	0											No Signs	No Signs	No	
45	50	385410	6206541	Marri	20+	>50	0											No Signs	No Signs	No	
63	50	385433	6206539	Marri	20+	>50	0											No Signs	No Signs	No	
64	50	385435	6206548	Marri	20+	>50	0											No Signs	No Signs	No	
65	50	385448	6206541	Marri	20+	>50	0											No Signs	No Signs	No	
67	50	385462	6206535	Marri	15-20	>50	0											No Signs	No Signs	No	
68	50	385470	6206538	Marri	20+	>50	0											No Signs	No Signs	No	
69	50	385474	6206526	Marri	15-20	>50	0											No Signs	No Signs	No	
70	50	385450	6206550	Marri	20+	>50	0											No Signs	No Signs	No	
79	50	385477	6206605	Marri	20+	>50	0											No Signs	No Signs	No	
80	50	385481	6206596	Dead	15-20	>50	0											No Signs	No Signs	No	
81	50	385469	6206579	Marri	20+	>50	0											No Signs	No Signs	No	
82	50	385475	6206574	Marri	20+	>50	1	Branch	5-10									No Signs	No Signs	No	Internal dimensions of hollows unknown
83	50	385458	6206561	Marri	20+	>50	0											No Signs	No Signs	No	
84	50	385493	6206534	Jarra	15-20	>50	0											No Signs	No Signs	No	
85	50	385498	6206536	Jarra	15-20	>50	5+	Knot Hole	<5	Knot Hole	5-10	Branch	<5	Branch	5-10	Spout Branch	5-10	No Signs	No Signs	No	Internal dimensions of hollows unknown
91	50	385500	6206606	Marri	15-20	>50	0											No Signs	No Signs	No	
92	50	385488	6206638	Marri	20+	>50	0											No Signs	No Signs	No	
93	50	385484	6206640	Marri	15-20	>50	0											No Signs	No Signs	No	
94	50	385478	6206637	Marri	20+	>50	0											No Signs	No Signs	No	
95	50	385483	6206644	Marri	20+	>50	0											No Signs	No Signs	No	
96	50	385488	6206650	Marri	20+	>50	5+	Knot Hole	5-10	Knot Hole	10-20	Branch	5-10	Branch	<5	Branch	5-10	Bees	No Signs	No	Bees in main hollow
97	50	385486	6206649	Marri	5-10	>50	1	Spout Trunk	5-10									No Signs	No Signs	No	Internal dimensions of hollows unknown
98	50	385484	6206658	Marri	15-20	>50	0											No Signs	No Signs	No	
99	50	385478	6206661	Marri	20+	>50	0											No Signs	No Signs	No	
100	50	385473	6206665	Marri	20+	>50	0											No Signs	No Signs	No	
103	50	385477	6206682	Tuart	20+	>50	0											No Signs	No Signs	No	
104	50	385478	6206686	Tuart	20+	>50	0											No Signs	No Signs	No	
105	50	385500	6206726	Marri	20+	>50	0											No Signs	No Signs	No	
108	50	385488	6206746	Marri	20+	>50	0											No Signs	No Signs	No	
162	50	385514	6207304	Tuart	20+	>50	2	Spout Branch	5-10	Spout Branch	10-20							No Signs	No Signs	Yes	Possibly too low
163	50	385516	6207287	Tuart	20+	>50	0											No Signs	No Signs	No	
176	50	385517	6207025	Marri	20+	>50	0											No Signs	No Signs	No	
177	50	385533	6206996	Marri	20+	>50	5+	Branch	<5	Branch	5-10	Branch	<5	Spout Branch	10-20	Spout Branch	10-20	No Signs	No Signs	Yes	Internal dimensions of hollows unknown

Tag Number	Zone	mE	mN	Tree Species	Tree Height (m)	DBH (cm)	Number of Hollows	Hollow Type 1	Hollow Size 1 (cm)	Hollow Type 2	Hollow Size 2 (cm)	Hollow Type 3	Hollow Size 3 (cm)	Hollow Type 4	Hollow Size 4 (cm)	Hollow Type 5	Hollow Size 5 (cm)	Occupancy	Chew Marks	Potential Cockatoo Nest Hollow	Comments
178	50	385512	6206997	Marri	20+	>50	0											No Signs	No Signs	No	
179	50	385510	6206980	Marri	20+	>50	0											No Signs	No Signs	No	
180	50	385526	6206968	Marri	20+	>50	1	Branch	5-10									No Signs	No Signs	No	Internal dimensions of hollows unknown
181	50	385538	6206953	Marri	20+	>50	1	Knot Hole	5-10									No Signs	No Signs	No	Internal dimensions of hollows unknown
182	50	385535	6206920	Marri	20+	>50	0											No Signs	No Signs	No	
183	50	385523	6206876	Marri	20+	>50	0											No Signs	No Signs	No	
184	50	385527	6206854	Marri	20+	>50	4	Knot Hole	5-10	Branch	<5	Branch	5-10	Branch	<5			No Signs	No Signs	No	Internal dimensions of hollows unknown
185	50	385503	6206831	Marri	15-20	>50	0											No Signs	No Signs	No	
186	50	385517	6206812	Marri	20+	>50	0											No Signs	No Signs	No	
187	50	385528	6206809	Marri	20+	>50	0											No Signs	No Signs	No	
188	50	385520	6206787	Marri	20+	>50	0											No Signs	No Signs	No	
189	50	385522	6206768	Marri	20+	>50	0											No Signs	No Signs	No	
190	50	385509	6206760	Marri	20+	>50	1	Branch	5-10									No Signs	No Signs	No	Internal dimensions of hollows unknown
191	50	385518	6206738	Marri	15-20	>50	0											No Signs	No Signs	No	
192	50	385528	6206716	Tuart	20+	>50	3	Branch	<5	Branch	5-10	Branch	<5					No Signs	No Signs	No	Internal dimensions of hollows unknown
193	50	385535	6206715	Tuart	20+	>50	1	Knot Hole	<5									Bees	No Signs	No	Internal dimensions of hollows unknown
194	50	385507	6206701	Marri	20+	>50	0											No Signs	No Signs	No	
195	50	385512	6206691	Marri	15-20	>50	0											No Signs	No Signs	No	
196	50	385513	6206677	Marri	20+	>50	0											No Signs	No Signs	No	
197	50	385514	6206670	Marri	20+	>50	0											No Signs	No Signs	No	
199	50	385507	6206651	Marri	20+	>50	0											No Signs	No Signs	No	
200	50	385502	6206656	Marri	20+	>50	0											No Signs	No Signs	No	
201	50	385494	6206683	Marri	15-20	>50	2	Spout Branch	<5	Spout Branch	5-10							No Signs	No Signs	No	Internal dimensions of hollows unknown
202	50	385493	6206680	Marri	20+	>50	0											No Signs	No Signs	No	
203	50	385503	6206643	Dead Marri	20+	>50	4	Branch	<5	Branch	5-10	Branch	<5	Branch	5-10	Branch	<5	No Signs	No Signs	No	Internal dimensions of hollows unknown
204	50	385525	6206637	Tuart	20+	>50	1	Fissure	5-10									No Signs	No Signs	No	Internal dimensions of hollows unknown
205	50	385524	6206599	Marri	15-20	>50	0											No Signs	No Signs	No	
207	50	385550	6206525	Marri	20+	>50	5+	Knot Hole	20+	Branch	<5	Branch	5-10	Spout Branch	5-10	Spout Branch	<5	No Signs	No Signs	No	Too low
208	50	385564	6206526	Marri	10-15	>50	1	Spout Trunk	5-10									No Signs	No Signs	No	Internal dimensions of hollows unknown
209	50	385569	6206538	Marri	20+	>50	0											No Signs	No Signs	No	
210	50	385582	6206536	Marri	20+	>50	0											No Signs	No Signs	No	
211	50	385592	6206534	Marri	20+	>50	0											No Signs	No Signs	No	
214	50	385612	6206558	Jarra	20+	>50	0											No Signs	No Signs	No	
216	50	385574	6206562	Jarra	15-20	>50	0											No Signs	No Signs	No	
220	50	385567	6206596	Jarra	15-20	>50	0											No Signs	No Signs	No	
223	50	385573	6206616	Jarra	15-20	>50	0											No Signs	No Signs	No	
237	50	385533	6206648	Marri	15-20	>50	0											No Signs	No Signs	No	
240	50	385589	6206644	Marri	20+	>50	5+	Knot Hole	20+	Branch	<5	Branch	5-10	Branch	20+	Branch	5-10	No Signs	No Signs	Yes	Internal dimensions of hollows unknown
243	50	385591	6206657	Tuart	20+	>50	2	Knot Hole	20+	Spout Branch	20+							No Signs	No Signs	Yes	Internal dimensions of hollows unknown
249	50	385550	6206717	Tuart	20+	>50	0											No Signs	No Signs	No	
250	50	385605	6206696	Tuart	20+	>50	5+	Branch	<5	Branch	5-10	Branch	<5	Branch	5-10	Branch	<5	No Signs	No Signs	No	Internal dimensions of hollows unknown
254	50	385633	6206716	Tuart	20+	>50	0											No Signs	No Signs	No	
255	50	385619	6206726	Tuart	15-20	>50	0											No Signs	No Signs	No	
256	50	385568	6206740	Tuart	20+	>50	0											No Signs	No Signs	No	
257	50	385590	6206748	Tuart	20+	>50	0											No Signs	No Signs	No	
258	50	385600	6206758	Tuart	20+	>50	0											No Signs	No Signs	No	
260	50	385590	6206775	Tuart	20+	>50	3	Branch	5-10	Spout Branch	5-10	Spout Trunk	20+					No Signs	No Signs	No	Too shallow
261	50	385611	6206773	Jarra	15-20	>50	0											No Signs	No Signs	No	
263	50	385635	6206778	Jarra	15-20	>50	0											No Signs	No Signs	No	
278	50	385647	6206820	Tuart	15-20	>50	0											No Signs	No Signs	No	
279	50	385653	6206835	Dead	20+	>50	5+	Branch	<5	Branch	5-10	Branch	<5	Branch	5-10	Branch	<5	No Signs	No Signs	No	Internal dimensions of hollows unknown
280	50	385626	6206838	Tuart	20+	>50	0											No Signs	No Signs	No	
281	50	385615	6206835	Dead	20+	>50	0											No Signs	No Signs	No	
282	50	385608	6206831	Marri	15-20	>50	0											No Signs	No Signs	No	
283	50	385596	6206862	Marri	20+	>50	0											No Signs	No Signs	No	
284	50	385608	6206865	Marri	20+	>50	0											No Signs	No Signs	No	
285	50	385610	6206856	Marri	20+	>50	0											No Signs	No Signs	No	
286	50	385648	6206860	Tuart	20+	>50	0											No Signs	No Signs	No	
287	50	385674	6206859	Dead	20+	>50	5+	Knot Hole	10-20	Branch	5-10	Branch	<5	Branch	5-10	Spout Branch	5-10	No Signs	Chew Marks	Yes	Internal dimensions of hollows unknown
288	50	385689	6206885	Tuart	20+	>50	0											No Signs	No Signs	No	

