Carramar Golf Course

Including Tranquil Park

Flora, Vegetation and Fauna Assessment

Prepared for the City of Wanneroo

DECEMBER 2018

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1.0 EXECUTIVE SUMMARY

This report was commissioned by the City of Wanneroo. It presents the findings of spring flora, vegetation and fauna assessments for the Carramar Golf Course and associated Tranquil Park Carramar (Figure 1).

The information presented is suitable for use in Western Australian and Commonwealth Environmental Impact Assessment (EIA) processes and therefore this assessment is based on the requirements of the Western Australian Environmental Protection Authority (EPA) and Department of Water, Environment and Regulation (DWER) and the Australian Department of Environment and Energy (DoEE). The surveys were designed to be consistent with EPA (2016e) for flora and vegetation and EPA (2016b, 2016c) for fauna.

1.1 FLORA

A Detailed Flora and Vegetation survey (Environmental Protection Authority, 2016e) (previously known as a Level 2 Survey) was completed for the survey area (Figure 1) on the 27th and 28th September 2018.

A search of the Department of Biodiversity Conservation and Attractions (DBCA) Threatened Species and Communities Branch database (DBCA, 2018) identified no previously known records of Priority or Threatened Flora from within the survey area. A search of the *EPBC Act 1999* Protected Matters Search Tool (Department of Environment and Energy, 2017) listed 11 Threatened Flora (TF) as potentially occurring in the region. In total nine Priority and 11 Threatened Flora species were identified as known from the region none of which had previously been recorded from within the survey area.

A total of 221 taxa were recorded from the survey area, of which 160 or 72.4% were natives. According to Florabase (Western Australian Herbarium, 1998-) the 160 native taxa represent 4.3% of the total native flora species known from the IBRA region of the Swan Coastal Plain.

Two Priority Flora species were recorded from the survey area:

Poranthera moorokatta (Priority 2) is an erect herb to 4.7cm (Barrett, 2012). There were 6 collections of this species in the WA Herbarium at the time of publication (Council of Heads of Australasian Herbaria, 2013). Its main range is between Kings Park and Ellenbrook, however this species is likely to be more widespread than records currently indicate due to it historically being overlooked as the more common *Poranthera microphylla.*

Jacksonia sericea (Priority 4) is a low spreading shrub to 60cm tall with orange pea flowers in December to February (Western Australian Herbarium, 1998-). There were 61 collections of this species in the WA Herbarium (Council of Heads of Australasian Herbaria, 2013) with its main range along near-coast areas between Pinjarra and Wanneroo. This species is known from multiple populations that span a relatively large area across the Swan Coastal Plain, although there is little information available on the current condition of many of those populations.

Eleven species of 'other' conservation significance were recorded. These were mainly species that were at the extent of their known range within the survey area or poorly collected species.

Sixty-one introduced flora species (weeds) were recorded from the survey area. This included a combination of herbaceous, grass and woody weeds. Eleven of these weeds had been given a High rating for invasiveness and spread as environmental weeds under the Western Australian Environmental Weed Strategy (WAEWS) (CALM, 1999). Two of the weeds recorded are listed as Declared Pests under the *Biosecurity and Agriculture Management Act* 2007. Two Weeds of National Significance (WONS) were recorded in the survey area. A full list of weeds is presented in Appendix A.

See Section 4.0 for more detail.

1.2 VEGETATION

A Detailed Flora and Vegetation Survey (Environmental Protection Authority, 2016e) (previously known as a Level 2 Survey) was completed for the survey area (Figure 1).

A search of the Department of Biodiversity Conservation and Attractions (DBCA) Threatened Species and Communities Branch Priority (PEC) and Threatened Ecological Community (TEC) database (DBCA, 2018) identified records of PEC 'Banksia Dominated Woodlands of the Swan Coastal Plain IBRA Region' (WA) (Figure 2) previously known from the survey area.

The vegetation was described as:

A JARRAH-BANKSIA-ALLOCASUARINA WOODLAND ON CONSOLIDATED DUNES

A1: Woodland to Open Forest of Jarrah *Eucalyptus marginata* subsp*. marginata, Banksia attenuata, B. menziesii* and/or *Allocasuarina fraseriana* over intact understorey. Tranquil Park Reserve (Very Good Condition). Small area in Carramar Golf Course (Good condition).

A2: Open Forest of Marri *Corymbia calophylla* over intact understorey. Tranquil Park Reserve (Good to Very Good Condition).

B: MODIFIED VEGETATION

B1: Open Woodland to Open Forest of Jarrah *Eucalyptus marginata* subsp*. marginata, Banksia attenuata, B. menziesii* and/or *Allocasuarina fraseriana* over modified understorey. Carramar Golf Course (Good to Degraded, Degraded).

B2: Open Forest of Marri *Corymbia calophylla* over modified understorey. Carramar Golf Course (Good to Degraded).

C: CLEARED AREAS

C1: Carramar Golf Course. Completely Degraded. Cleared areas. Fairways, grassed and landscaped areas, infrastructure, clubhouse, paths, firebreaks.

C2: **Constructed Lake.** Carramar Golf Course. Completely Degraded. Native colonisers included the native sedges *Juncus pallidus* and *Elatine gratioloides*.

Statistical analysis demonstrated that Vegetation Types A1 and A2 represent Floristic Community Type (FCT) 28 (Gibson *et al.*, 1994). Vegetation Types B1 and B2 would also originally have represented FCT28 prior to disturbance.

FCT28 and state-listed PEC 'Banksia Dominated Woodlands of the Swan Coastal Plain IBRA Region' (P3) represent the 'Banksia Woodlands of the Swan Coastal Plain' TEC (Endangered) protected under the *Environmental Protection Biodiversity Conservation (EPBC) Act 1999*.

Vegetation condition was a significant factor when assessing TEC status under the *EPBC Act 1999*, as the thresholds for inclusion generally apply at Good and better condition. Vegetation Types A1 and A2 (Tranquil Park) were predominantly in Very Good condition and therefore represent the federal TEC 'Banksia Woodlands of the Swan Coastal Plain'. Vegetation Types B1 and B2 (Figure 2) (Carramar Golf Course) varied from Degraded to Degraded to Good (Figure 3) condition and therefore do not represent the TEC or are extremely marginal in representing this TEC. There was also a small area in the Carramar Golf Course that was in Good condition (Figure 2 and 3) and qualifies for TEC status, however this area is exposed to ongoing degradation from weed invasion, grazing and exposure. It is possible that if some of the grazing pressure is removed from Carramar Golf Course, some areas may over time improve to Good condition.

The vegetation in Tranquil Park (Figure 1) has high conservation significance. It is predominantly in Very Good condition. It represents the state listed PEC 'Banksia Dominated Woodlands of the Swan Coastal Plain IBRA Region' (P3) and the federally listed 'Banksia Woodlands of the Swan Coastal Plain' TEC (Endangered). It represents a vegetation complex (Heddle *et al.*, 1980) and type (Beard, 1979) that has less than 30% remaining (taking into account that these figures are over-estimates and don't take into account rarer subtypes).

See Section 4.0 for more detail.

1.3 FAUNA

The Level 1 Fauna Assessment comprised a Fauna Desktop Study and an on-site Level 1 Reconnaissance Fauna Survey over the survey area (Figure 5). Full details on the aims of a level 1 Fauna Assessment can be found in Section 5.1 and the methodology in Section 5.2.

Five distinct fauna habitats were identified in the present survey. These were:

Banksia - Jarrah - Marri Woodland representing state-listed Priority Ecological Community (PEC) (P3) '*Banksia* Dominated Woodlands of the Swan Coastal Plain IBRA Region' and Federally listed Threatened Ecological Community (TEC) 'Banksia Woodlands of the Swan Coastal Plain) (Plate 7).

Disturbed *Banksia* – Jarrah – Marri Woodland over Grass Tree (*Xanthorrhoea*) (Plates 8 and 9).

Parkland cleared Jarrah-Marri over Grass Tree (*Xanthorrhoea*) (Plate 10).

Watered Turf Fairways (Plate 11).

Ornamental Pond/Lake (in the centre of the Carramar Golf Course).

The Fauna Desktop Study identified 562 fauna species as potentially occurring in the general region. During the on-site Level 1 Reconnaissance Fauna Survey, a number of species were recorded and these are marked with an asterisk in Appendix E.

The combined Fauna Desktop Study and on-site Level 1 Reconnaissance Fauna Survey identified 15 amphibians, 73 reptiles, 216 birds, 28 mammals and 230 invertebrates as potentially occurring in the general region (Appendix E). These included five conservation significant reptiles, eight birds, four mammals and seven invertebrates. More detail about these species, their scientific names, conservation status and the possible threats to them can be found in Table 16.

In total the combined Fauna Desktop Study and on-site Level 1 Reconnaissance Fauna Survey produced a list of 24 conservation significant species that may potentially be in the general region.

Table 16 lists these fauna species, together with information on their conservation status and reason for that conservation status (if applicable), their biology, probability of their presence within the survey area (rated as Confirmed or rating from High, High-Medium, Medium, Medium-Low, Low, Low-Negligible and Negligible probability), the threats and impacts that will affect them if they are present and in which areas they would be most affected. This table is ordered to reflect the relative conservation and management priority for each of these species as a guideline only, based on these factors and the biology of each species.

The Carramar Golf Course including Tranquil Park (Figure 1 and 5) has a number of fauna conservation values:

It helps provide a corridor of reserved vegetation in suburbia. Some of the fauna habitat in the survey area is very good quality, while some is parkland cleared (degraded) but contains valuable large mature native trees. Although it is not directly connected to other suburban reserves, it is almost adjacent to the Neerabup National Park and very close to Lake Joondalup and various bushland blocks to the north. It is also bordered on its north side by a large area of semi-rural blocks in Carramar that have been established for a long time and contain many large trees and quite a lot of understorey.

It supports *Banksia* – Jarrah - Marri Woodland which is a State listed Priority Ecological Community (P3) '*Banksia* Dominated Woodlands of the Swan Coastal Plain IBRA Region' and Federally listed Threatened Ecological Community (TEC) 'Banksia Woodlands of the Swan Coastal Plain' (Plate 7). This TEC is located in Tranquil Park and supports its own unique assemblage of fauna. As a fauna habitat, it is in good to very good condition. For more detail on this TEC refer to vegetation (Section 4.4.3).

The *Banksia* – Jarrah – Marri Woodland Fauna Habitat 1 supports a high diversity of plant species and appears to support a high diversity of animal species, which is particularly significant considering that it is a small area located in suburbia.

Out of the 24 conservation significant species listed as potentially being in the nearby region, there is reasonable probability that the survey area supports seven of these. It is important that these are

considered carefully in managing the area (see Section 5 and Table 16). Particularly notable species in this regard are the Carnaby's Black-Cockatoo, Red-tailed Black-Cockatoo, Baudin's Black-Cockatoo, Southern Brown Bandicoot, Graceful Sunmoth, Rainbow Bee-eater and Peregrine Falcon.

The Carramar Golf Course and Tranquil Park may be important for the Carnaby's Black-Cockatoo (classified as Vulnerable under the *EPBC Act 1999*) (recorded in the present survey), the Red-tailed Black-Cockatoo (Endangered under the *EPBC Act 1999*) (recorded in the present survey) and the Baudin's Black-Cockatoo (Vulnerable under the *EPBC Act 1999*) by providing food and roosts, and potentially providing nesting hollows. It may also be important for the Southern Brown Bandicoot (DBCA Priority 4) (recorded in the present survey), the Graceful Sunmoth (DBCA Priority 4) which has been previously recorded in the reserve and there is plenty of its host plant *Lomandra hermaphrodita* present and the Rainbow Bee-eater (classified as a Marine Species under the *EPBC Act 1999*) (recorded in present survey), which may also breed there. The Peregrine Falcon (classified under Other Specially Protected Fauna Schedule 7 of the *Biodiversity Conservation Act 2016*) may also use the area, taking advantage of the large trees, open areas and pond/lake containing waterbirds.

The survey area supports a high number of large mature trees, which can provide nest hollows and large canopies for tree dwelling fauna. These can be found in Tranquil Park and the Carramar Golf Course.

Most of Fauna Habitat 1: *Banksia* - Jarrah - Marri Woodland in Tranquil Park is in good to very good condition (Figure 5). However, rabbits have disrupted this bushland in places as is evidenced by diggings. There are warrens that are largely disused however this pest species appears to be returning to the area.

The healthiest part of Fauna Habitat 2 (Figure 5), which has quite a lot of intact understory and lots of leaf litter, is also in good condition. This area is located within the Carramar Golf Course, immediately south of Tranquil Park and appears not to be used greatly by the resident kangaroos.

Tranquil Park appears to be free of disease. Although, this could change with the number of people using it with the possibility of dieback and other diseases being introduced.

Tranquil Park appears to be appreciated for passive recreation and education. Observations made during the present survey, suggests it is well used by the public for walking and dog walking. It is also potentially used for jogging, looking for wildflowers, bird watching and may be used by families. There are only a few tracks through this area, and pedestrians appear to be adhering to those tracks. It was notably very clean, with no sign of people dumping or dropping rubbish.

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2.0 PROJECT

This report was commissioned by the City of Wanneroo. It presents the findings of a spring flora, vegetation and fauna assessment for the Carramar Golf Course and associated Tranquil Park (Figure 1).

The information presented is suitable for use in Western Australian and Commonwealth Environmental Impact Assessment (EIA) processes and therefore to satisfy the requirements of the Western Australian Environmental Protection Authority (EPA) and Department of Water, Environment and Regulation (DWER) and the Australian Department of Environment and Energy (DoEE).

2.1 SCOPE

The scope of works requested by the City of Wanneroo included a desktop review and spring flora, vegetation and fauna survey, including mapping and data.