Tag Number	Zone	mE	mN	Tree Species	Tree Height (m)	DBH (cm)	Number of Hollows	Hollow Type 1	Hollow Size 1 (cm)	Hollow Type 2	Hollow Size 2 (cm)	Hollow Type 3	Hollow Size 3 (cm)	Hollow Type 4	Hollow Size 4 (cm)	Hollow Type 5	Hollow Size 5 (cm)	Occupancy	Chew Marks	Potential Cockatoo Nest Hollow	Comments
289	50	385665	6206895	Tuart	20+	>50	0											No Signs	No Signs	No	
291	50	385597	6206884	Marri	20+	>50	0											No Signs	No Signs	No	
292	50	385589	6206892	Tuart	20+	>50	3	Branch	<5	Branch	5-10	Branch	<5					No Signs	No Signs	No	Internal dimensions of hollows unknown
293	50	385606	6206919	Marri	20+	>50	0											No Signs	No Signs	No	
294	50	385669	6206913	Marri	20+	>50	0											No Signs	No Signs	No	
295	50	385685	6206919	Tuart	20+	>50	0											No Signs	No Signs	No	
298	50	385686	6206969	Tuart	15-20	>50	0											No Signs	No Signs	No	
299	50	385674	6206968	Tuart	20+	>50	5+	Branch	<5	Branch	5-10	Branch	10-20	Spout Branch	20+	Spout Branch	20+	No Signs	No Signs	Yes	Internal dimensions of hollows unknown
301	50	385663	6206960	Tuart	20+	>50	0											No Signs	No Signs	No	
302	50	385643	6206987	Tuart	20+	>50	2	Branch	<5	Branch	5-10							Bees	No Signs	No	Internal dimensions of hollows unknown
304	50	385648	6207006	Tuart	15-20	>50	0											No Signs	No Signs	No	
309	50	385605	6207038	Marri	20+	>50	0											No Signs	No Signs	No	
310	50	385591	6207021	Tuart	20+	>50	0											No Signs	No Signs	No	
311	50	385589	6207026	Tuart	20+	>50	0											No Signs	No Signs	No	
312	50	385589	6207037	Marri	20+	>50	0											No Signs	No Signs	No	
314	50	385568	6207036	Marri	20+	>50	0											No Signs	No Signs	No	
315	50	385573	6207017	Marri	20+	>50	0											No Signs	No Signs	No	
316	50	385572	6206976	Marri	20+	>50	0											No Signs	No Signs	No	
317	50	385587	6206973	Marri	20+	>50	0											No Signs	No Signs	No	
318	50	385547	6206965	Tuart	20+	>50	0											No Signs	No Signs	No	
319	50	385563	6206969	Marri	15-20	>50	0											No Signs	No Signs	No	
320	50	385549	6206941	Marri	5-10	>50	0											No Signs	No Signs	No	
321	50	385564	6206943	Tuart	20+	>50	0											No Signs	No Signs	No	
322	50	385576	6206936	Marri	20+	>50	2	Branch	<5	Branch	<5							No Signs	No Signs	No	Internal dimensions of hollows unknown
323	50	385579	6206908	Marri	20+	>50	0											No Signs	No Signs	No	
324	50	385570	6206916	Marri	20+	>50	0											No Signs	No Signs	No	
325	50	385558	6206910	Marri	20+	>50	1	Spout Branch	5-10									No Signs	No Signs	No	Internal dimensions of hollows unknown
326	50	385549	6206915	Marri	20+	>50	0											No Signs	No Signs	No	
327	50	385550	6206925	Marri	20+	>50	2	Branch	<5	Branch	5-10							No Signs	No Signs	No	Internal dimensions of hollows unknown
328	50	385556	6206895	Marri	20+	>50	2	Knot Hole	10-20	Spout Branch	5-10							Galahs	No Signs	Yes	Internal dimensions of hollows unknown
329	50	385562	6206897	Marri	20+	>50	1	Branch	5-10									Bees	Chew Marks	Yes	Internal dimensions of hollows unknown
332	50	385546	6206863	Marri	20+	>50	1	Branch	5-10									No Signs	No Signs	No	Internal dimensions of hollows unknown
334	50	385544	6206834	Marri	20+	>50	1	Branch	<5									No Signs	No Signs	No	Internal dimensions of hollows unknown
337	50	385551	6206791	Marri	20+	>50	0											No Signs	No Signs	No	
338	50	385579	6207090	Jarra	15-20	>50	0											No Signs	No Signs	No	
339	50	385538	6206778	Marri	20+	>50	0											No Signs	No Signs	No	
341	50	385570	6207096	Jarra	15-20	>50	0											No Signs	No Signs	No	
342	50	385589	6207095	Jarra	20+	>50	0											No Signs	No Signs	No	
344	50	385635	6207075	Marri	20+	>50	0											No Signs	No Signs	No	
346	50	385629	6207086	Marri	15-20	>50	1	Branch	5-10									No Signs	No Signs	No	Internal dimensions of hollows unknown
348	50	385657	6207106	Jarra	20+	>50	0											No Signs	No Signs	No	
350	50	385636	6207162	Marri	20+	>50	0											No Signs	No Signs	No	
351	50	385604	6207175	Jarra	15-20	>50	0											No Signs	No Signs	No	
352	50	385605	6207177	Jarra	15-20	>50	0											No Signs	No Signs	No	
354	50	385581	6207176	Jarra	15-20	>50	0											No Signs	No Signs	No	
355	50	385589	6207172	Jarra	15-20	>50	0											No Signs	No Signs	No	
356	50	385583	6207166	Marri	20+	>50	0											No Signs	No Signs	No	
359	50	385560	6207164	Marri	20+	>50	0											No Signs	No Signs	No	
361	50	385580	6207149	Marri	20+	>50	5+	Knot Hole	<5	Knot Hole	<5	Branch	<5	Branch	5-10	Spout Branch	20+	Ducks	No Signs	No	Ducks breeding - too low
362	50	385587	6207158	Marri	15-20	>50	0											No Signs	No Signs	No	
363	50	385588	6207149	Marri	20+	>50	1	Spout Branch	20+									No Signs	No Signs	Yes	Internal dimensions of hollows unknown
364	50	385590	6207135	Marri	20+	>50	0											No Signs	No Signs	No	
368	50	385562	6207119	Marri	20+	>50	0											No Signs	No Signs	No	
370	50	385518	6207137	Marri	20+	>50	0											No Signs	No Signs	No	
371	50	385510	6207133	Marri	20+	>50	0											No Signs	No Signs	No	
372	50	385509	6207135	Marri	20+	>50	0											No Signs	No Signs	No	
373	50	385519	6207102	Marri	20+	>50	0											No Signs	No Signs	No	
374	50	385513	6207090	Marri	20+	>50	5+	Knot Hole	20+	Branch	<5	Branch	5-10	Branch	<5	Branch	<5	No Signs	Chew Marks	No	Hollow too shallow
375	50	385526	6207090	Marri	20+	>50	0											No Signs	No Signs	No	
376	50	385524	6207181	Tuart	20+	>50	2	Branch	<5	Branch	5-10							No Signs	No Signs	No	Internal dimensions of hollows unknown