As this assessment may be used in the Environmental Impact Assessment (EIA) processes, this report presents the findings of biological assessments that are consistent with a:

Detailed Flora and Vegetation Survey (EPA, 2016e)(Previously known as a Level 2 Survey)

Level 1 Reconnaissance Fauna Survey (EPA, 2016b and 2016c)

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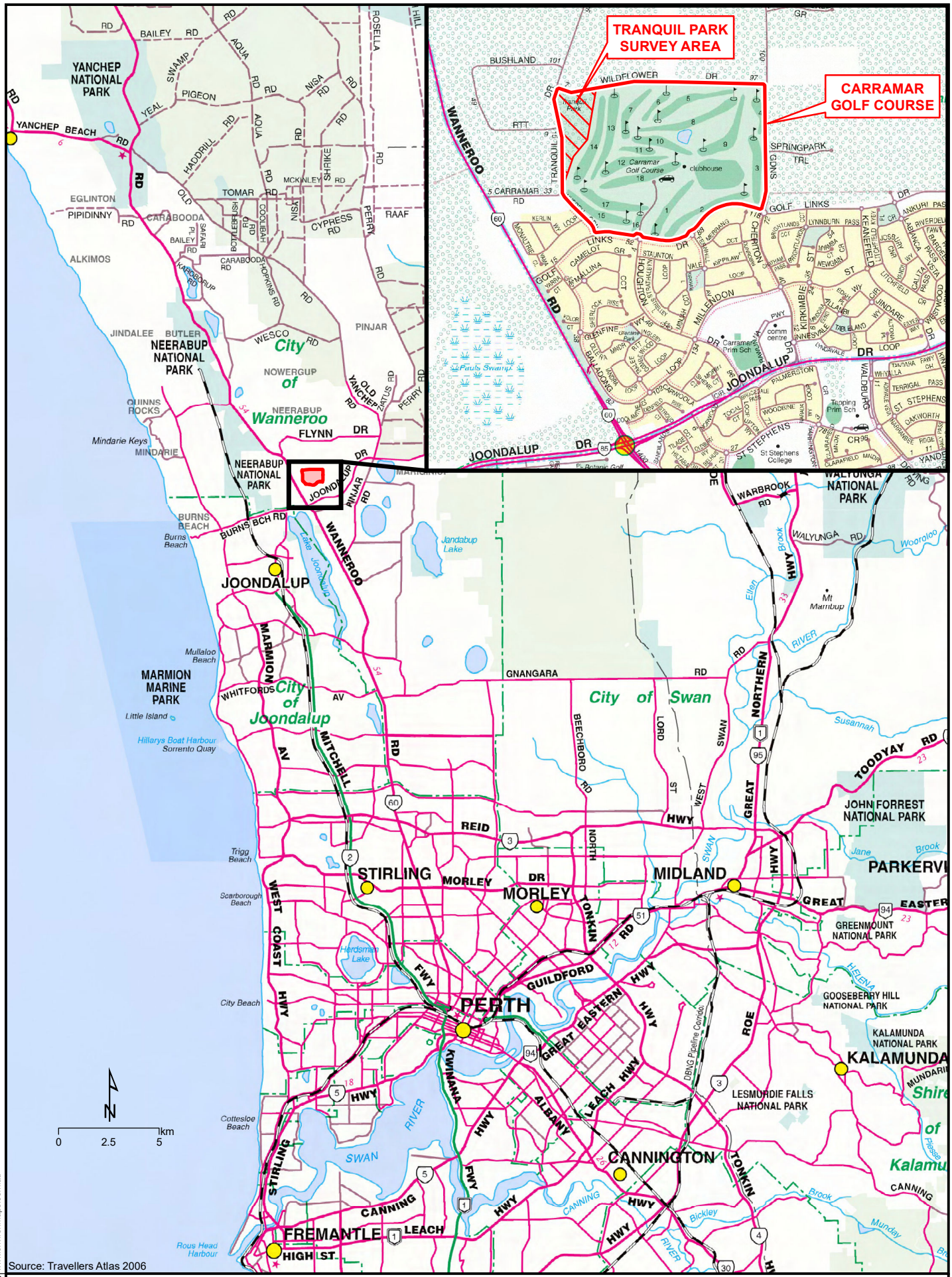

Source: Travellers Atlas 2006

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FIGURE 1

CARRAMAR GOLF COURSE LOCALITY MAP

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3.0 BACKGROUND

3.1 LANDFORMS AND SOIL

Churchward and McArthur (1980) describe the dune systems of the Swan Coastal Plain as arranged in an age sequence from east to west. The Bassendean Dunes are the oldest in the east, the Spearwood then the Quindalup the youngest dunes closest to the coast.

The survey area is in the Spearwood Dunes, which is described as limestone overlain by yellow-brown sand. There are two different sub-types within the Spearwood Dunes, the Karrakatta system in the east and the Cottesloe system in the west. The soils are shallower in the Cottesloe system, with limestone often close to the surface while deep sands occur in the Karrakatta system. The project is within the Karrakatta system.

3.2 CLIMATE AND SEASONAL CONDITIONS

The closest comprehensive Bureau of Meteorology (BoM) weather recording station was Wanneroo (Site No. 009105) (Latitude: 31.73° S, Longitude: 115.79° E). The mean annual rainfall between 1905 and 2017 for Wanneroo was 796.8 mm (Bureau of Meteorology, 2018). Most rainfall occurs between the months of May and August (726.9 mm).

Rainfall for the months of April to August 2018 leading up to the field survey in mid-September was 556.2 mm. This is compared to a long-term mean for the same period of 595.4 mm.

3.2.1.1 IBRA Region

The survey area is in the Interim Biogeographical Regionalisation of Australia (IBRA) region of the Swan Coastal Plan (SCP) in sub-region SWA2: Perth (Thackway and Cresswell, 1995) (Department of Environment and Heritage, 2000).

4.0 FLORA AND VEGETATION

4.1 PREVIOUS STUDIES

4.1.1 Vegetation Complexes

According to 1:250,000-scale vegetation mapping by Heddle *et al.* (1980), the survey area is in the Spearwood Dunes in vegetation complex 49: Karrakatta Central and South. The vegetation is described as an open forest of Tuart-Jarrah-Marri, with Tuart being more common in the drier western parts and Jarrah in the moister eastern parts. Common species are described as *Banksia attenuata, B. menziesii, Banksia grandis* and *Allocasuarina fraseriana* with some *Agonis flexuosa* and shrubs *Hibbertia hypericoides, Conospermum stoechadis, Hovea trisperma* and *Bossiaea eriocarpa*.

The original extent of Karrakatta Central and South was 49,786 hectares, of which 11,906 hectares or 24% remains (Local Biodiversity Project, 2013). This figure does not take into account fully the condition of the remaining areas.

4.1.2 Vegetation Survey of Western Australia (Beard, 1979)

Beard (1979) mapped the survey area as Vegetation Association 6: *'Medium Woodland, tuart and jarrah'*. Shepherd *et al.* (2002) states that the original extent of Vegetation Association 6 was 70,001 hectares of which 18,398 hectares or 23.3% remains.

4.2 LEGISLATION AND GUIDELINES

4.2.1 Western Australian *Environmental Protection Act 1986*

The *Environmental Protection (EP) Act 1986* is the guiding legislation for Environmental Impact Assessment (EIA) in Western Australia.

Even where no formal assessment is required by the EPA, clearing of native vegetation in Western Australia requires a permit under the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*.

The supporting information required for processes under the *Environmental Protection Act 1986* is generally as per EPA technical guidance (Environmental Protection Authority, 2016e).

4.2.1.1 *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*

The *EP Act 1986* includes the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004* under which clearing permits are required to clear native vegetation. The permit system is administered by the Western Australian Department of Water and Environmental Regulation (DWER).

4.2.2 Commonwealth *Environmental Protection Biodiversity Conservation Act 1999*

Species and ecosystems listed as Matters of National Environmental Significance (MNES) are protected under the Commonwealth *Environmental Protection Biodiversity Conservation Act 1999*.

4.2.3 Western Australian *Wildlife Conservation Act 1950*

This is the principal guiding legislation for protection of flora and fauna in Western Australia. All native species are protected under the *Wildlife Conservation Act 1950*. Additionally, Threatened Flora and Fauna are provided an extra degree of protection, with fines of $10,000 for 'taking' of these species.

4.2.4 Western Australian *Biodiversity Conservation Act 2016*

This act is to replace the *Wildlife Conservation Act 1950* in Western Australia. Both acts are currently in force. The *BC Act 2016* is not yet fully functional, with not all regulations in force. According to Department

of Biodiversity Conservation and Attractions (2018) the remaining regulations will come into full force on the 1st January 2019.

What is known about the new act is that it will facilitate the listing of ecological communities as well as species under the legislation. There will be substantially higher and broader ranging fines, up to $500,000 for individuals and $2,500,000 for corporate entities. There are also substantial fines to individuals and organisations for not reporting matters of environmental significance.

4.2.5 Flora

All native flora are protected under the Western Australian *Wildlife Conservation Act 1950*. Flora cannot be taken without a permit.

4.2.5.1 Threatened Flora – *Wildlife Conservation Act 1950*

Additionally, the Western Australian Minister for Environment can declare any species thought 'rare' an extra level of protection. Species on this list are referred to as Threatened Flora (TF). The definition of TF are provided in Table 1 (Department of Parks and Wildlife, 2017a). These are also sometimes referred to as DRF or Declared Rare Flora. Each TF species is also given a rank consistent with IUCN Red List criteria (Table 2) (Department of Parks and Wildlife, 2017a). The TF list is periodically updated under the *Wildlife Conservation Act 1950* and updated lists are published in the Government Gazette. The TF status of species is also published on Florabase (Western Australian Herbarium, 1998-). According to Florabase, there are 429 TF (T) currently listed for the southwest of Western Australia and 15 species which are thought to be extinct (X).

Table 1: Definition of Threatened Flora under the *Wildlife Conservation Act 1950*

T:	**Threatened species**
Specially protected under the *Wildlife Conservation Act 1950,* listed under Schedule 1 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora (which may also be referred to as Declared Rare Flora). Species 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:	**Presumed extinct species**
Specially protected under the *Wildlife Conservation Act 1950,* listed under Schedule 2 of the Wildlife Conservation (Specially Protected Fauna) Notice for Presumed Extinct Fauna and Wildlife Conservation (Rare Flora) Notice for Presumed Extinct Flora (which may also be referred to as Declared Rare Flora). Species which have been adequately searched for and there is no reasonable doubt that the last individual has died, and have been gazetted as such.	

Table 2: IUCN-Equivalent Status of Threatened Flora under *Wildlife Conservation Act 1950*

CR	**Critically Endangered**	Considered to be facing an extremely high risk of extinction in the wild.
EN	**Endangered**	Considered to be facing a very high risk of extinction in the wild.
VU	**Vulnerable**	Considered to be facing a high risk of extinction in the wild.

4.2.5.2 Priority Flora (Western Australia)

A supplementary Priority Flora (PF) list is maintained by the Department of Parks and Wildlife. This contains flora species that are in need of further study before being assessed for Threatened Flora (TF) status. It also includes species that have been adequately surveyed, but which require close monitoring to prevent their decline. Species on the PF list are not specifically protected under current legislation, however they are closely considered in environmental impact assessment processes. There are four categories of PF (Table 3) (Department of Parks and Wildlife, 2017a). The status of PF are regularly updated and published on Florabase (Western Australian Herbarium, 1998-).

Table 3: Western Australian Priority Flora Criteria and Definitions.

P1: Priority One: Poorly-known species
Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.
P2: Priority Two: Poorly-known species
Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.
P3: Priority Three: Poorly-known species
Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.
P4: Priority Four: Rare, Near Threatened and other species in need of monitoring
(a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These species are usually represented on conservation lands. (b) Near Threatened. Species that are considered to have been adequately surveyed and that are close to qualifying for Vulnerable, but are not listed as Conservation Dependent. (c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

4.2.5.3 Threatened Flora – *Environmental Protection Biodiversity Conservation (EPBC) Act 1999*

Some flora species have additional protection under the Commonwealth *Environmental Protection Biodiversity Conservation (EPBC) Act 1999.* There is significant overlap in that state-listed TF are largely the same species as TF listed under the federal *EPBC Act*. There are six categories of Threatened Flora under the *EPBC Act* (Table 4).

Table 4: Categories of Threatened Flora Species under the *EPBC Act 1999* (IUCN-Equivalent Status).

EX:	**Extinct**
No reasonable doubt that the last member of the species has died.	
EW:	**Extinct in the Wild**
Species known only to survive in cultivation, in captivity or as a naturalised population well outside its past range or it has not been recorded in its known habitat in an appropriate season anywhere in its past range despite exhaustive surveys.	
CR:	**Critically Endangered**
Species is considered to be facing an extremely high risk of extinction in the wild.	
EN:	**Endangered**
Species is not critically endangered; and it is facing a very high risk of extinction in the wild in the near future	
VU:	**Vulnerable**
Species is not critically endangered or endangered; and it is facing a high risk of extinction in the wild in the medium−term future	
CD:	**Conservation Dependent**
Species is the focus of a specific conservation program the cessation of which would result in the species becoming vulnerable, endangered or critically endangered.	

4.2.5.4 Species of 'Other' Conservation Significance

Species other than those listed under state and federal legislation and guidelines e.g. Threatened Flora, may have conservation significance. These are defined by the Environmental Protection Authority (2016e) as those species that may include but not be limited to those that are:

Priority flora species.

Locally endemic or associated with a restricted habitat type.

New species or anomalous features that indicate a potential new species.

Representation of a species range (extensions, edges of ranges or an outlier population).

Unusual species including restricted sub-species, varieties or naturally occurring hybrids.

Relictual status, representative of taxonomic groups no longer in the broader landscape.

4.2.6 Vegetation

4.2.6.1 Threatened Ecological Communities (TECs) (Western Australia)

In Western Australia, Threatened Ecological Communities (TECs) are not currently specifically protected under the *Wildlife Conservation Act 1950*. However Western Australian TECs are still closely considered in environmental impact assessment processes. There are four criteria for state listed TECs (Table 5)

(Department of Parks and Wildlife, 2013b). Currently there are 69 TECs that have been endorsed by the Western Australian Minister for Environment (DBCA, 2018).