Tag Number	Zone	mE	mN	Tree Species	Tree Height (m)	DBH (cm)	Number of Hollows	Hollow Type 1	Hollow Size 1 (cm)	Hollow Type 2	Hollow Size 2 (cm)	Hollow Type 3	Hollow Size 3 (cm)	Hollow Type 4	Hollow Size 4 (cm)	Hollow Type 5	Hollow Size 5 (cm)	Occupancy	Chew Marks	Potential Cockatoo Nest Hollow	Comments
377	50	385533	6207192	Tuart	20+	>50	2	Branch	<5	Branch	5-10							No Signs	No Signs	No	Internal dimensions of hollows unknown
378	50	385552	6207195	Tuart	20+	>50	0											No Signs	No Signs	No	
379	50	385565	6207211	Tuart	20+	>50	5+	Branch	<5	Branch	5-10	Branch	<5	Spout Branch	10-20	Spout Trunk	20+	No Signs	No Signs	Yes	Possibly too low
389	50	385583	6207247	Jarrah	15-20	>50	0											No Signs	No Signs	No	
391	50	385584	6207265	Jarrah	15-20	>50	0											No Signs	No Signs	No	
392	50	385581	6207267	Jarrah	15-20	>50	0											No Signs	No Signs	No	
396	50	385564	6207261	Tuart	20+	>50	0											No Signs	No Signs	No	
397	50	385572	6207268	Jarrah	15-20	>50	0											No Signs	No Signs	No	
402	50	385547	6207316	Tuart	20+	>50	0											No Signs	No Signs	No	
403	50	385546	6207318	Tuart	20+	>50	2	Knot Hole	<5	Knot Hole	5-10							Bees	No Signs	No	Internal dimensions of hollows unknown
404	50	385544	6207317	Tuart	20+	>50	5+	Knot Hole	20+	Branch	20+	Branch	20+	Spout Branch	20+	Spout Trunk	20+	No Signs	Chew Marks	Yes	Internal dimensions of hollows unknown
405	50	385525	6207275	Tuart	20+	>50	5+	Knot Hole	20+	Branch	20+	Branch	20+	Spout Branch	20+	Spout Trunk	20+	No Signs	No Signs	Yes	Internal dimensions of hollows unknown
409	50	385513	6207238	Tuart	20+	>50	0											No Signs	No Signs	No	
410	50	385534	6207344	Tuart	20+	>50	0											No Signs	No Signs	No	
414	50	385550	6207368	Tuart	20+	>50	0											No Signs	No Signs	No	
415	50	385567	6207358	Tuart	15-20	>50	0											No Signs	No Signs	No	
430	50	385599	6207427	Tuart	20+	>50	0											No Signs	No Signs	No	
431	50	385609	6207458	Marri	15-20	>50	2	Branch	5-10	Branch	5-10							No Signs	No Signs	No	Internal dimensions of hollows unknown
436	50	385639	6207498	Tuart	15-20	>50	4	Branch	<5	Branch	5-10	Branch	<5	Branch	5-10			No Signs	No Signs	No	Internal dimensions of hollows unknown
437	50	385646	6207494	Marri	20+	>50	0											No Signs	No Signs	No	
438	50	385649	6207492	Marri	20+	>50	0											No Signs	No Signs	No	
440	50	385652	6207501	Marri	15-20	>50	0											No Signs	No Signs	No	
442	50	385677	6207520	Tuart	20+	>50	4	Knot Hole	5-10	Branch	5-10	Branch	<5	Branch	<5			No Signs	No Signs	No	Internal dimensions of hollows unknown
443	50	385688	6207510	Marri	20+	>50	0											No Signs	No Signs	No	
444	50	385708	6207542	Marri	20+	>50	0											No Signs	No Signs	No	
449	50	385714	6207485	Marri	15-20	>50	0											No Signs	No Signs	No	
454	50	385721	6207424	Marri	20+	>50	0											No Signs	No Signs	No	
455	50	385715	6207420	Marri	20+	>50	0											No Signs	No Signs	No	
456	50	385725	6207407	Marri	15-20	>50	0											No Signs	No Signs	No	
457	50	385712	6207396	Marri	15-20	>50	0											No Signs	No Signs	No	
458	50	385721	6207385	Marri	20+	>50	0											No Signs	No Signs	No	
459	50	385716	6207371	Marri	20+	>50	5+	Knot Hole	5-10	Knot Hole	10-20	Branch	<5	Branch	5-10	Branch	<5	No Signs	No Signs	Yes	Internal dimensions of hollows unknown
467	50	385733	6207333	Jarrah	15-20	>50	0											No Signs	No Signs	No	
469	50	385728	6207311	Jarrah	15-20	>50	0											No Signs	No Signs	No	
471	50	385739	6207298	Tuart	15-20	>50	0											No Signs	No Signs	No	
472	50	385739	6207293	Tuart	20+	>50	0											No Signs	No Signs	No	
473	50	385726	6207291	Jarrah	15-20	>50	1	Knot Hole	5-10									No Signs	No Signs	No	Internal dimensions of hollows unknown
477	50	385744	6207246	Tuart	15-20	>50	0											No Signs	No Signs	No	
478	50	385735	6207226	Tuart	20+	>50	1	Branch	5-10									No Signs	No Signs	No	Internal dimensions of hollows unknown
482	50	385748	6207196	Tuart	20+	>50	0											No Signs	No Signs	No	
487	50	385751	6207144	Tuart	20+	>50	0											No Signs	No Signs	No	
491	50	385754	6207124	Tuart	20+	>50	0											No Signs	No Signs	No	
492	50	385752	6207115	Tuart	20+	>50	0											No Signs	No Signs	No	
497	50	385765	6207057	Tuart	20+	>50	0											No Signs	No Signs	No	
512	50	385874	6206871	Jarrah	15-20	>50	1	Knot Hole	5-10									No Signs	No Signs	No	Internal dimensions of hollows unknown
516	50	385920	6206816	Jarrah	15-20	>50	0											No Signs	No Signs	No	
517	50	385912	6206810	Marri	15-20	>50	0											No Signs	No Signs	No	
521	50	385931	6206795	Jarrah	15-20	>50	0											No Signs	No Signs	No	
523	50	385939	6206787	Jarrah	10-15	>50	1	Spout Branch	5-10									No Signs	No Signs	No	Internal dimensions of hollows unknown
535	50	386000	6206671	Jarrah	15-20	>50	0											No Signs	No Signs	No	
536	50	386001	6206661	Jarrah	15-20	>50	0											No Signs	No Signs	No	
541	50	385965	6206663	Jarrah	15-20	>50	0											No Signs	No Signs	No	
544	50	385959	6206632	Jarrah	5-10	>50	0											No Signs	No Signs	No	
547	50	386019	6206621	Jarrah	15-20	>50	0											No Signs	No Signs	No	
550	50	386039	6206578	Jarrah	20+	>50	0											No Signs	No Signs	No	
551	50	386058	6206554	Jarrah	15-20	>50	0											No Signs	No Signs	No	
552	50	386059	6206538	Jarrah	15-20	>50	0											No Signs	No Signs	No	
554	50	386053	6206512	Jarrah	20+	>50	5+	Branch	<5	Branch	5-10	Branch	<5	Branch	5-10	Branch	<5	No Signs	No Signs	No	Internal dimensions of hollows unknown
557	50	386037	6206563	Jarrah	15-20	>50	0											No Signs	No Signs	No	
559	50	386007	6206568	Jarrah	15-20	>50	0											No Signs	No Signs	No	