Table 5: Criteria for Western Australian Threatened Ecological Communities (TECs).

Presumed Totally Destroyed (PD)
An ecological community that has been adequately searched for but for which no representative occurrences have been located. The community has been found to be totally destroyed, or so extensively modified throughout its range that no occurrence of it is likely to recover its species composition and/or structure in the foreseeable future. An ecological community will be listed as presumed totally destroyed if there are no recent records of the community being extant and either of the following applies (A or B): **A)** Records within the last 50 years have not been confirmed despite thorough searches of known or likely habitats; or **B)** All occurrences recorded within the last 50 years have since been destroyed. Three communities are currently listed in this category for WA.
Critically Endangered (CR)
An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or that was originally of limited distribution and is facing severe modification or destruction throughout its range in the immediate future, or is already severely degraded throughout its range but capable of being substantially restored. An ecological community will be listed as Critically Endangered when it has been adequately surveyed and is found to be facing an extremely high risk of total destruction in the immediate future. This will be determined on the basis of the best available information, by it meeting any one or more of the following criteria (A, B or C): **A)** The estimated geographic range, and/or total area occupied, and/or number of discrete occurrences since European settlement have been reduced by at least 90% and either or both of the following apply (i or ii): i) geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is imminent (within approximately 10 years); or ii) modification throughout its range is continuing such that in the immediate future (within approximately 10 years) the community is unlikely to be capable of being substantially rehabilitated. **B)** Current distribution is limited, and one or more of the following apply (i, ii or iii): i) geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the immediate future (within approximately 10 years); or ii) there are very few occurrences, each of which is small and/or isolated and extremely vulnerable to known threatening processes; or iii) there may be many occurrences but total area is very small and each occurrence is small and/or isolated and extremely vulnerable to known threatening processes. **C)** The ecological community exists only as highly modified occurrences that may be capable of being rehabilitated if such work begins in the immediate future (within approximately 10 years). Twenty-one communities are currently listed in this category for WA.
Endangered (EN)
An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or was originally of limited distribution and is in danger of significant modification throughout its range or severe modification or destruction over most of its range in the near future. An ecological community will be listed as Endangered when it has been adequately surveyed and is not Critically Endangered but is facing a very high risk of total destruction in the near future. This will be determined on the basis of the best available information by it meeting any one or more of the following criteria (A, B, or C): **A)** The geographic range, and/or total area occupied, and/or number of discrete occurrences have been reduced by at least 70% since European settlement and either or both of the following apply (i or ii): i) the estimated geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is likely in the short term future (within approximately 20 years); ii) modification throughout its range is continuing such that in the short term future (within approximately 20 years) the

community is unlikely to be capable of being substantially restored or rehabilitated. **B)** Current distribution is limited, and one or more of the following apply (i, ii or iii): i) geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the short term future (within approximately 20 years); ii) there are few occurrences, each of which is small and/or isolated and all or most occurrences are very vulnerable to known threatening processes; iii) there may be many occurrences but total area is small and all or most occurrences are small and/or isolated and very vulnerable to known threatening processes. **C)** The ecological community exists only as very modified occurrences that may be capable of being substantially restored or rehabilitated if such work begins in the short-term future (within approximately 20 years). Seventeen communities are currently listed in this category for WA.
Vulnerable (VU)
An ecological community that has been adequately surveyed and is found to be declining and/or has declined in distribution and/or condition and whose ultimate security has not yet been assured and/or a community that is still widespread but is believed likely to move into a category of higher threat in the near future if threatening processes continue or begin operating throughout its range. An ecological community will be listed as Vulnerable when it 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 (within approximately 50 years) to long-term future. This will be determined on the basis of the best available information by it meeting any one or more of the following criteria (A, B or C): **A)** The ecological community exists largely as modified occurrences that are likely to be capable of being substantially restored or rehabilitated. **B)** The ecological community may already be modified and would be vulnerable to threatening processes, is restricted in area and/or range and/or is only found at a few locations. **C)** The ecological community may be still widespread but is believed likely to move into a category of higher threat in the medium to long-term future because of existing or impending threatening processes. Twenty-eight communities are currently listed in this category for WA.

4.2.6.2 Priority Ecological Communities (PECs)

In Western Australia, potential TECs that do not meet criteria or that are not adequately defined or do not have adequate information are added to the Priority Ecological Community (PEC) List as Priority 1, 2 or 3 (Table 6) (Department of Parks and Wildlife, 2013b). Communities that are rare but not threatened and are adequately known, or that have been recently removed from the threatened list, are placed in Priority 4 for regular monitoring purposes. Conservation dependent communities are placed in Priority 5. As of June 2017 there were 391 PECs listed by the DBCA Threatened Species and Communities Branch (Department of Biodiversity Conservation and Attractions, 2017b).

Table 6: Priority Ecological Communities (PECs) Definitions and Criteria

Priority One: Poorly-known ecological communities
Ecological communities that are known from very few occurrences with a very restricted distribution (generally ≤5 occurrences or a total area of ≤ 100ha). Occurrences are believed to be under threat either due to limited extent, or being on lands under immediate threat (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) or for which current threats exist. May include communities with occurrences on protected lands. Communities may be included if they are comparatively well-known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range.

Priority Two: Poorly-known ecological communities
Communities that are known from few occurrences with a restricted distribution (generally ≤10 occurrences or a total area of ≤200ha). At least some occurrences are not believed to be under immediate threat 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 Three: Poorly known ecological communities
(i) 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: (ii) Communities known from a few widespread occurrences, which are either large or with significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat, or; (iii) Communities made up of large, and/or widespread occurrences, that may or may not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, 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 Four: 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.
(i) Rare. Ecological communities known from few occurrences 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 communities are usually represented on conservation lands. (ii) Near Threatened. Ecological communities that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable. (iii) Ecological communities that have been removed from the list of threatened communities during the past five years.
Priority Five: Conservation Dependent ecological communities
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.

4.2.6.3 Threatened Ecological Communities (TECs) (Commonwealth) *(EPBC Act 1999)*

The *Environmental Protection Biodiversity Conservation (EPBC) Act 1999* provides legislative protection for Threatened Ecological Communities (TECs). The definition and criteria for TECs under the *EPBC Act* are presented in Table 7.

Table 7: Threatened Ecological Communities (TECs) (*EPBC Act 1999*) Definitions and Criteria.

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

4.2.6.4 Vegetation of 'Other' Conservation Significance

Vegetation other than that listed under state and federal legislation and guidelines e.g. TECs, may have conservation significance, and these are defined by the Environmental Protection Authority (2016e) as those that may include, but not be limited to vegetation that:

Represents a Priority Ecological Community (PEC).

Has a restricted distribution.

Have implications due to historical impacts.

Has a role as a refuge.

Provides a function required to maintain the ecological integrity of a significant ecosystem.

4.2.7 Weeds

4.2.7.1 Environmental Weeds

There is currently no coordinated approach to prioritising environmental weeds in Western Australia.

Under the Western Australian *Conservation and Land Management Act 1984*, the Department of Biodiversity Conservation and Attractions (DBCA) is required to monitor and manage weeds on their managed lands. As a part of this responsibility, the Western Australian Environmental Weed Strategy (WAEWS) (Department of Conservation and Land Management, 1999) was developed. This programme rated environmental weed species on their invasiveness, distribution and environmental impact. The purpose of this publication was also to eventually tie into the Weeds of National Significance (WONS) project (Department of Conservation and Land Management, 1999 p58), enabling a compatible rating system to be applied to Western Australian environmental weed species. The idea was also to eventually provide a regionally based rating system, based on Interim Biogeographic Regionalisation for Australia (IBRA) (Thackway and Cresswell, 1995) regions.

Since the WAEWS was published, DBCA moved towards a regionally prioritised process, called An Integrated Approach to Weed Management on DPW-managed Lands in Western Australia (Department of Parks and Wildlife, 2013a). Contrary to the direction outlined in WAEWS to use IBRA regions, the new prioritisation has been based on DBCA management regions. The survey area is in the DBCA management region of Perth. There was an environmental weed priority list for the Perth NRM region, however as of January 4th 2017 it was unavailable as it is being revised (Danielle Wiseman DBCA Weeds Programme pers. comm.).

The WAEWS was therefore used in this report as a proxy to identify the most serious environmental weeds present in the survey area.

4.2.7.2 Biosecurity and Agriculture Management (BAM) Act 2007

This act replaces amongst other related legislation, the *Agriculture and Related Resources Protection Act 1976*, which legislated for the control of Declared Plants in Western Australia (Sandy Lloyd DAFWA, pers. comm.). The Declared Plants list under old legislation has been replaced by the Western Australian Organism List (WAOL) under the *BAM Act 2007*. The WAOL is administered by the Department of Primary Industries and Regional Development (Agriculture and Food). The *BAM Act 2007* represents the only legally binding requirement for weed control and/or eradication in Western Australia. There are three categories of Declared Pest (Table 8).

Table 8: Declared Pest Categories *Biosecurity and Agriculture Management Act 2007*

The C1 category (Exclusion)
Pests will be assigned to this category if they are 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.
The C2 category (Eradication)
Pests will be assigned to this category if they are present in Western Australia in low enough numbers or in sufficiently limited areas that their eradication is still a possibility.
The C3 category (Management)
Pests will be assigned to this category if they are 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.

4.2.7.3 Weeds of National Significance (WONS)

The Weeds of National Significance (WoNS) project is an initiative of the Commonwealth in collaboration with state governments aimed at establishing a national prioritisation process for environmental weeds. Thirty-two species of WONS have currently been prioritised, based on invasiveness, potential for spread and environmental, social and economic impacts. Their ability to be managed was also taken into account. This programme is in the early stages of development and is a work in progress. It only provides a limited prioritisation of environmental weeds.

4.3 METHODS

4.3.1 Flora

4.3.1.1 Desktop Assessment

Searches of the Department of Biodiversity Conservation and Attractions (DBCA) Species and Communities Branch (DBCA, 2018) and the Department of Environment and Energy Protected Matters Search Tool (DoEE, 2018) databases were completed in September 2018 to identify any Threatened (TF) or Priority (PF) Flora (rare flora) previously known from the survey area or surrounds.

Assessment of the conservation significance of flora recorded during the survey involved cross-referencing all taxa recorded against criteria for significance under state and federal legislation and guidelines (Section 4.2). Geographic distribution was assessed using the map-based resources the Australian Virtual Herbarium (Council of Heads of Australasian Herbaria, 2013) and Florabase (Western Australian Herbarium, 1998-).

4.3.1.2 Field Survey

The field survey was completed of the survey area between the 27th and 28th September 2018 (2 person days) by botanist Kelli McCreery under Licence for Scientific or Other Prescribed Purposes No. SL012210 and Permit to Take Declared Rare Flora No. 91-1718.

The field survey consisted of a Traverse based survey (Environmental Protection Authority, 2016e p. 7) at 20m intervals across intact vegetated areas to record:

Priority, Threatened and other flora of conservation significance as defined by EPA (2016e).

Weed species.

Additional flora species not recorded in quadrats.

Any matters of interest e.g. including but not limited to rubbish, vegetation, condition.

The flora inventory was compiled from the traverses, species recorded during the quadrat survey (Section 4.3.2) and opportunistic observations and collections. A full inventory of flora species recorded in the survey area is provided in Appendix A.

4.3.1.3 Flora Identifications

Flora identifications were completed by a botanist with over 22 years experience on the Swan Coastal Plain (SCP). Flora were identified using the taxonomic and other resources of the WA Herbarium.

Nomenclature was based on Florabase (Western Australian Herbarium, 1998-). All taxa were cross-referenced against Florabase to ensure that names were current at the time of publication.

4.3.2 Vegetation

4.3.2.1 Desktop Assessment

A search of the DBCA Species and Communities Branch and the Department of Environment and Energy Matters of National Significance Protected Matters databases were completed in September 2018, to identify any Threatened (TECs) or Priority Ecological Communities (PECs) previously known from the survey area or surrounds.

4.3.2.2 Field Survey

The field survey consisted of a quadrat (Environmental Protection Authority, 2016e p. 8) based survey. Quadrat sizes were 10m x 10m in line with established methodology for the Swan Coastal Plain. An area

surrounding the quadrat was also surveyed to record other species typical of the vegetation type. The information recorded for each quadrat included:

Location (accuracy <1m) for all four corners of quadrat (Appendix C). Quadrats were permanently marked, with each corner pegged with wooden stakes (visible approximately 10cm above the soil surface).

All flora species present (floristics) in quadrat and their height and cover/density (structure) (Appendix B). Percentage cover refers to the foliage cover (as required by Environmental Protection Authority, 2016e) of each species within the 100m^2 quadrat (1m^2 cover = 1% cover). Species that overhung the quadrat were included.

Description of vegetation and documentation of vegetation structure based on National Vegetation Information System (NVIS) (ESCAVI, 2003) (as required by Environmental Protection Authority, 2016e).

Photographs of vegetation (taken from NW corner of quadrat).

Habitat information including but not limited to landform, aspect and soil and leaf litter.

A condition rating was given according to the (as required by Environmental Protection Authority, 2016e) condition scale (Table 9).

Vegetation type and condition mapping was refined during flora traverses.

Table 9: Vegetation Condition Rating for the South West Botanical Province.

P	**Pristine**	Pristine or nearly so, no obvious signs of disturbance or damage caused by human activities since European settlement.
E	**Excellent**	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species. Damage to trees caused by fire, the presence of non-aggressive weeds and occasional vehicle tracks.
VG	**Very Good**	Vegetation structure altered, obvious signs of disturbance. Disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.
G	**Good**	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it. Disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.
D	**Degraded**	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. Disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds at high density, partial clearing, dieback and grazing.
CD	**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 and shrubs.

4.3.2.3 Statistical Analysis

The four quadrats recorded as a part of this survey were compared to quadrats surveyed as a part of A Floristic Survey of the Southern Swan Coastal Plain (Gibson *et al.,* 1994), using a multivariate analysis run on the programme 'R' (R Development Core Team, 2007). Many TECs and PECs were originally defined on the

basis of the floristic analysis in Gibson *et al.* (1994). Therefore the aim of this methodology was to help quantify the presence or otherwise of TECs and PECs.