Tag Number	Zone	mE	mN	Tree Species	Tree Height (m)	DBH (cm)	Number of Hollows	Hollow Type 1	Hollow Size 1 (cm)	Hollow Type 2	Hollow Size 2 (cm)	Hollow Type 3	Hollow Size 3 (cm)	Hollow Type 4	Hollow Size 4 (cm)	Hollow Type 5	Hollow Size 5 (cm)	Occupancy	Chew Marks	Potential Cockatoo Nest Hollow	Comments
562	50	386002	6206514	Jarrah	15-20	>50	0											No Signs	No Signs	No	
570	50	385939	6206522	Jarrah	15-20	>50	0											No Signs	No Signs	No	
572	50	385920	6206594	Jarrah	15-20	>50	0											No Signs	No Signs	No	
573	50	385900	6206605	Jarrah	15-20	>50	0											No Signs	No Signs	No	
575	50	385898	6206560	Marri	15-20	>50	2	Knot Hole	20+	Knot Hole	<5							Ducks	No Signs	Yes	Evidence of ducks breeding
576	50	385888	6206527	Jarrah	15-20	>50	0											No Signs	No Signs	No	
577	50	385876	6206540	Jarrah	15-20	>50	0											No Signs	No Signs	No	
578	50	385834	6206541	Jarrah	15-20	>50	0											No Signs	No Signs	No	
579	50	385829	6206532	Jarrah	20+	>50	3	Branch	5-10	Branch	10-20	Branch	5-10					No Signs	No Signs	No	Internal dimensions of hollows unknown
580	50	385822	6206535	Jarrah	15-20	>50	0											No Signs	No Signs	No	
582	50	385795	6206533	Jarrah	15-20	>50	0											No Signs	No Signs	No	
583	50	385762	6206518	Jarrah	15-20	>50	0											No Signs	No Signs	No	
584	50	385740	6206518	Tuart	20+	>50	3	Branch	5-10	Branch	5-10	Spout Branch	5-10					No Signs	No Signs	No	Internal dimensions of hollows unknown
585	50	385724	6206514	Tuart	20+	>50	0											No Signs	No Signs	No	
587	50	385725	6206538	Tuart	20+	>50	0											No Signs	No Signs	No	
588	50	385701	6206547	Tuart	15-20	>50	0											No Signs	No Signs	No	
589	50	385703	6206522	Tuart	20+	>50	1	Knot Hole	5-10									No Signs	No Signs	No	Internal dimensions of hollows unknown
590	50	385661	6206536	Jarrah	10-15	>50	1	Spout Branch	5-10									No Signs	No Signs	No	Internal dimensions of hollows unknown
591	50	385653	6206546	Jarrah	20+	>50	5+	Branch	<5	Branch	5-10	Branch	10-20	Branch	<5	Branch	5-10	No Signs	No Signs	Yes	Internal dimensions of hollows unknown
592	50	385636	6206532	Jarrah	20+	>50	5+	Fissure	5-10	Branch	<5	Branch	5-10	Branch	<5	Branch	5-10	No Signs	No Signs	No	Internal dimensions of hollows unknown
595	50	385610	6206582	Tuart	15-20	>50	0											No Signs	No Signs	No	
596	50	385606	6206605	Tuart	20+	>50	0											No Signs	No Signs	No	
598	50	385635	6206609	Tuart	20+	>50	0											No Signs	No Signs	No	
599	50	385653	6206624	Tuart	20+	>50	0											No Signs	No Signs	No	
600	50	385654	6206619	Tuart	20+	>50	0											No Signs	No Signs	No	
549	50	386042	6206596	Jarrah	0-5	>50	0											No Signs	No Signs	No	

APPENDIX E

SIGNIFICANT SPECIES PROFILES

Graceful Sun Moth *Synemon gratiosa*

Status and Distribution: Listed as Priority 4 by the DPaW.

The GSM was up until a few years ago thought to be confined to a small number of bush reserves in the northern suburbs of Perth. Targeted survey work since that time by several consultants and DPaW have extended the known range of the species north to Leeman and south as far as Binningup (Bishop *et al.* 2010b).

Survey work carried out in 2010 expanded the previously document area of occupancy of the GSM from 18km² to 43 km² and the extent of occurrence from 230km² to 2,015km². The area of occupancy is potentially a conservative estimate at this stage and if habitat anticipated to be occupied by GSM is included, the area of occupancy may be as high as 119 km² (Bishop *et al.* 2010b). Additional surveys have been carried out in 2011 north and south of the known range and these may also expand the species range (results not as yet publically available).

The conservation status of the graceful sun-moth was change at a state level in 2012 from Schedule 1 to Priority 4 and it has also been delisted from the *EPBC Act* threatened species list altogether because of the additional information illustrating the species much greater range and abundance.

Habitat: The graceful sun-moth is currently only known from two general vegetation types:

- Banksia woodland/woolly bush on deep sands, in the northern suburbs of Perth on the Swan Coastal Plain. In these sites the GSM breeds on *Lomandra hermaphrodita*, which often occurs in low numbers.
- Open areas of herbland, heathland and shrubland on Quindalup soils (sand and limestone) close to the coast where it breeds on *Lomandra maritima*, which is often present in reasonable numbers and may even be a dominant understorey herb. Sites on limestone may have both *Lomandra* species present.

The presence of these two *Lomandra* species therefore provides a good indication of prospective habitat, however, sufficient numbers and densities of these plants are thought to be necessary to sustain a viable breeding colony of Graceful Sun-Moths.

Likely presence in subject site: The subject site does not contain suitable vegetation (type and quality) normally associated with the presence of the GSM (i.e. *Lomandra hermaphrodita* and *L. maritima*). It is therefore considered very unlikely that GSM would persist onsite.

Potential impact of development: No impact on this species or its preferred habitat is considered likely to occur as a consequence of development at the site occurring.

Perth Lined Lerista *Lerista lineata*

Status and Distribution: Listed as Priority 3 by DPaW. Found in the lower west coast from Perth south to Leschenault Peninsula/Kemerton. It has also been found at Rottnest Island and Garden Island (Storr *et al.* 1999, Bush *et al.* 2007).

Habitat: This small species of skink inhabits white sands (Storr *et al.* 1999) under areas of shrubs and heath where it inhabits loose soil and leaf litter (Nevill 2005) particularly in association with *banksias* (Bush *et al.* 2002).

Likely presence in subject site: Status within the subject site difficult to determine. The area is however within the documented range of this species and some areas of habitat appear suitable, so it may occur. Known to inhabit gardens (Nevill 2005, Bush *et al.* 2010) so may persist in degraded areas and subsequent to development.

Potential impact of development: Loss or modification of some areas of habitat.

Black-striped Snake *Neelaps calonotos*

Status and Distribution: Listed as Priority 3 by DPaW. Found in the lower west coast from Lancelin to Mandurah. It is locally abundant but is under threat due to land clearing (Storr *et al.* 1999).

Habitat: This species of snake favours sandy soils supporting heath and banksia/eucalypt woodland (Nevill 2005).

Likely presence in study area: Status in area difficult to determine, however the lack of recent records in the general area despite several detailed surveys (e.g. Rockingham, East Rockingham, Bibra Lake, Jandakot) suggests that it no longer persists in the southern Perth suburbs. Not listed as a potential species.

Potential impact of development: No impact on this species will occur as it is unlikely to be present.

Malleefowl *Leipoa ocellata*

Status and Distribution: This species is listed as Schedule 3 under the *WC Act* and as Vulnerable under the *EPBC Act*. Originally common, but now generally rare to uncommon and patchily distributed.

Current distribution mainly southern arid and semi-arid zones, north to Shark Bay, Jingemarra, Colga Downs and Yeelirrie, east to Earnest Giles Range, Yeo Lake, lower

Pontoon Creek and to Eucla and west and south to Cockleshell Gully, the Wongan Hills, Stirling Range, Beaufort Inlet, Hatters Hill, Mt Ragged and Point Malcolm (Johnstone and Storr 1998).

Habitat: Mainly scrubs and thickets of mallee *Eucalyptus* spp., boree *Melaleuca lanceolata* and bowgada *Acacia linophylla*, also dense litter forming shrublands.

Likely presence in subject site: This species is regionally extinct and would never, under normal circumstances occur anywhere on the Swan Coastal Plain. Not listed as a potential species.

Potential impact of development: No impact on this species will occur as it would not occur.

Hooded Plover (western) *Thinornis rubricollis tregellasi*

Status and Distribution: The western subspecies of the hooded plover is listed as Priority 4 by DPaW and as Vulnerable C1 by the IUCN. Breeds on south-west Western Australian coast, from Cape Naturaliste to Eyre, and on inland lakes as far north-east as L. Cowan and L. Moore and north-west to Yalgorup Lakes, south of Perth.

Habitat: Broad sandy ocean beaches and bays, coastal and inland salt lakes (Pizzey & Knight 2012).

Likely presence in subject site: No suitable habitat. Not listed as a potential species.

Potential impact of development: No impact on this species or its preferred habitat will occur.

Great Egret *Ardea alba*

Status and Distribution: This species of egret is listed as Schedule 5 under the *WC Act* and as migratory under the *EPBC Act* and under international agreements to which Australia is a signatory. The Great Egret is common and very widespread in any suitable permanent or temporary habitat (Morcombe 2004).

Habitat: Wetlands, flooded pasture, dams, estuarine mudflats, mangroves and reefs (Morcombe 2004).

Likely presence in subject site: There is no habitat suitable for this species within the subject site though it may occur in nearby wetland areas.

Potential impact of development: No significant impact on this species or its preferred habitat will occur.

Cattle Egret *Ardea ibis*

Status and Distribution: This species of egret is listed as Schedule 5 under the *WC Act* and as migratory under the *EPBC Act* and under international agreements to which Australia is a signatory. The Cattle Egret is common in the north sections of its range but is an irregular visitor to the better watered parts of the state (Johnstone and Storr 1998). The population is expanding (Morcombe 2004).

Habitat: Moist pastures with tall grasses, shallow open wetlands and margins, mudflats (Morcombe 2004).

Likely presence in subject site: There is no habitat suitable for this species within the subject site though it may occur in nearby wetland areas.

Potential impact of development: No significant impact on this species or its preferred habitat will occur.

Painted Snipe *Rostratula benghalensis*

Status and Distribution: This species is listed as Schedule 2 under the *WC Act* and as Endangered and Migratory under the *EPBC Act*. Sparsely distributed in better watered regions: Kimberley, North West and South Western divisions. Also, eastern Australia and Tasmanian (Johnstone and Storr 1998).

Habitat: Well vegetated shallows and margins of wetlands, dams, sewerage ponds, wet pastures, marshy areas, irrigation systems, lignum, tea tree scrub, open timber. Requires dense low cover (Morcombe 2004).

Likely presence in subject site: No suitable habitat. Not listed as a potential species.

Potential impact of development: No significant impact on this species or its preferred habitat will occur.

Australasian Bittern *Botaurus poiciloptilus*

Status and Distribution: Classified as Schedule 2 under the *WC Act* and as Endangered under the *EPBC Act*. The species is uncommon to rare (Morcombe 2004), but locally common in wetter parts of south west (Johnstone and Storr 1998). Occurs north to Moora and east to Mt Arid (Johnstone and Storr 1998).

Habitat: Freshwater wetlands, occasionally estuarine; prefers heavy vegetation (Morcombe 2004) such as beds of tall dense *Typha*, *Baumea* and sedges in freshwater swamps (Johnstone and Storr 1998).

Likely presence in subject site: While this species may sometimes frequent nearby wetland areas the subject site itself contains no suitable habitat.

Potential impact of development: No impact on this species or its preferred habitat will occur.

Other Migratory Shorebirds/Wetland Species

A number of migratory shorebirds/wetland species are listed as potentially occurring in the general area. Specific species are not discussed.

Status and Distribution: Migratory shorebirds are listed under the Schedule 5 of the *WC Act*, the *EPBC Act* and under international agreements to which Australia is a signatory. All species are either widespread summer migrants to Australia or residents. State and Federal conservation status varies between species.

Habitat: Varies between species but includes beaches and permanent/temporary wetlands varying from billabongs, swamps, lakes, floodplains, sewerage farms, saltwork ponds, estuaries, lagoons, mudflats sandbars, pastures, airfields, sports fields and lawns.

Likely presence in subject site: There is no habitat suitable for these species within the subject site though some may occur occasionally in nearby wetland areas.