To ensure the datasets were as compatible as possible the taxonomy was reverted back to what it would have been in 1994. To test for any methodological differences in the parameters set for the multivariate analysis, a test run was completed first, using only the SCP dataset to ensure that the results for the grouping were consistent with the original findings of that study. Then the quadrats recorded in this survey were run against the SCP dataset to see which Gibson et al. (1994) they were most floristically similar to.

This was a floristic analysis based on presence-absence of species within a 10m x 10m quadrat.

The agglomerative methods used were Bray-Curtis distance and Ward's clustering. The results are discussed in Section 4.4.3.

4.4 RESULTS

4.4.1 Flora

4.4.1.1 Database Search Results

The search of the DBCA Threatened Species and Communities flora database (Department of Biodiversity Conservation and Attractions, 2018) identified no previously known records of Priority or Threatened Flora within the survey area.

The search of the *EPBC Act 1999* Protected Matters Search Tool (Department of Environment and Energy, 2017) listed 11 Threatened Flora (TF) as known from the region. None of these species have previously been recorded from within the survey area.

In total, nine Priority Flora and 11 Threatened Flora species were identified as known from the broader region, none of which had previously been recorded from within the survey area.

Table 10 summarises the search results from both database searches and identifies the likelihood of each occurring within the survey area.

Table 10: Threatened and Priority Flora Database Search Results.

WESTERN AUSTRALIA	CONSERVATION STATUS*		OCCURRENCE Known/Likely/Possible/Unlikely
	WA	EPBC	
Acacia benthamii	P2	-	Possible but not recorded.
Andersonia gracilis	VU	EN	Unlikely. From near wetlands.
Anigozanthos viridis subsp. terraspectans	VU	VU	Unlikely. From wetlands.
Austrostipa mundula	P3	-	Possible but not recorded.
Baeckea sp. Limestone (N. Gibson & M.N. Lyons *1425)*	P1	-	Unlikely if habitat is limestone.
Caladenia huegelii	CR	EN	Possible but not recorded.
Conostylis bracteata	P3	-	Possible but not recorded.
Diuris micrantha	VU	VU	Unlikely (known from wetlands further south).
Diuris purdiei	EN	EN	Unlikely (known from wetlands further south).
Drakaea elastica	CR	EN	Unlikely but possible. Not recorded.
Drakaea micrantha	EN	VU	Unlikely but possible. Not recorded.
Eleocharis keigheryi	VU	VU	Unlikely (wetland habitat)
Eucalyptus argutifolia	VU	VU	Unlikely (limestone habitat)
Jacksonia sericea	P4	-	Recorded during this survey.
Lepidosperma rostratum	EN	EN	Unlikely (wetland habitat)
Marianthus paralias	EN	EN	Unlikely (limestone habitat near-coastal)
Pimelea calcicola	P3		Possible but not recorded.
Styphelia filifolia	P3		Possible but not recorded.
Tetraria sp. Chandala (G.J. Keighery 17055)	P2		Unlikely (wetland habitat)
Thelymitra variegata	P2		Possible but not recorded.

See Section 4.2 for definitions of conservation status codes. Habitat preference information from WAH (1998-) and DBCA database search results.

4.4.1.2 Statistics

A total of 221 taxa were recorded from the survey area, of which 160 or 72.4% were natives. According to Florabase (Western Australian Herbarium, 1998-) the 160 native taxa represent 4.3% of the total native flora species known from the IBRA region of the Swan Coastal Plain.

The 221 taxa represented 60 different plant families and 160 plant genera. The families represented by the largest number of species are shown in Table 11. The genera represented by the largest number of species are shown in Table 12.

See Appendix A for a full list of species recorded for the survey area.

Table 11: Dominant Vascular Plant Families Recorded in the Survey Area.

FAMILY	COMMON NAME	NATIVE	INTRODUCED	TOTAL
FABACEAE	Peas, Wattles	17	8	25
MYRTACEAE	Eucalypts, Melaleuca etc	12	5	17
ASTERACEAE	Daisies	9	13	22
PROTEACEAE	Grevillea, Hakea, Banksia, Coneflowers	11	2	13
POACEAE	Grasses	5	9	14

FAMILY	COMMON NAME	NATIVE	INTRODUCED	TOTAL
ASPARAGACEAE	Lilies	8	2	10
ORCHIDACEAE	Orchids	9	0	9
CYPERACEAE	Sedges	5	1	6
HAEMODORACEAE	(Kangaroo Paw Family)	6	0	6
IRIDACEAE	(Iris Family)	2	4	6

Table 12: Dominant Vascular Plant Genera Recorded in the Survey area.

GENUS	COMMON NAME	NATIVE	INTRODUCED	TOTAL
Acacia	Wattles	5	3	8
Banksia	Banksia	6	0	6
Stylidium	Triggerplants	5	0	5
Hibbertia	Guinea-flowers	5	0	5
Eucalyptus	Eucalypts	2	2	4
Lomandra	Mat-rushes	4	0	4
Podotheca	(Daisy Family)	3	0	3
Conostylis	(Kangaroo Paw Family)	3	0	3
Daviesia	(Pea Family)	3	0	3
Jacksonia	(Pea Family)	3	0	3
Thysanotus	Fringe Lilies	3	0	3

4.4.1.3 Threatened Flora

No Threatened Flora (TF) species as listed under the *Wildlife Conservation (WC) Act 1950* were recorded during the field survey. No TF under the *Environmental Protection and Biodiversity Conservation Act 1999* were recorded.

4.4.1.4 Priority Flora

Two Priority Flora species were recorded from the survey area. This consisted of one Priority 2 flora species *Poranthera moorokatta* and one Priority 4 *Jacksonia sericea*.

Poranthera moorokatta **Priority 2**

This species was recorded in the Tranquil Park (Figures 1 and 2). It is an erect herb to 4.7cm (Barrett, 2012), but is often less. It has likely historically to have been mistaken for the more common *Poranthera microphylla*. The most easily observed difference between the two species can be seen when comparing the seeds, with *P. moorokatta* having smaller and more finely patterned seeds. With practice the form of each species can be seen to be different, with *P. moorokatta* being generally smaller and more compact.

Priority 2 flora are taxa that are poorly known, that are known from one or a few collections, some of which are on lands not under imminent threat of habitat destruction or degradation. See Section 3.2.5 for a full definition of Priority 2 Flora.

There were 6 collections of this species in the WAH at the time of publication (Council of Heads of Australasian Herbaria, 2013). Its main range is between Kings Park and Ellenbrook, however this species is likely to be more widespread than records currently indicate.

Jacksonia sericea **Priority 4**

This is a low spreading shrub to approximately 60cm tall from the Fabaceae or Pea family. It has orange flowers usually in December to February (Western Australian Herbarium, 1998-). This species was recorded from the northern edge of Tranquil Park (Figure 2). Priority 4 are those flora that are considered rare, near threatened or otherwise in need of monitoring. They are usually represented on conservation lands and are considered to have been adequately surveyed. See Section 3.2.5 for a full definition of Priority 4 Flora.

There were 61 collections of this species in the WAH at the time of publication (Council of Heads of Australasian Herbaria, 2013). Its main range is along near-coast areas between Pinjarra to the south and Wanneroo in the north.

4.4.1.5 Species of 'Other' Conservation Significance

See Section 4.2.5 for a definition of species of 'other' conservation significance.

Most of the species of 'other' conservation significance recorded in the survey area were due to range implications (Table 13). These included range extensions or species at the extremity of their known range, local or short-range endemics or species with a restricted distribution.

Table 13: Species of 'Other' Conservation Significance (EPA, 2016e).

SPECIES	SIGNIFICANCE
Banksia sessilis var. *cygnorum*	East extent of known range.
Caladenia arenicola	North-east extent of known range. Endemic to SCP.
Craspedia sp. Yalgorup National Park (G.J. Keighery 14449)	Poorly collected 7 records in WAH. One record north of Swan R.
Eucalyptus todtiana	West extent of known range.
Grevillea crithmifolia	East extent of known range.
Hibbertia cuneifolius	Slight range extension to north (Edgewater is the closest record)
Hypocalymma robustum	North-west extent of known range.
Jacksonia sericea P4	Short range endemic (200km along Swan Coastal Plain)
Olearia lehmanniana	Poorly Collected on Swan Coastal Plain (2 Records)(29 in WA)
Poranthera moorokatta P2	Poorly collected 7 records in WAH. Short range endemic <100km.
Spyridium globulosum	East extent known range.

4.4.2 Weed Flora

Sixty-one introduced flora species (weeds) were recorded in the survey area. This included a combination of herbaceous, grass and woody weeds. A full list of weeds is presented in Appendix A (species marked with an asterisk).

4.4.2.1 Environmental Weeds

Of the 61 species of weed recorded in the survey area, 11 had been given a High rating for invasiveness and spread as environmental weeds under the Western Australian Environmental Weed Strategy (WAEWS) (Department of Conservation and Land Management, 1999) (Table 14). See Section 4.2.7 for more detail on these criteria.

Table 14: Environmental Weeds High Rating Recorded in the Survey Area.

SPECIES	COMMON NAME	RATING (CALM, 1999)
Asparagus asparagoides	Bridal Creeper	High
Brassica tournefortii	Mediterranean Turnip	High
Ehrharta calycinus	Perennial Veldt Grass	High
Eragrostis curvula	African Lovegrass	High
Euphorbia terracina	Geraldton Carnation Weed	High
Freesia alba × leichtlinii	Freesia	High
Leptospermum laevigatum	Eastern States Teatree	High
Lupinus cosentinii	Sandplain Lupin	High
Moraea flaccida	Cape Tulip	High
Pelargonium capitatum	Rose Pelargonium	High
Romulea rosea var. *australis*	Guildford Grass	High

4.4.2.2 Declared Pest Plants (*BAM Act 2007*)

Two of the weeds recorded in the survey area are listed as Declared Pests under the *Biosecurity and Agriculture Management Act 2007*. These were Bridal Creeper **Asparagus asparagoides* and Cape Tulip **Moraea flaccida*. See Section 4.2.7 for an explanation of Declared Pests.

4.4.2.3 Weeds of National Significance

Two Weeds of National Significance (WONS) (Section 4.2.7) were recorded in the survey area. These were Bridal Creeper **Asparagus asparagoides* and Bridal Veil **Asparagus declinatus*.

4.4.3 Vegetation

4.4.3.1 Database Search Results

The results of the search of the Department of Biodiversity Conservation and Attractions Species and Communities Databases for state listed Threatened (TEC) and Priority (PEC) Ecological Communities and the *EPBC Act 1999* Protected Matters Search Tool (Department of Environment and Energy, 2018) for federally listed TECs, are presented in Table 15.

One of the Priority Ecological Communities (PECs) (WA) identified in the search results 'Banksia Dominated Woodlands of the Swan Coastal Plain IBRA Region' was previously known from multiple records within the survey area (Figure 2).

Table 15: Threatened and Priority Ecological Communities Database Search Results

WESTERN AUSTRALIA	**COMMONWEALTH EQUIVALENT** (EPBC ACT 1999)	**CONSERVATION STATUS***		**OCCURRENCE** Known/Likely/Possible/Unlikely
		DBCA	EPBC Act	
Banksia Dominated Woodlands of the Swan Coastal Plain IBRA Region	Banksia Woodlands of the Swan Coastal Plain	P3	EN	Previously known records (DBCA, 2018) present in survey area (Figure 2). Re-recorded during current survey. Sub-type FCT28.
SCP20a: *Banksia attenuata* woodlands over species rich dense shrublands		EN		Unlikely. Statistical analysis of quadrat data collected during this survey indicated that FCT28 is present onsite and not FCT20a (FCT20a equivalent to SCP20a).
SCP24: Northern Spearwood shrublands and woodlands		P3		Not present.
SCP25: Southern *Eucalyptus gomphocephala-Agonis flexuosa* woodlands		P3		Unlikely, not seen onsite, may have been present prior to clearing.
SCP29a: Coastal shrublands on shallow sands		P3		Not present.
SCP30a: *Callitris preissii* (or *Melaleuca lanceolata*) forests and woodlands, Swan Coastal Plain		VU		Not present.

* See Section 4.2.6 for definitions of conservation status codes.

4.4.3.2 Statistics

The three quadrats in Vegetation Type A1 (CG01, CG03 and CG04) (Figure 2) had a mean species richness of 73 ± 10 species. Of those the two quadrats in Very Good condition within Tranquil Park (CG01, CG04) had a mean species richness of 79 ± 2 species, while the quadrat in Carramar Golf Course in Good condition (CG03) had 61 species. The one quadrat in Vegetation Type A2 (CG02) had a species richness of 42 species.

4.4.4 Vegetation and Site Description

The vegetation in the survey area was summarised as:

A JARRAH-BANKSIA-ALLOCASUARINA WOODLAND ON CONSOLIDATED DUNES

A1: Woodland to Open Forest of Jarrah *Eucalyptus marginata* subsp*. marginata, Banksia attenuata, B. menziesii* and/or *Allocasuarina fraseriana* over intact understorey. Tranquil Park Reserve (Very Good Condition). Small area in Carramar Golf Course (Good condition).

A2: Open Forest of Marri *Corymbia calophylla* over intact understorey. Tranquil Park Reserve (Good to Very Good Condition).

B: MODIFIED VEGETATION

B1: Open Woodland to Open Forest of Jarrah *Eucalyptus marginata* subsp*. marginata, Banksia attenuata, B. menziesii* and/or *Allocasuarina fraseriana* over modified understorey*.* Carramar Golf Course (Good to Degraded, Degraded).

B2: Open Forest of Marri *Corymbia calophylla* over modified understorey. Carramar Golf Course (Good to Degraded).

C: CLEARED AREAS

C1: Carramar Golf Course. Completely Degraded. Cleared areas. Fairways, grassed and landscaped areas, infrastructure, clubhouse, paths, firebreaks.

C2: **Constructed Lake.** Carramar Golf Course. Completely Degraded. Native colonisers included the native sedges *Juncus pallidus* and *Elatine gratioloides*.

A more detailed description of each vegetation type is provided below.

A JARRAH-BANKSIA-ALLOCASUARINA WOODLAND ON CONSOLIDATED DUNES

A1: Woodland to Open Forest of Jarrah *Eucalyptus marginata* subsp*. marginata, Banksia attenuata, B. menziesii* and/or *Allocasuarina fraseriana* over intact understorey. Tranquil Park. Very Good Condition. There is a very small remnant in Carramar Golf Course in Good condition. Other typical trees included *Nuytsia floribunda* and emergent Marri *Corymbia calophylla* over a species-rich understorey of Heathland to Open Heathland (shrubs), Sparse to Open Forbland (herbs), Sparse Rushes and Sedges. (Figures 2 and 3) (Plate 1).

Shrub species were dominated by *Xanthorrhoea preissii, X. brunonis subsp. brunonis, Hibbertia h. subsp. hypericoides* and *Bossiaea eriocarpa* but also typically included *Calectasia narragara, Conostephium pendulum, Daviesia nudiflora subsp. nudiflora, D. triflora, Gompholobium tomentosa, Hakea lissocarpha, Hardenbergia comptoniana, Hibbertia huegelii, Hovea trisperma, Hybanthus calycinus, Hypocalymma*

robustum, Jacksonia sternbergiana, Kennedia prostrata, Leucopogon propinquus, Petrophile macrostachya, Philotheca spicata, Phyllanthus calycinus, Pimelea sulphurea and *Stirlingia latifolia*.

Sedge species typically included *Mesomelaena pseudostygia*, *Lepidosperma scabrum* and *Tetraria octandra*. Rush species typically were *Lyginia imberbis, Desmocladus flexuosus, D. asper* and *Alexgeorgea nitens*.

Herbs typically included *Burchardia congesta*, *Conostylis aculeata* subsp. *aculeata*, *Caesia micrantha*, *Caladenia flava* var. *flava*, *Crassula colorata* var. *colorata*, *Drosera erythrorhiza*, *Elythranthera brunonis*, *Haemodorum laxum, Isotropis cuneifolia* subsp. *cuneifolia*, *Lomandra caespitosa, L. hermaphrodita*, *L. sericea, Podotheca gnaphalioides, Pterostylis recurva, Ptilotus manglesii, Sowerbaea laxiflora, Stylidium androsaceum, S. neurophyllum* ms, *S. piliferum, Trachymene pilosa* and *Waitzia nitida*.

The vegetation was predominantly in Very Good condition, with some localised disturbance. There was one small area in Good condition within the golf course. Total weed cover was between 1-5% with species typically including the herbs **Pelargonium capitatum, *Hypochaeris glabra, *Ursinia anthemoides* and **Gladiolus caryophyllaceous*, grasses **Briza maxima, *Aira caryophyllea* and **Vulpia bromoides* and sedge **Isolepis marginata*.

Quadrats CG01, CG03 and CG04 (Appendix C) were located in this vegetation type. Statistical analysis demonstrated that this plant community is equivalent to Floristic Community Type (FCT) 28 (Gibson *et al.*, 1994) (Figure 4).

A2: Open Forest of Marri *Corymbia calophylla* over intact understorey. Tranquil Park Reserve. Good to Very Good Condition. Other typical trees included Jarrah *Eucalyptus marginata* subsp. *marginata*, *Allocasuarina fraseriana* and *Banksia attenuata*. Understorey varied but typically a Sparse Heathland dominated by *Xanthorrhoea preissii* over an Open Rushland of *Desmocladus flexuosus* and Open Sedgeland *Tetraria octandra* and *Mesomelaena pseudostygia* and Forbland dominated by *Caesia micrantha*. (Figures 2 and 3) (Plate 3).

Typical shrubs included *Hibbertia h.* subsp. *hypericoides*, *Hardenbergia comptoniana* (woody creeper) and *Bossiaea eriocarpa*. Other typical herbs included *Sowerbaea laxiflora*, *Conostylis a.* subsp. *aculeata*, *Corynotheca m.* var. *micrantha*, *Orthrosanthus l.* var. *laxus*, *Lomandra sericea* and *Diuris magnifica*. A Sparse Tussock Grassland of native grass *Microlaena s*. var. *stipoides* was present.

The vegetation was mostly in Very Good condition, with some localised disturbance. Adjacent to the road verge the condition declines to Good. Total weed cover was between 2-7%. Weeds typically included the herbs **Hypochaeris radicata* and **Gladiolus caryophyllaceous* and the grasses **Briza maxima* and **Ehrharta longiflora*.

Quadrat CG02 (Appendix C) was located in this vegetation type. Statistical analysis demonstrated that this plant community is equivalent to Floristic Community Type (FCT) 28 (Gibson *et al.*, 1994) (Figure 4).

Plate 1: **Vegetation Type A1:** Woodland to Open Forest of Jarrah *Eucalyptus marginata* subsp. *marginata*, *Banksia attenuata, B. menziesii* and/or *Allocasuarina fraseriana* over intact understorey. Very Good Condition. Tranquil Park.

Plate 2: **Vegetation Type B1:** Woodland to Open Forest of Jarrah *Eucalyptus marginata* subsp. *marginata*, *Banksia attenuata, B. menziesii* and/or *Allocasuarina fraseriana* over modified understorey. Degraded to Good Condition. Carramar Golf Course.

B: MODIFIED VEGETATION

B1: Open Woodland to Open Forest of Jarrah *Eucalyptus marginata* subsp. *marginata, Banksia attenuata, B. menziesii* and/or *Allocasuarina fraseriana* over modified understorey. Carramar Golf Course. Good to Degraded. Originally equivalent to Community A1 but heavily and variously modified with the structure impacted and a loss of species richness. Typically consists of remnant overstorey of Jarrah *Eucalyptus m.* subsp. *marginata* with or without *Banksia attenuata*, *B. menziesii* and/or *Allocasuarina fraseriana* (dominant in some areas) over weeds and scattered native shrubs, herbs, rushes and sedges. (Figures 2 and 3) (Plate 2).

The vegetation varied from Degraded to Good to Degraded. Total weed cover varied. Structure was largely lost. Exotic planted trees and shrubs were often present. Degraded areas had very little structure remaining in the understorey, which was dominated by weeds however there was still scattered native shrubs, herbs, sedges and/or rushes present. The structure had been impacted in Good-Degraded areas also, however it was slightly more intact. There were more scattered native species present and at higher densities.

B2: Open Forest of Marri *Corymbia calophylla* over modified understorey. Carramar Golf Course. Good to Degraded. Other typical trees included Jarrah *Eucalyptus m.* subsp. *marginata*, *Allocasuarina fraseriana, Banksia menziesii* and *B. attenuata*. Originally equivalent to Community A2 but has been disturbed. Understorey was dominated by weeds but with scattered native shrubs, herbs, sedges and rushes. (Figures 2 and 3) (Plate 4).

The structure was largely lost however scattered native shrubs included *Xanthorrhoea preissii, Stirlingia latifolia, Jacksonia furcellata, J. sternbergiana, Hibbertia cuneifolia, H. hypericoides* subsp. *hypericoides*. Scattered native rushes and sedges included *Desmocladus asper* and *Tetraria octandra* and herbs *Crassula colorata* subsp. *colorata*, *Podotheca gnaphalioides* and *Drosera erythrorhiza*. Weed species were numerous but typically included woody weeds **Osteospermum ecklonis*, **Agonis flexuosus* and **Acacia longiflora* var.

sophorae, herbs **Cotula turbinata*, **Moraea flaccida* and **Pelargonium capitatum*. Grazing was evident with many individual plants reduced to stumps.

Plate 3: **Vegetation Type A2:** Open Forest of Marri *Corymbia calophylla* over intact understorey. Very Good Condition. Tranquil Park. Natives dominant in understorey.

Plate 4: **Vegetation Type B2:** Open Forest of Marri *Corymbia calophylla* over modified understorey. Degraded-Good Condition. Golf Course Grounds. Weeds dominant in understorey.

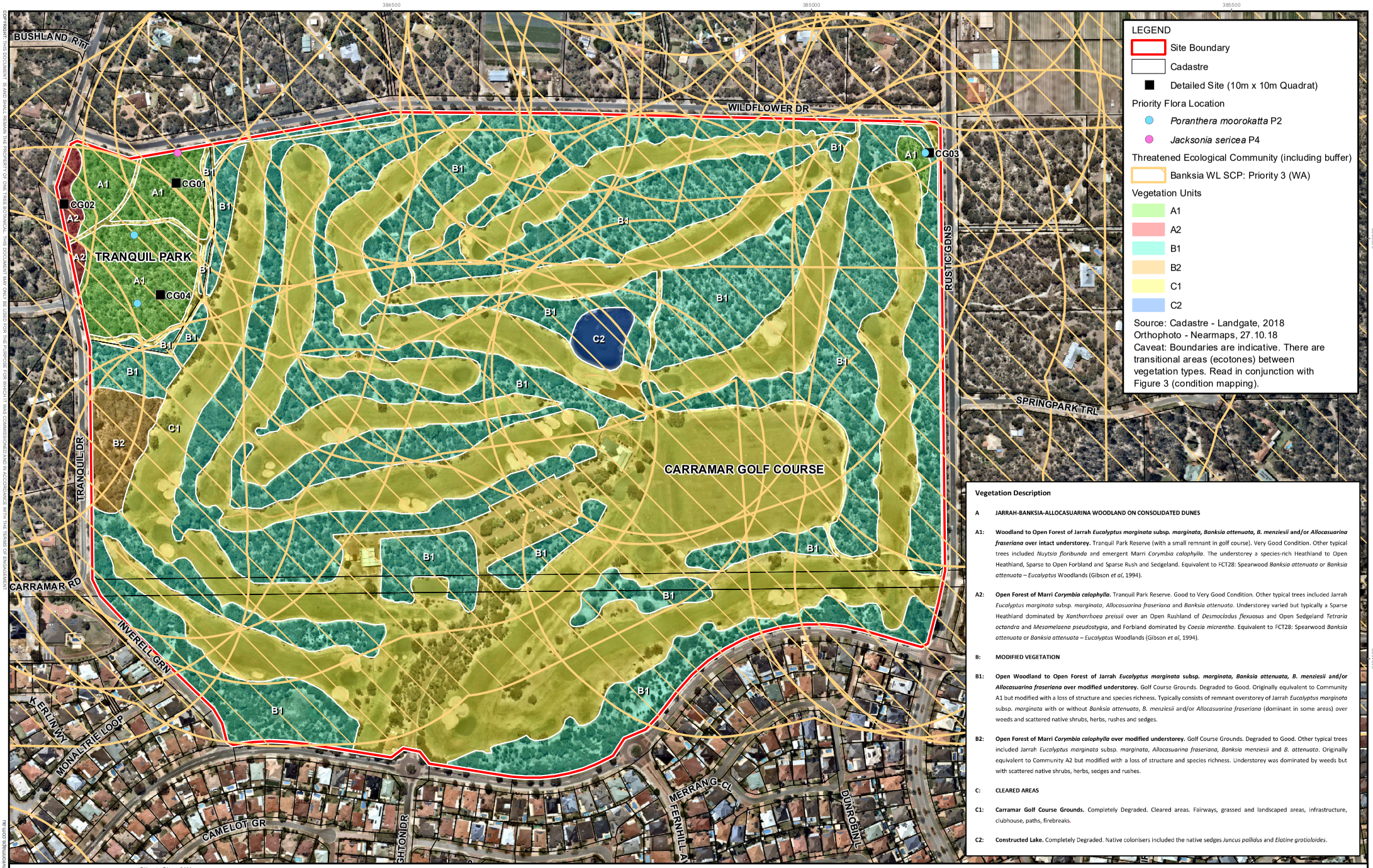
C: CLEARED AREAS

C1: Carramar Golf Course Grounds. Completely Degraded. Cleared areas. Fairways, grassed and landscaped areas, infrastructure, clubhouse, paths, firebreaks (Figures 2 and 3) (Plate 5).

C2: **Constructed Lake.** Completely Degraded. Native colonisers included the native sedges *Juncus pallidus* and *Elatine gratioloides*. (Figures 2 and 3) (Plate 6).

Plate 5: **C1:**Carramar Golf Course Grounds. Completely Degraded.

Plate 6: **C2: Constructed Lake.** Completely Degraded.



LEGEND

- Site Boundary
- Cadastre
- Detailed Site (10m x 10m Quadrat)

Priority Flora Location

- *Poranthera moorokatta* P2
- *Jacksonia sericea* P4

Threatened Ecological Community (including buffer)

- Banksia WL SCP: Priority 3 (WA)

Vegetation Units

- A1
- A2
- B1
- B2
- C1
- C2

Source: Cadastre - Landgate, 2018
Orthophoto - Nearmaps, 27.10.18
Caveat: Boundaries are indicative. There are transitional areas (ecotones) between vegetation types. Read in conjunction with Figure 3 (condition mapping).

Vegetation Description

A **JARRAH-BANKSIA-ALLOCASUARINA WOODLAND ON CONSOLIDATED DUNES**

A1: **Woodland to Open Forest of Jarrah *Eucalyptus marginata* subsp. *marginata, Banksia attenuata, B. menziesii* and/or *Allocasuarina fraseriana* over intact understorey.** Tranquil Park Reserve (with a small remnant in golf course). Very Good Condition. Other typical trees included *Nuytsia floribunda* and emergent Marri *Corymbia calophylla*. The understorey a species-rich Heathland to Open Heathland, Sparse to Open Forbland and Sparse Rush and Sedgeland. Equivalent to FCT28: Spearwood *Banksia attenuata* or *Banksia attenuata – Eucalyptus* Woodlands (Gibson *et al*, 1994).