Potential impact of development: No significant impact on these species or their preferred habitat will occur.

White-bellied Sea Eagle *Haliaeetus leucogaster*

Status and Distribution: This species is listed as Marine under the *EPBC Act* and as Migratory under international agreements to which Australia is a signatory. White-bellied sea eagles are moderately common to common on Kimberley and Pilbara islands, coasts and estuaries, on Bernier, Dorre and Dirk Hartog Is., in Houtman Abrolhos and in the Archipelago of the Recherche; rare to uncommon elsewhere (Johnstone and Storr 1998). Also found in New Guinea, Indonesia, China, southeast Asia and India. Scarce near major coastal cities (Morcombe 2004).

Habitat: They nest and forage usually near the coast over islands, reefs, headlands, beaches, bays, estuaries, mangroves, but will also live near seasonally flooded inland swamps, lagoons and floodplains, often far inland on large pools of major rivers. Established pairs usually sedentary, immatures dispersive (Morcombe 2003). White-bellied sea-eagles build a large stick nest, which is used for many seasons in succession.

Likely presence in subject site: May very occasionally fly over the site due to proximity to ocean and Mandurah estuary. Known to nest in coastal forest adjacent to lakes or rivers (record from Baldivis). No existing nest sites observed during the field survey. Despite this not listed as a potential species as the probability of the species ever using the site for any purpose is extremely low.

Potential impact of development: No impact on this species or its preferred habitat will occur.

Osprey *Pandion haliaetus*

Status and Distribution: This species is listed as Schedule 5 under the *WC Act* and as Migratory under the *EPBC Act* and under international agreements to which Australia is a signatory. Moderately common to very common in sheltered seas around the north and west coast islands south to 31°S; uncommon to common on mainland coasts, estuaries and large rivers north of tropic, rare to uncommon elsewhere (Johnstone and Storr 1998).

Habitat: Coasts, estuaries, bays, inlets, islands, and surrounding waters, coral atolls, reefs, lagoons, rock cliffs and stacks. Ascends larger rivers (Pizzey & Knight 2012). Construct nests on prominent headland, large trees, communication towers (Simpson & Day 2010).

Likely presence in subject site: May fly over on rare occasions given presence of nearby rivers, lake systems and ocean but there is no suitable habitat for this species inside the subject site.

Potential impact of development: No significant impact on this species or its preferred habitat will occur.

Peregrine Falcon *Falco peregrinus*

Status and Distribution: This species is listed as Schedule 7 under the *WC Act*. Individuals of this species are uncommon/rare but wide ranging across Australia. Moderately common at higher levels of the Stirling Range, uncommon in hilly, north west Kimberley, Hamersley and Darling Ranges; rare or scarce elsewhere (Johnstone and Storr 1998).

Habitat: Diverse from rainforest to arid shrublands, from coastal heath to alpine (Morcombe 2004). Mainly about cliffs along coasts, rivers and ranges and about wooded watercourses and lakes (Johnstone and Storr 1998). The species utilises the ledges, cliff faces and large hollows/broken spouts of trees for nesting. It will also occasionally use the abandoned nests of other birds of prey.

Likely presence in subject site: This species potentially utilises some sections of the subject site as part of a much larger home range. No evidence of nesting was observed and the probability of this species breeding within the subject site can be considered to be low.

Potential impact of development: Loss or modification of some habitat. However, no significant impact on this species is considered likely.

Masked Owl *Tyto novaehollandae novaehollandae*

Status and Distribution: Listed as Priority 3 by DPaW. Found north to Yanchep and east to Yealering, Gnowangerup and Albany, casual further north. Locally common in south west but generally uncommon (Johnstone and Storr 1998).

Habitat: Roosts and nests in heavy forest, hunts over open woodlands and farmlands (Morcombe, 2003). Probably breeding in forested deep south west with some autumn–winter wanderings northwards (Johnstone and Storr 1998).

Likely presence in subject site: Status on-site and in the general area is difficult to determine. May occasionally be present but not listed as a potential species as the frequency of occurrence would be very low and only for limited periods.

Potential impact of development: No impact on this species will occur.

Fork-tailed Swift *Apus pacificus*

Status and Distribution: The fork-tailed swift is listed as Schedule 5 under the *WC Act* and as Migratory under the *EPBC Act* and under international agreements to which Australia is a signatory. This species breeds in Siberia and the Himalayas and migrates to Australia in October, returning to the breeding grounds by May or June (Morcombe 2004).

Habitat: Low to very high airspace over varied habitat from rainforest to semi desert (Morcombe 2004).

Likely presence in subject site: It is potentially a very occasional summer visitor to the general area but is entirely aerial and largely independent of terrestrial habitats. Not listed as a potential species as frequency of occurrence would be very low and then only for very brief periods of time.

Potential impact of development: No significant impact on this species or its preferred habitat will occur.

Rainbow Bee-eater *Merops ornatus*

Status and Distribution: This species is listed as Schedule 5 under the *WC Act* and as Migratory under the *EPBC Act* and under international agreements to which Australia is a signatory. The Rainbow Bee-eater is a common summer migrant to southern Australia but in the north they are resident (Morcombe 2003).

Habitat: Open Country, of woodlands, open forest, semi arid scrub, grasslands, clearings in heavier forest, farmlands (Morcombe 2003). Breeds underground in areas of suitable soft soil firm enough to support tunnel building.

Likely presence in subject site: This species is a common seasonal visitor to south west. It possibly breeds in some sections of the subject site where ground conditions permit (e.g. sandy areas) though population levels would not be significant as it usually breeds in pairs, rarely in small colonies (Johnstone and Storr 1998).

Potential impact of development: No significant impact on this species is anticipated as individuals' present onsite at any one time would not under any circumstances represent a substantial proportion of the population. It can be expected to continue to utilise the area, if it does now, despite any future development.

Grey Wagtail *Motacilla cinerea*

Status and Distribution: The grey wagtail is listed as Schedule 3 under the *WC Act* and as Migratory under the *EPBC Act* including international agreements to which Australia is a signatory. A rarely recorded, accidental vagrant that has on a few occasions been recorded on widely separated parts of the Australian coastline (Pizzey & Knight 2012).

Habitat: In Australia, near running water in disused quarries, sandy, rocky streams in escarpments and rainforest, sewerage ponds, ploughed fields and airfields (Pizzey & Knight 2012).

Likely presence in subject site: There is no habitat suitable for these species within the subject site.

Potential impact of development: No significant impact on these species or their preferred habitat will occur.


Forest Red-tailed Black Cockatoo *Calyptorhynchus banksii naso*

Status and Distribution: Listed as Scheduled 3 under the *WC Act* and as Vulnerable under the *EPBC Act*. Found in the humid and subhumid south west, mainly hilly interior, north to Gingin and east to Mt Helena, Christmas Tree Well, North Bannister, Mt Saddleback, Rock Gully and the upper King River (Johnstone and Storr 1998).

Habitat: Eucalypt forests, feeds on marri, jarrah, blackbutt, karri, sheoak and snottygobble. The forest red-tailed black cockatoo nests in the large hollows of marri, jarrah and karri (Johnstone and Kirkby 1999). In marri, the nest hollows of the forest red-tailed black cockatoo range from 8-14m above ground, the entrance is 12 – 41cm in diameter and the depth is one to five metres (Johnstone and Storr 1998).

Breeding commences in winter/spring. There are few records of breeding in the forest red-tailed black cockatoo (Johnstone and Storr 1998), but eggs are laid in October and November (Johnstone 1997; Johnstone and Storr 1998). Recent data however indicates that breeding in all months of the year occurs with peaks in spring and autumn–winter (Ron Johnstone pers comms). Incubation period 29 – 31 days. Young fledge at 8 to 9 weeks (Simpson and Day 2010).