A2: **Open Forest of Marri *Corymbia calophylla*.** Tranquil Park Reserve. Good to Very Good Condition. Other typical trees included Jarrah *Eucalyptus marginata* subsp. *marginata, Allocasuarina fraseriana* and *Banksia attenuata*. Understorey varied but typically a Sparse Heathland dominated by *Xanthorrhoea preissii* over an Open Rushland of *Desmocladus flexuosus* and Open Sedgeland *Tetraria octandra* and *Mesomelaena pseudostygia*, and Forbland dominated by *Caesia micrantha*. Equivalent to FCT28: Spearwood *Banksia attenuata* or *Banksia attenuata – Eucalyptus* Woodlands (Gibson *et al*, 1994).

B: **MODIFIED VEGETATION**

B1: **Open Woodland to Open Forest of Jarrah *Eucalyptus marginata* subsp. *marginata, Banksia attenuata, B. menziesii* and/or *Allocasuarina fraseriana* over modified understorey.** Golf Course Grounds. Degraded to Good. Originally equivalent to Community A1 but modified with a loss of structure and species richness. Typically consists of remnant overstorey of Jarrah *Eucalyptus marginata* subsp. *marginata* with or without *Banksia attenuata*, *B. menziesii* and/or *Allocasuarina fraseriana* (dominant in some areas) over weeds and scattered native shrubs, herbs, rushes and sedges.

B2: **Open Forest of Marri *Corymbia calophylla* over modified understorey.** Golf Course Grounds. Degraded to Good. Other typical trees included Jarrah *Eucalyptus marginata* subsp. *marginata*, *Allocasuarina fraseriana, Banksia menziesii* and *B. attenuata*. Originally equivalent to Community A2 but modified with a loss of structure and species richness. Understorey was dominated by weeds but with scattered native shrubs, herbs, sedges and rushes.

C: **CLEARED AREAS**

C1: **Carramar Golf Course Grounds.** Completely Degraded. Cleared areas. Fairways, grassed and landscaped areas, infrastructure, clubhouse, paths, firebreaks.

C2: **Constructed Lake.** Completely Degraded. Native colonisers included the native sedges *Juncus pallidus* and *Elatine gratioloides*.

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P: (08) 9371 9491
M: 0407 423 928

N

0 25 50 100 150 200 m

Scale: 1:4,000 @ A3
GDA 1994 MGA Zone 50

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FIGURE 2

CARRAMAR GOLF COURSE AND TRANQUIL PARK FLORA AND VEGETATION MAPPING

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Vegetation Condition Rating for the South West Botanical Province (EPA, 2016).

P	Pristine	Pristine or nearly so, no obvious signs of disturbance or damage caused by human activities since European settlement.
E	Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species. Damage to trees caused by fire, the presence of non-aggressive weeds and occasional vehicle tracks.
VG	Very Good	Vegetation structure altered, obvious signs of disturbance. Disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.
G	Good	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it. Disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.
D	Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. Disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds at high density, partial clearing, dieback and grazing.
CD	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 and shrubs.

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0 20 40 80 120 160 m

Scale: 1:4,000 @ A3
GDA 1994 MGA Zone 50

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FIGURE 3

CARRAMAR GOLF COURSE AND TRANQUIL PARK VEGETATION CONDITION MAPPING

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4.4.4.1 Floristic Statistical Analysis

The results of the statistical analysis were that the quadrats aligned with Floristic Community Type 28 in the Gibson *et al.* (1994) dataset (Figure 4). The survey quadrats grouped most closely with Gibson *et al.* (1994) quadrats DEPOT1 (3km to the south of the survey area) and YAN3 (15km to the north-west). The next closest quadrats are from Warwick Open Space, Neerabup National Park, Yanchep, Shenton Park, Trigg Bushland and Kings Park.

CG02 grouped slightly apart from CG01, CG03 and CG04, which would be expected as this quadrat was in Marri dominated rather than Jarrah and *Banksia* dominated vegetation. CG01 and CG04 group very closely, which is to be expected as they are both close together in Tranquil Park (Figure 2) and in Very Good condition, while CG03 is in the Carramar Golf Course grounds and in Good due to grazing and weeds and came out slightly apart. However all four quadrats clearly aligned with FCT28.

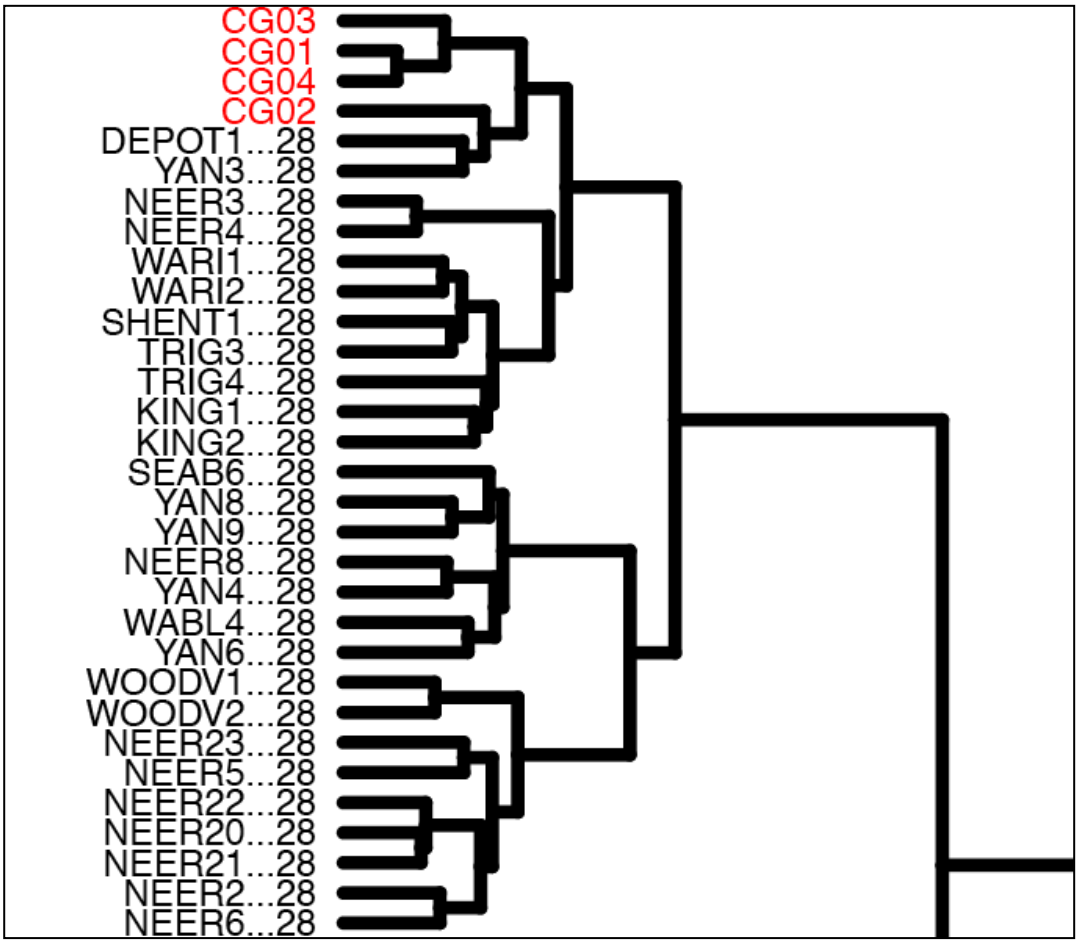

Figure 4: Statistical Analysis of Quadrat Data (Relevant branches of Dendrogram, survey area quadrats in red)

4.5 DISCUSSION

4.5.1 Flora and Vegetation Conservation Values

Two Priority Flora were recorded from the survey area *Poranthera moorokatta* (Priority 2) and *Jacksonia sericea* (Priority 4). Both were recorded from Tranquil Park Reserve (Figures 1 and 2). *Poranthera moorokatta* is a recently described species that is poorly documented. It is likely that in the past it was misidentified as *Poranthera microphylla*. These two species grow together and the former can easily be confused for a young *P. microphylla*. It is likely to be more widespread than records currently indicate.

Jacksonia sericea is known from multiple populations that span a relatively large area across the Swan Coastal Plain, although there is little information available on the current condition of many of those populations.

The vegetation represents a vegetation complex (Heddle *et al.*, 1980) and type (Beard, 1979) that has less than 30% remaining. It is worth noting that percentage remaining figures are over-estimates. They represent broad ecological systems and do not take into account the often numerous restricted sub-types. The percent remaining figures are derived from aerial photography and do not fully take into account the condition of what remains.

Vegetation Type A1 and A2 (Figure 2) represent a known occurrence of Priority Ecological Community (PEC) 'Banksia Dominated Woodlands of the Swan Coastal Plain IBRA Region' (P3) (Western Australia)(Figure 2). It also by proxy represents TEC 'Banksia Woodlands of the Swan Coastal Plain' (Endangered), which is protected under the *EPBC Act 1999* (Commonwealth). See the following discussion about condition as it relates to TEC status.

Condition is a significant factor in the survey area, as the condition thresholds for delineation as the 'Banksia Woodlands of the Swan Coastal Plain' TEC under the *EPBC Act 1999* apply at Good and better condition. Therefore the remnants in Carramar Golf Course in Degraded to Good condition (Figure 3) (apart from the small remnant in Good condition) all are marginal in terms of Commonwealth TEC status. It is possible that if grazing pressure was removed, some of the remnants in may recover to Good condition.

Tranquil Park Reserve was mostly in Very Good condition. Weed invasion was low, the structure was intact and there was a high species richness supported. The edges were less intact, due to exposure and weed invasion. The area of Open Forest of Marri *Corymbia calophylla* (Figure 2 and 3) was slightly less intact, with a higher level of weed invasion. As an example of a PEC and a TEC in Very Good condition, this vegetation is highly conservation significant.

The remnant vegetation in the Carramar Golf Course mostly consisted of remnants in Degraded or Degraded to Good condition likely due to fragmentation, grazing by Kangaroos and weed invasion. There was one small area of vegetation type A1: Woodland to Open Forest of Jarrah *Eucalyptus marginata* subsp. *marginata, Banksia attenuata, B. menziesii* and/or *Allocasuarina fraseriana* over intact understorey in the north-west corner in Good condition, however this area will be exposed to ongoing degradation through fragmentation, grazing and weed invasion.

At the time of the survey Jarrah *Eucalyptus m.* subsp. *marginata* was quite severely affected by Jarrah Leafminer across the site, including Tranquil Park.

4.5.2 Limitations

Botanical surveys for a number of reasons are random sampling exercises. Not all species may be recorded, due to seasonality, fire age and other factors. A single survey is a snapshot in time in dynamic systems. And even relatively intensive transect surveys at 20m spacing may mean that some species present go unobserved, particularly where vegetation is thick and species richness high.

Due to a number of factors, flora identifications are not usually 100% correct. There may be taxonomic difficulties, a lack of supporting information and because flora flower at different times of the year, good material can not always be collected for all flora at all times. It is estimated that the accuracy of flora identifications in this assessment was >90%.

The statistical analysis of Gibson *et al.* (1994) quadrat data is a tool only. This work completed in 1994 was never meant to be the end point for this methodology. It was intended that the base data be built upon and the findings refined. However due to the original findings being ensconced as statutory listings, it has forced a regression back to the original study. A true conservation significance assessment of vegetation would include analysis of a comprehensive bioregional quadrat dataset, which Western Australia does not currently have.

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5.0 FAUNA

Australasian Ecological Services (AES) was commissioned by One Tree Botanical to conduct a Level 1 Fauna Assessment of the Carramar Golf Course and the associated Tranquil Park and contribute this assessment as a chapter within One Tree Botanical's Flora, Vegetation and Fauna Assessment of the Carramar Golf Course, including Tranquil Park.

For background and introductory information refer to the earlier chapters in this report.

The Level 1 Fauna Assessment comprised a Fauna Desktop Study and an on-site Level 1 Reconnaissance Fauna Survey over the survey area shown in Figure 1.

5.1 OBJECTIVES

The aims of a Level 1 Fauna Assessment are to:

Conduct an up to date Fauna Desktop Study to ascertain what fauna assemblages and conservation significant fauna are likely to be in the region, based on available information.

Verify the accuracy of the Fauna Desktop Study and determine what species assemblages are actually likely to be within the survey area, by conducting an on-site Level 1 Reconnaissance Fauna Survey. This survey will consider the condition of the fauna habitats found and opportunistic sightings of species, directly (e.g. birds and some of the larger mammals and reptiles) or indirectly via the presence of calls, tracks, scats, feeding signs, nests, burrows and skeletal material. This on-site survey may also add species to the original Fauna Desktop Study list.

Identify potential threats and impacts on this fauna, based on available information and make recommendations for management and/or further survey, monitoring or research work, if necessary, taking into account guidance from EPA (2016a, b and c).

Where possible, within the time constraints of the Reconnaissance Fauna Survey (Level 1), collect the necessary data to assist in the design of additional Level 2 Targeted, Detailed or Comprehensive Fauna Surveys, in case they are needed.

Provide a Level 1 Fauna Survey Assessment report that is appropriately researched and written to the standards required by the Environmental Protection Authority's Environmental Impact Assessment process (EPA 2016b).

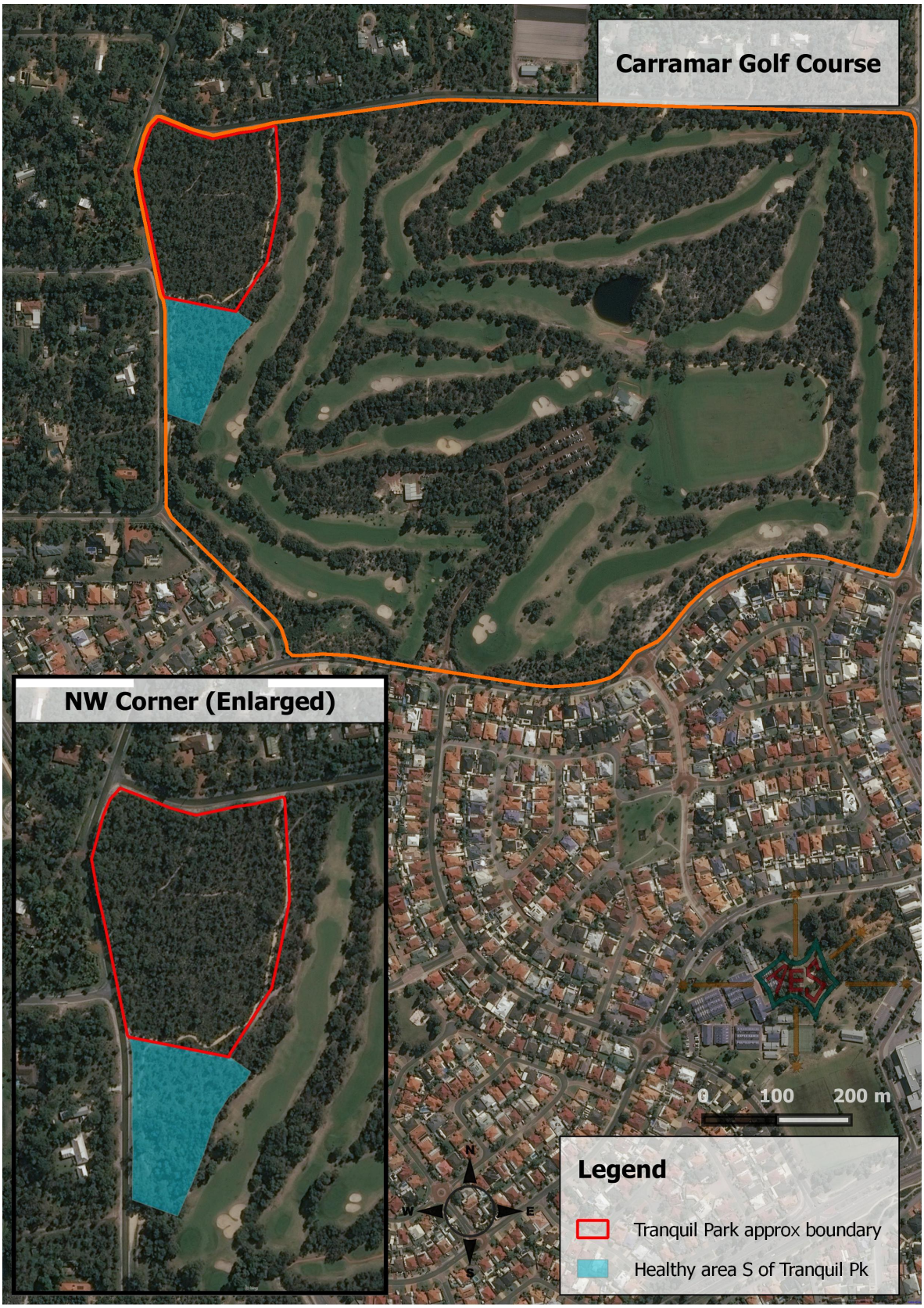

Figure 5: Carramar Golf Course and associated Tranquil Park including approximate boundary of Tranquil Park and healthiest part of Fauna Habitat 2.

5.2 METHODS

5.2.1 Fauna Desktop Study

The Fauna Desktop Study drew information from a number of different sources. These included the Commonwealth *Environment Protection Biodiversity Conservation (EPBC) Act 1999* Protected Matters Search Tool (Department of Environment and Energy [DEE], 2017) and the Department of Biodiversity, Conservation and Attractions (DBCA) NatureMap database (DBCA, 2017) (both accessed September 18th 2018 using a 30km by 40km polygon centred on the survey area and designed to avoid the coast and Darling Scarp). NatureMap includes data from the DBCA Threatened Fauna Database (2017), BirdLife Australia Databases (Birdata) (2017) and the Western Australian Museum. In addition, a specific search for Threatened and Priority Flora and Fauna was obtained from the DBCA by One Tree Botanical as described in previous chapters.

In conducting web searches, it is necessary to draw records from either a circle of chosen radius from the location of interest, or a drawn polygon around that location. Due to the coarse scale used on these data bases, they usually include records that clearly are from very different habitats within the search radius or search polygon. As the final desktop analysis was conducted, species that were recognised as clearly belonging to these extraneous habitats were excluded (e.g. marine related species, wetland species that require a complex wetland habitat, not just an ornamental lake, or some species from heavier soils).

The Fauna Desktop Study also considered the results of various fauna surveys and reviews including:

Astron Environmental Services (2018), Terrestrial Ecology (2018), Astron Environmental Services (2017a), Astron Environmental Services (2017b), Eco-logical Australia (2017), Eco-logical Australia (2016), Terratree (2016), Ecoscape Australia (2015), GHD (2010), Coffey Environments (2009a), Coffey Environments (2009b), ATA Environmental (2007), Ecoscape Australia (2007a), Ecoscape Australia (2007b).

All this information is supplemented with information on the habitat requirements and general distributions of fauna species from field guides and other standard references including frogs (Tyler *et al.,* 1994; Tyler and Doughty 2009), reptiles (Storr *et al*. 1983; 1990; 1999; 2002; Wilson and Swan 2008), birds (Morcombe 2004; Garnett *et al*., 2010 and specific volumes of the Handbook of Australian and New Zealand and Antarctic Birds as stated), mammals (Churchill 2008; Menkhorst *et al.* 2011; van Dyke and Strahan 2008), Short Range Endemic invertebrates (Harvey 2002 and some other specific references stated) and tracks (Triggs 1996 and Moseby *et al*. 2011).

In assessing the likely threats and impacts in the local area, the area within a 15 km radius of the impact site is generally adopted as a guide according to the EPA guidelines (EPA 2016b).

5.2.2 On-site Level 1 Reconnaissance Fauna Survey

The survey area for the present on-site Level 1 Reconnaissance Fauna Survey comprised five obvious fauna habitats, which were considered in the survey design. 1) Tranquil Park, which is a reserve located on the north-west side of the Carramar Golf Course and open to the public, 2) the Carramar Golf Course remnant

vegetation which comprises the native vegetation around the edges of the golf course and between the fairways, 3) parkland cleared vegetation between the fairways, 4) the fairways and 5) the ornamental pond/lake within the golf course (Figure 5).

The Level 1 Reconnaissance Fauna Survey design considers the following guidelines: Environmental Factor Guideline-Terrestrial Fauna (EPA, 2016a), Technical Guidance-Terrestrial Fauna Surveys (EPA, 2016b), Technical Guidance – Sampling Methods for Terrestrial Vertebrate Fauna (EPA, 2016c) and Technical guidance – Sampling of Short Range Endemic vertebrate fauna (EPA, 2016d).

The survey involved walking over the survey area and looking for species directly (e.g. birds and some of the larger mammals and reptiles), as well as indirectly by listening for bird calls and finding scats, tracks, diggings, burrows, nests and skeletal material. Effort was also focused on significant conservation species and searching for habitat characteristics that are important to these species.

5.2.3 Personnel

Survey work and reporting was carried out by Specialist Consultant, Julie Raines (Australasian Ecological Services), a zoologist and ecologist with over 30 years of experience in vertebrate ecology.

5.2.4 Nomenclature and Taxonomy

The taxonomy and nomenclature used in this report mainly follows the 'Checklist of Vertebrates of Western Australia' (Western Australian Museum website Nov 2016). This nomenclature is sourced from Hutchins (2001) for fish, Aplin and Smith (2001) for amphibians and reptiles, Johnstone (2001) for birds and How *et al.* (2001) for mammals. However, where data were extracted from the DBCA NatureMap database, the alphabetical order of species within broad taxonomic groups is maintained.

5.3 RESULTS OF THE LEVEL 1 RECONNAISSANCE FAUNA SURVEY

5.3.1 Fauna Habitat

5.3.1.1 Fauna Habitat 1. *Banksia* – Jarrah - Marri Woodland (Plate 7)

Within Tranquil Park, only one fauna habitat was identified. This was *Banksia* – Jarrah - Marri Woodland (Plate 7). This woodland is part of a State listed Priority Ecological Community (P3) '*Banksia* Dominated Woodlands of the Swan Coastal Plain IBRA Region' and Federally listed Threatened Ecological Community (TEC); '*Banksia* Woodlands of the Swan Coastal Plain'. The floristics and vegetation pertaining to this particular fauna habitat are fully described in the previous chapters on vegetation within this report.

This fauna habitat has a very rich variety of plant species. It featured a medium-dense upper storey of Jarrah (*Eucalyptus marginata)* and Marri *(Corymbia calophylla)* and *Banksia* species (mainly *B. attenuata,* but also some *B. menziesii*) with *Allocasuarina fraseriana,* over a medium-dense middle story of predominantly Grass Trees (*Xanthorrhoea preissii* and *X. brunonis*), with some *Macrozamia*, *Acacia saligna*, and *Jacksonia*, over a very rich medium-dense to dense lower storey shrubland comprising many species.

These included, but were not limited to, the genera *Hibbertia, Stirlingia*, *Acacia*, *Mesomelaena, Eremaea, Jacksonia, Synaphea*, *Phyllanthus*, **Watsonia*, *Hardenbergia, Conostylis* and a range of smaller plants including various orchid species, *Isotropis*, *Burchardia*, *Ptilotus*, *Drosera, *Carpobrotus, Waitzia* and various species from the Restionaceae. There was extensive leaf litter on the ground. Soils comprised cream to grey sands (Plate 7). Section 4.0 in this report provides an extensive botanical description of the flora and vegetation found within Fauna Habitat 1.

This fauna habitat was generally in very good condition and was in a surprisingly good condition for a small reserve in the suburbs of Perth. In most places a variety of weed species were present, mainly in the lower story, including **Carpobrotus, *Erodium, *Homeria*, **Gladiolus* and various grasses. However, they generally did not overshadow or appear to exclude native species substantially (refer to Section 4.0 of this report). Two exotic species of animal were recorded, the Rabbit (*Oryctolagus cuniculus*) and the Red Fox (*Vulpes vulpes*). Virtually no Rabbits or sign of rabbits were found on Carramar Golf Course. However, quite a few Rabbit diggings and some warrens were found in Tranquil Park, though the warrens mostly looked disused. A burrow that may have been a previously used fox den was also found. Dogs were also recorded at the reserve, however the majority are likely to be escorted by their owners.

Plate 7: Fauna Habitat 1. *Banksia* – Jarrah - Marri Woodland. This woodland is part of a State listed Priority Ecological Community (P3) '*Banksia* Dominated Woodlands of the Swan Coastal Plain IBRA Region' and Federally listed Threatened Ecological Community (TEC); '*Banksia* Woodlands of the Swan Coastal Plain'.

Within the Carramar Golf Course four fauna habitats were identified.

5.3.1.2 Fauna Habitat 2. Disturbed *Banksia* - Jarrah - Marri over Grass Tree (*Xanthorrhoea*) (Plates 8 and 9).

This fauna habitat is a disturbed and partially degraded form of Fauna Habitat 1. It comprises *Banksia* – Jarrah - Marri Woodland. Its upper story is the same, comprising a medium-dense upper story of Jarrah and Marri and *Banksia* species (mainly *B. attenuata*) sometimes with significant amounts of *Allocasuarina fraseriana.* This is over a medium to dense middle story of predominantly Grass Trees (*Xanthorrhoea preissii* and *X. brunonis*) with occasional *Macrozamia* (low-medium density). However, the middle story is also sometimes dominated by patches of *Jacksonia* and/or *Acacia and/or thick Grevillea,* in which case this middle story is often dense in these patches compared to Fauna Habitat 1.

The lower story is the most disturbed. This layer is much less dense. It is a low-density shrubland dominated by *Hibbertia, Stirlingia*, *Mesomelaena* and *Eremaea,* with the occasional other species such as *Synaphea* and **Watsonia*. The odd small plant such as *Thysanotus*, *Burchardia* or *Dampiera* were also recorded. The amount of leaf litter was highly variable. Soils comprised cream to grey sands.

In some places there was extensive leaf litter on the ground, however in other areas the ground was very bare, loose and sandy. Bare ground particularly occurred in areas where evidence indicated the resident Western Grey Kangaroos (*Macropus fuliginosus*) rest during the day. They dig in the soil, as well as excavating themselves cool rest places to use during the day. In these cases the condition of the fauna habitat was rated as degraded to poor (Plate 8).

The healthiest example of Fauna Habitat 2 was found on the west boundary immediately south of Tranquil Park. There the lower story was more dense and supported a slightly greater number of species and had a lot of leaf litter. There was also less sign that kangaroos were using this area (Plate 9). This area of Fauna Habitat 2 was rated as good.

Section 4.0 in this report provides an extensive botanical description of the flora and vegetation found within Fauna Habitat 2

Plate 8: Fauna Habitat 2. Disturbed *Banksia* – Jarrah – Marri over Grass Tree (*Xanthorrhoea*). This photograph illustrates the many patches of bare, loose sandy ground and only a few lower story species. It was rated as degraded to poor condition as a fauna habitat.

Plate 9: Fauna Habitat 2. Disturbed *Banksia* – Jarrah – Marri over Grass Tree (*Xanthorrhoea*). Healthiest example of Fauna Habitat 2 illustrating a more intact lower story with leaf litter. Its condition was rated as good as a fauna habitat.

5.3.1.3 Fauna Habitat 3. Parkland Cleared Jarrah-Marri Over Grass Tree (*Xanthorrhoea*) (Plate 10).

This fauna habitat was a parkland cleared Jarrah – Marri over Grass Tree woodland (Plate 10). Occasional *Banksia*, Peppermint (*Agonis*) and *Macrozamia* were present and in places, non-local eucalypts were present such as Rose Gum (**Eucalyptus grandis)* and Spotted Gum (**Corymbia maculata*) from the eastern states, and exotic species. This fauna habitat was in a degraded condition due to the parkland clearing of most of the middle story and almost all the understory.