J	F	M	A	M	J	J	A	S	O	N	D


 Period in which breeding is most likely to commence
 Period in which fledging/weening could extend through

Likely presence in subject site: Individuals of this species were recorded within the subject site during the field reconnaissance survey. Numerous examples of foraging evidence attributed to this species was also found (mainly chewed marri fruits). Most of the remnant native vegetation present (i.e. marri, jarrah and sheoak trees) within the subject site represents foraging habitat for this species.

Larger native endemic trees (>50cm DBH) present within the subject site can be considered potential breeding habitat, a number of which appeared to contain large hollows possibly suitable for actual nesting, though no confirmed nesting activity has been found to date despite an intensive assessment of potential hollows. One instance of apparent opportunistic roosting activity observed.

Potential impact of development: Potential for the loss of areas of breeding, foraging and roosting habitat.

Carnaby’s Black- Cockatoo *Calyptorhynchus latirostris*

Status and Distribution: Carnaby’s black cockatoo is listed as Scheduled 2 under the *WC Act* and as Endangered under the *EPBC Act*. Confined to the south-west of Western Australia, north to the lower Murchison River and east to Nabawa, Wilroy, Waddi Forest, Nugadong, Manmanning, Durokoppin, Noongar (Moorine Rock), Lake Cronin, Ravensthorpe Range, head of Oldfield River, 20 km ESE of Condingup and Cape Arid; also casual on Rottnest Island (Johnstone and Storr 1998).



Habitat: Forests, woodlands, heathlands, farms; feeds on *banksia*, *hakeas* and marri. Carnaby’s black cockatoo has specific nesting site requirements. Nests are mostly in

smoothed-barked eucalypts with the nest hollows ranging from 2.5 to 12m above the ground, an entrance from 23-30cm diameter and a depth of 0.1-2.5m (Johnstone and Storr, 1998).

Breeding occurs in winter/spring mainly in eastern forest and wheatbelt where they can find mature hollow bearing trees to nest in (Morcombe 2004). Judging from breeding records in the Storr – Johnstone Bird Data Bank, this species is currently expanding its breeding range westward and south into the jarrah – marri forests of the Darling Scarp and into the tuart forests of the Swan Coastal Plain including Yanchep, Lake Clifton and near Bunbury and possibly also in the Lancelin region. Carnaby’s black cockatoo have also been known to breed close to the town of Mandurah, as well as at Dawesville, Lake Clifton and Baldivis (pers. comm., Ron Johnstone, WA Museum) and there are small resident populations on the southern Swan Coastal Plain near Mandurah, Lake Clifton and near Bunbury. At each of these sites the birds forage in remnant vegetation and adjacent pine plantations (Johnstone 2008).

Carnaby's black cockatoo lays eggs from July/August to October/November, with most clutches being laid in August and September (Saunders 1986). Most of the breeding is in September through to December (Ron Johnstone pers comms). Birds in inland regions may begin laying up to three weeks earlier than those in coastal areas (Saunders 1977). The female incubates the eggs over a period of 28-29 days. The young depart the nest 10–12 weeks after hatching (Saunders 1977; Smith & Saunders 1986).

J	F	M	A	M	J	J	A	S	O	N	D

 Period in which breeding is most likely to commence
 Period in which fledging/weening could extend through

Likely presence in subject site: Some foraging evidence attributed to this species found during the field survey (chewed jarrah fruits and banksia cones). Most of the remnant native vegetation present (i.e. marri, jarrah and banksia trees) within the subject site represents foraging habitat for this species.

Larger native endemic trees (>50cm DBH) present within the subject site can be considered potential breeding habitat, a number of which appeared to contain large hollows possibly suitable for actual nesting, though no confirmed nesting activity has been found to date despite an intensive assessment of potential hollows. No roosting activity observed.

Potential impact of development: Potential for the loss of areas of breeding, foraging and roosting habitat.



Baudin’s Black- Cockatoo *Calyptorhynchus baudinii*

Status and Distribution: Listed as Scheduled 2 under the *WC Act* and as Vulnerable under the *EPBC Act*. Confined to the south-west of Western Australia, north to Gidgegannup, east to Mt Helena, Wandering, Quindanning, Kojonup, Frankland and King River and west to the eastern strip of the Swan Coastal Plain including West Midland, Byford, Nth Dandalup, Yarloop, Wokalup and Bunbury (Johnstone and Storr 1998). On the southern Swan Coastal Plain this cockatoo is in some areas resident but mainly a migrant moving from the deep south-west to the central and northern Darling Range. Between March and September most flocks move north and are concentrated in the northern parts of the Darling Range. During this period birds forage well out onto the southern Swan Coastal Plain to areas such as Harvey, Myalup, Bunbury, Capel, Dunsborough and Meelup. While generally more common in the Darling Range this species can also be common on parts of the southern Swan Coastal Plain especially in mid-August – September when flocks begin to return to their breeding quarters (Johnstone 2008).

Habitat: Mainly eucalypt forests where it feeds primarily on the marri seeds, (Morcombe 2004), *banksia*, *hakeas* and *erodium* sp. Also strips bark from trees in search of beetle larvae (Johnstone and Storr 1998). This species of cockatoo nests in large tree hollows, 30–40 cm in diameter and more than 30 cm deep (Saunders 1974).

Baudin's black cockatoo breeds in late winter and spring, from August to November or December (Johnstone 1997; Saunders 1974; Saunders *et al.* 1985). Eggs laid in October (Johnstone and Storr 1998). Based on observations at currently known nest sites breeding mainly occurs within the October-December period (Ron Johnstone pers comm.). Incubation is 28 – 30 days. Young fledge at 8 to 9 weeks (Simpson and Day 2010).

J	F	M	A	M	J	J	A	S	O	N	D

 Period in which breeding is most likely to commence
 Period in which fledging/weening could extend through

Likely presence in subject site: This species is only recorded in this area of its documented range on infrequent occasions. It is listed as a potential species but probably only occurs in small groups and on rare occasions.

Potential impact of development: No impact on this species or its preferred habitat is anticipated.

Chuditch *Dasyurus geoffroi*

Status and Distribution: Listed as Scheduled 3 under the *WC Act* and as Vulnerable under the *EPBC Act*. Formerly occurred over nearly 70 per cent of Australia. The Chuditch now has a patchy distribution throughout the Jarrah forest and mixed Karri/Marri/Jarrah forest of southwest Western Australia. Also occurs in very low numbers in the Midwest, Wheatbelt and South Coast Regions with records from Moora to the north, Yellowdine to the east and south to Hopetoun.

Habitat: Chuditch are known to have occupied a wide range of habitats from woodlands, dry sclerophyll (leafy) forests, riparian vegetation, beaches and deserts. Riparian vegetation appears to support higher densities of Chuditch, possibly because food supply is better or more reliable and better cover is offered by dense vegetation. Chuditch appear to utilise native vegetation along road sides in the wheatbelt (DEC 2012a). The estimated home range of a male chuditch is over 15 km² whilst that for females is 3-4 km² (Sorena and Soderquist 1995).

Likely presence in subject site: This species is rarely recorded on the coastal plain (Dell 2000). A single male Chuditch was captured in the Paganoni Swamp reserve in May 2010 (Chambers 2010). No Chuditch were captured during a second trapping program of the same area in late 2010. Besides this one individual it was considered unlikely that any other Chuditch were present within Paganoni Swamp Reserve and that it had in all probability moved into the area while searching for females to mate with (Chambers 2011).

These observations are consistent with the general acceptance of the fact that the species is extinct on the Perth section of the Swan Coastal Plain due to severe habitat fragmentation, degradation and the presence of feral predators. Occasional records (e.g. Wandi, Paganoni Swamp) are most likely transient male individuals from Darling Range forests and are extremely unlikely to represent members of resident populations in the areas where they were observed.

This species is not listed as potential species as it is only likely to occur on very rare occasions. A self-sustaining population of this species could not persist in the area.

Potential impact of development: No impact on this species or its preferred habitat is anticipated.

South-western Brush-tailed Phascogale *Phascogale tapoatafa wambenger*

Status and Distribution: Listed as Scheduled 6 under the *WC Act*. Present distribution is believed to have been reduced to approximately 50 per cent of its former range. Now known from Perth and south to Albany, west of Albany Highway. Occurs at low densities in the northern jarrah forest. Highest densities occur in the Perup/Kingston area, Collie

River valley, and near Margaret River and Busselton (DEC information pamphlet). Records are less common from wetter forests.

Habitat: The south-western brush-tailed phascogale is a nocturnal carnivore relying on tree hollows as nest sites. It has been observed in dry sclerophyll forests and open woodlands that contain hollow-bearing trees generally with a sparse ground cover. The home range for a female brush-tailed phascogale is estimated at between 20 and 70 ha, whilst that for males is given as twice that of females. In addition, they tend to utilise a large number (approximately 20) of different nest sites throughout their range (Soderquist 1995).

Likely presence in subject site: Several individuals of this species have been captured in Paganoni Swamp reserve and east of the Kwinana Freeway at Keralup in the past though foxes and drying weather conditions appear to be affecting population levels (Chambers 2010, 2011). While the current status within the subject site itself is difficult to ascertain, it does contain suitable habitat with numerous trees containing hollows so a population may persist.

Potential impact of development: Loss or modification of some areas of habitat.

Southern Brown Bandicoot *Isoodon obesulus fusciventer*

Status and Distribution: Listed as Priority 4 by DPaW. Widely distributed in the south west from near Cervantes north of Perth to east of Esperance, patchy distribution through the Jarrah and Karri forest and on the Swan Coastal Plain, and inland as far as Hyden. Has been translocated to Julimar State Forest, Hills Forest Mundaring, Tutanning Nature Reserve, Boyagin Nature Reserve, Dongolocking Nature Reserve, Leschenault Conservation Park, and Karakamia and Paruna Sanctuaries (DPaW information pamphlet) and Nambung National Park (DPaW pers. coms.)

Habitat: Dense scrubby, often swampy, vegetation with dense cover up to one metre high, often feeds in adjacent forest and woodland that is burnt on a regular basis and in areas of pasture and cropland lying close to dense cover. Populations inhabiting jarrah and wandoo forests are usually associated with watercourses. Southern brown bandicoot can thrive in more open habitat subject to exotic predator control (DPaW information pamphlet).

Likely presence in subject site: The majority of the subject site appears to be unsuitable for this species to utilise due to a lack of ground cover. Not listed as a potential species though it may occur in adjoin wetland habitats to the west.

Potential impact of development: No impact on this species or its preferred habitat will occur.

Western Ringtail Possum *Pseudocheirus occidentalis*

Status and Distribution: Listed as Scheduled 1 under the *WC Act* and as Vulnerable under the *EPBC Act*. Common in suitable habitat (de Tores 2008). The highest densities of this species are recorded in peppermint habitat near the Busselton area (de Tores 2008).

The western ringtail possum has a restricted distribution in south-western Western Australia. Most known populations (natural and translocated) are now restricted to near coastal areas of the south west from the Dawesville area to the Waychinicup National Park. Inland, it is also known to be relatively common in a small part of the lower Collie River valley, the Perup Nature Reserve and surrounding forest blocks near Manjimup.

Habitat: The western ringtail possum was once located in a variety of habitats including coastal peppermint, coastal peppermint-tuart, jarrah-marri associations, sheoak woodland, and eucalypt woodland and mallee. Coastal populations mostly inhabit peppermint-tuart associations with highest densities in habitats with dense, relatively lush vegetation. Inland, the largest known populations occur in the Upper Warren area east of Manjimup (Wayne *et al.* 2005). In this area the peppermint tree is naturally absent and jarrah-marri associations constitute the species refuge and foraging habitat. In areas where peppermint is absent or rare WRP's have been observed feeding predominately on young jarrah, *Nuytsia floribunda* and *Allocasuarina fraseriana* (G Harewood pers. obs.).

Likely presence in subject site: This species is not known to persist north of the Dawesville area and is considered to be locally extinct. Not listed as potential species.

Potential impact of development: No impact on this species or its preferred habitat will occur.

Western Brush Wallaby *Macropus irma*

Status and Distribution: Listed as Priority 4 by DPaW. The western brush wallaby is distributed across the south-west of Western Australia from north of Kalbarri to Cape Arid (DPaW information pamphlet nd).

Habitat: The species optimum habitat is open forest or woodland, particularly favouring open, seasonally wet flats with low grasses and open scrubby thickets. It is also found in some areas of mallee and heathland, and is uncommon in karri forest (DPaW information pamphlet nd).

Likely presence in subject site: Most the subject site is unsuitable for this species given the sparse nature of vegetation. Possibly locally extinct.

Potential impact of development: No impact on this species or its preferred habitat will occur.

Woylie *Bettongia penicillata ogibyi*

Status and Distribution: Listed as Schedule 1 under the *WC Act* and as Endangered under the *EPBC Act*. Restricted to remnant habitat patches in south west WA where populations are managed by way of fox control and reintroduction programs (e.g. Avon Valley, Walyunga National Park and Paruna Sanctuary).

Habitat: Open forest and woodland with a low, dense, understorey of tussock grasses or woody scrub. Formerly occurred in a wider range of habitats including spinifex hummock grasslands.

Likely presence in subject site: This species is locally extinct. Not listed as potential species.

Potential impact of development: No impact on this species or its preferred habitat will occur.

Western False Pipistrelle *Falsistrellus mackenziei*

Status and Distribution: Listed as Priority 4 by DPaW. Listed as Near Threatened by the ICUN. Confined to south west W.A. south of Perth and east to the wheat belt. Most records from Karri forests but also recorded in wetter stands of jarrah and tuart and woodlands on the Swan Coastal Plain (Menkhorst and Knight 2011). Range appears to be contracting southwards, presumably due to drying climate. Not recorded north of Collie in recent times (Bob Bullen 2010, pers. comm.)

Habitat: This species of bat occurs in high forest and coastal woodlands. It roosts in small colonies in tree hollows and forages at canopy level and in the cathedral-like spaces between trees.

Likely presence in subject site: Rarely recorded in this area in recent times and possibly locally extinct. Not listed as a potential species.

Potential impact of development: No impact on this species is anticipated.

Water Rat *Hydromys chrysogaster*

Status and Distribution: Listed as Priority 4 by DPaW. The water rat is widely distributed around Australia and its offshore islands, New Guinea and some adjacent islands. It occurs in fresh brackish water habitats in the south-west of Western Australia, but occurs in marine environments along the Pilbara coastline and offshore islands.

Previous survey work in the south west suggested this species was relatively common and widespread though difficult to capture (Christensen *et al.* 1985, How *et al.* 1987).

Habitat: The water rat occupies habitat in the vicinity of permanent water, fresh, brackish or marine. Likely to occur in all major rivers and most of the larger streams as well as bodies of permanent water in the lower south west (Christensen *et al.* 1985).

Likely presence in subject site: No suitable habitat within the subject site itself.

Potential impact of development: No impact on this species or its preferred habitat will occur.

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The conclusions are based upon field data and the environmental monitoring and/or testing carried out over a limited period of time and are therefore merely indicative of the environmental condition of the site at the time of preparing the report. Also it should be recognised that site conditions, can change with time.

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