Remnants of the original lower story were present sporadically and sparsely in very low densities, including, but not limited to, the odd *Patersonia*, *Hibbertia*, *Stirlingia* and/or *Mesomelaena* (Plate 9). The understory was predominantly exotic grasses and other small herbaceous species. In some places there was extensive leaf litter on the ground, however in other areas the ground was very bare, loose and sandy. Bare ground occurred in areas where the resident Western Grey Kangaroos rest during the day. They dig in the soil as well as excavating themselves cool rest places to use during the day. Soils comprised cream to grey sands. Section 4.0 in this report provide an extensive botanical description of the flora and vegetation within Fauna Habitat 3. The condition of this fauna habitat is poor to degraded, as it supports only a small variety of native species and contains a larger proportion of weeds and a lot of bare ground. Some of it appears to be regularly mowed.

Plate 10: Fauna Habitat 3. Parkland Cleared Jarrah-Marri Over Grass Tree. This contains a little middle story and virtually no understory. This was found between some fairways and is rated as degraded as a fauna habitat.

5.3.1.4 Fauna Habitat 4. Watered Turf Fairways (Plate 11).

The watered, mown grass provides moisture and an ongoing, renewable food source for graziers, particularly the Western Grey Kangaroos. It would also support a small variety of invertebrates (both native and exotic), which would provide food sources for other animals such as ducks. As a natural fauna habitat this area is classified as totally degraded, as it is completely artificial and probably contains significant amounts of fertilizer, pesticides and possibly other chemicals.

Plate 11: Fauna Habitat 4. Watered Turf Fairways. These provide moisture and food for graziers such as kangaroos.

5.3.1.5 Fauna Habitat 5. Ornamental Pond/Lake (Plate 12).

A large, artificial pond/small lake is located in the centre of the Carramar Golf Course. It has virtually no wetland vegetation surrounding it. There are some trees and a few sedges and reeds at the edge, and mown grass is planted to its boundaries. It also has some eucalypts on its edges. It is on cream to grey sands. As a natural fauna habitat this area is classified as degraded – completely degraded, as it lacks the complexity of a natural wetland and is likely to contain high levels of fertilizer, pesticides and possibly other chemicals.

Plate 12: Fauna Habitat 5. Ornamental Pond/Lake (located in the centre of the Carramar Golf Course).

5.3.2 Fauna recorded during Desktop Study and Level 1 Reconnaissance Survey

The Fauna Desktop Study identified 562 fauna species as potentially occurring in the general region. During the on-site Level 1 Reconnaissance Fauna Survey, a number of species were recorded and these are marked with an asterisk in Appendix E. Introduced species are marked with a cross and species of conservation significance are indicated according to the key provided at the front of the Appendix E.

Conservation significant species are those species listed as either Threatened under the Commonwealth *Environmental Protection and Biodiversity Conservation (EPBC) Act 1999* and/or the *Biodiversity Conservation Act 2016* or are listed as Priority species by the Department of Biodiversity, Conservation and Attractions (DBCA). These species need specific consideration in any impact assessment process.

5.3.2.1 Amphibians and Reptiles

The combined Fauna Desktop Study and on-site Level 1 Reconnaissance Fauna Survey identified 15 amphibians and 73 reptiles as potentially occurring in the general region (Appendix E). No frog species were recorded in the present Level 1 Reconnaissance Fauna Survey. However, two reptile species were recorded (confirmed) and these are marked with an asterisk in Appendix E. Some monitor burrows were also seen, but it was not possible to identify which specific species dug them. Five conservation significant reptile species were identified in the Fauna Desktop Study as potentially being in the survey area. More detail about these species, their scientific names, conservation status and the possible threats to them can be found in Table 16.

5.3.2.2 Birds

The combined Fauna Desktop Study and on-site Level 1 Reconnaissance Fauna Survey identified 216 birds as potentially occurring in the general region at some time. Thirty-nine bird species were seen or heard (confirmed) during the present Level 1 Reconnaissance Fauna Survey and these are indicated with an asterisk in Appendix E. Eight bird species were identified in the Desktop Study as conservation significant (Appendix 1). More detail about these species, their scientific names, conservation status and the possible threats to them can be found in Table 16.

5.3.2.3 Mammals

The combined Fauna Desktop Study and on-site Level 1 Reconnaissance Fauna Survey identified 28 mammals as potentially occurring in the general region at some time (Appendix E). Four mammal species were recorded (confirmed) during the on-site Level 1 Reconnaissance Fauna Survey and these are indicated with an asterisk in Appendix E. Four mammals were identified in the Desktop Study as conservation significant. More detail about these species, their scientific names, conservation status and the possible threats to them can be found in Table 16.

5.3.2.4 Invertebrates

Short Range Endemic (SRE) invertebrate species are not very mobile and can only move over a short range. They therefore cannot re-distribute themselves when impact occurs in their area. This lack of mobility also causes species to become isolated and they may inbreed to the point of becoming taxonomically distinct and therefore unique over the generations and important in terms of preserving biodiversity. It should be noted that the taxonomy for many of these invertebrates has not been finalised.

The Fauna Desktop Study identified 230 invertebrate species as potentially occurring in the general region. These are listed in Appendix E. Seven of these species are conservation significant. More detail about these species, their scientific names, conservation status and the possible threats to them can be found in Table 16.

5.3.3 Limitations of this Level 1 Fauna Assessment

Any survey can be limited in its effectiveness by variables ranging from the weather to the competency and experience of the personnel conducting the survey. The Environmental Protection Authority (2016b) provides guidelines to assess the limitations and effectiveness of both Level 1 and 2 fauna surveys. The assessment of the present Level 1 Fauna Assessment is summarised in Appendix F. The Level 1 Reconnaissance Fauna Survey had no limitations.

5.3.4 Conservation Significant Species

The Fauna Desktop Study combined with the on-site Level 1 Reconnaissance Fauna Survey produced a list of 24 conservation significant species that may potentially be in the area.

Table 16 lists these fauna species, together with information on their conservation status and reason for that conservation status (if applicable), their biology, probability of their presence within the survey area (rated as Confirmed or otherwise rated ranging from High, High-Medium, Medium, Medium-Low, Low, Low-Negligible and Negligible probability of presence), the impacts that will affect them if they are present and in which areas they would be most affected. These tables are ordered to reflect the relative conservation and management priority for each of these species as a guideline only, based on these factors and the biology of each species.

The Carramar Golf Course and Tranquil Park may be important for the Carnaby's Black-Cockatoo (classified as Vulnerable under the *EPBC Act 1999*) (recorded in the present survey), the Red-tailed Black-Cockatoo (Endangered, *EPBC Act 1999*) (recorded in the present survey) and the Baudin's Black-Cockatoo (Vulnerable, *EPBC Act 1999*) by providing food and roosts, and potentially providing nesting hollows.

It may also be important for the Southern Brown Bandicoot (DBCA Priority 4) (recorded in the present survey), the Graceful Sunmoth (DBCA Priority 4) which has been previously recorded in the reserve and there is plenty of its host plant *Synemon gratiosa* present and the Rainbow Bee-eater (classified as a Marine Species under the EPBC Act, 1999) (recorded in present survey), which may also breed there. The Peregrine Falcon (classified under Other Specially Protected Fauna, Schedule 7, of the *Biodiversity Conservation Act 2016* may also use the area, taking advantage of the large trees, open areas and pond/lake containing waterbirds.

The survey area may also possibly support DBCA Priority 4 Species: Water Rat and Blue-billed Duck. If present both these later species are likely to be temporary visitors.

For various reasons, there is a low probability that the remaining conservation significant species listed will be present, either because the habitat is marginal for the species, or it has become isolated by agriculture and/or development or because there are no records within 30 - 40 km or more of the survey area or the species will remain independent of the area (such as the Fork-tailed Swift, which spends most of its life in the air, except when it breeds).

Table 16: Summary of Conservation Significant Fauna Species and Ecological Considerations

Species are ordered to reflect relative conservation and management priority as a guideline only, taking into considering the conservation significance of the species, its biology, probability of it being present and in which particular areas threats/impacts would occur.

* = Recorded in Level 1 Reconnaissance Fauna Survey. Probability of presence is expressed as Confirmed or otherwise ranging through Very High, High, High-Medium, Medium, Medium–Low, Low, Low-Negligible to Negligible.

The references listed in the Fauna Desktop Study method section are used to produce this table, except where otherwise stated.

SPECIES	CONSERVATION SIGNIFICANCE	REASON SPECIES IS CONSERVATION SIGNIFICANT	PROBABILITY OF PRESENCE IN THE SURVEY AREA AND ECOLOGICAL CONSIDERATIONS	POTENTIAL THREATS THAT WOULD IMPACT THIS SPECIES IF THERE
***Carnaby's Cockatoo** (*Calyptorhynchus latirostris*) Also known as Carnaby's Black-Cockatoo.	Endangered *EPBC Act 1999*, Endangered (Schedule 2) Biodiversity Conservation Act, 2016.	Once common, this cockatoo's population has declined due to loss and fragmentation of breeding and feeding habitat in the wheatbelt and incremental loss of foraging and some breeding habitat on the west coast, partly due to urban expansion. Also poaching and competition for hollows from introduced species. It feeds on the seeds of *Eucalyptus*, *Banksia* and other proteaceous shrubs.	**Confirmed- recorded in survey area.** A pair of birds were seen checking out a nest hollow in Tranquil Park. Other records confirmed presence in survey area, 1 record (2017) and 9 records (2004-2005). Extensive records surrounding survey area, including within the local area.	Removal or death of feeding habitat particularly the proteaceous species and eucalypts in the survey area. Removal or death of large trees that can provide nesting hollows.

SPECIES	CONSERVATION SIGNIFICANCE	REASON SPECIES IS CONSERVATION SIGNIFICANT	PROBABILITY OF PRESENCE IN THE SURVEY AREA AND ECOLOGICAL CONSIDERATIONS	POTENTIAL THREATS THAT WOULD IMPACT THIS SPECIES IF THERE
***Forest Red-tailed Black Cockatoo** *Calyptorhynchus banksii* subsp. *naso* Also known as the Forest Red-tailed Black-Cockatoo	Vulnerable *EPBC Act 1999*, Vulnerable (Schedule 3) Biodiversity Conservation Act, 2016.	This forest cockatoo species has declined over 39 – 44% of its range. It mostly inhabits the Jarrah, Karri and Marri forests receiving more than 600 mm of annual average rainfall. However, is now found on the Swan Coastal Plain and known to nest there (DEC 2008). It has declined due to habitat loss, illegal shooting and competition for limited nest hollows including from feral bees. It feeds mainly on Marri and Jarrah but also on other eucalypts as well as Sheoak, *Persoonia*, Cape Lilac and invertebrate larvae.	**Confirmed- recorded in survey area.** Several birds were seen feeding in Jarrah. Records – nearest record 6.3km SW (2018). Several records south of survey area – 1 record 10.9km ESE (2017), 1*8.7km SE (2017), 2*11.1km SE (2017, 2014), 1*11.3km SE (2017). Cluster 3 records approx. 13.4km S (2012, 2016, 2017), all within local area. 2 records 19.4km SE (2014) and 1*19.9km SE (2017) outside local area.	Removal or death of feeding habitat, mainly the Jarrah and Marri. Removal or death of large trees that can provide nesting hollows.
Baudin's Cockatoo *(Calyptorhynchus baudinii)* Also known as Baudin's Black - Cockatoo	Vulnerable *EPBC Act 1999*, Endangered (Schedule 2) Biodiversity Conservation Act, 2016.	This forest cockatoo species has declined over more than 50 per cent of its range. It is mostly within Jarrah, Marri and Karri forest receiving more than 750mm average annual rainfall. The principal cause of this decline was clearing of the eastern margins of the forests for agriculture. The species is also found in the agricultural areas and Swan Coastal Plain (DEC 2008). In recent times it has nested on the Swan Coastal Plain. The primary threat to the population at present is illegal shooting by fruit growers. Also, competition for limited nest hollows including from feral bees. Approx 90% of diet is made up of the seeds from Marri and Jarrah. Also feeds from other eucalypts, *Banksia*, Sheoak, *Persoonia*, Cape Lilac and *Erodium botrys* and invertebrate larvae.	**Medium - High** May feed or roost there but unlikely to breed there. Records –1 record 2.4km S (2009), 2*4.1km S (2009, 2008), 1*6.9km SE (2002) (all within local area). Records at further distances in all directions.	Removal or death of feeding habitat, mainly the Jarrah and Marri.

SPECIES	CONSERVATION SIGNIFICANCE	REASON SPECIES IS CONSERVATION SIGNIFICANT	PROBABILITY OF PRESENCE IN THE SURVEY AREA AND ECOLOGICAL CONSIDERATIONS	POTENTIAL THREATS THAT WOULD IMPACT THIS SPECIES IF THERE
***Southern Brown Bandicoot** (*Isoodon fusciventer*) (Quenda)	DBCA Priority 4	The Southern Brown Bandicoot has undergone a large reduction in range, particularly on the Swan Coastal Plain where it is very patchily distributed. This is due to feral predators and habitat loss from clearing and degradation.	**Confirmed.** Recorded in Tranquil Park in present survey. Records nearby – 1 record 1.7km SW (2000), 1*2km N (2014), 1*2km NW (2018), cluster of records 3-5km SW (1998, 2012, 2016), a cluster 5km W and a cluster 4-7km E all including modern records in the local area. Many records beyond that including in local area.	Removal, disturbance of *Banksia*- Jarrah-Marri woodland, particularly its thick understory, including by fire would be a problem. Could be predated by exotic predators: cats, dogs and foxes.
Graceful Sunmoth *(Synemon gratiosa)*	DBCA Priority 4.	Declined due to habitat loss on the Swan Coastal Plain. Relies on host plants, *Lomandra hermaphrodita* or *L. maritima*.	**High** Previously recorded at study site or very close by. Host plant *Lomandra hermaphrodita* was recorded frequently in Tranquil Park during the present flora and fauna surveys. 1 record 2.3km W (1995), 2*3km W (1996). Several clusters of records 5-7km W (many new and old records) and 2 records 8km SSE (1984).	High loss if host plants die from fire, disease or disturbance.
***Rainbow Bee-eater** (*Merops ornatus*)	No longer classified as a threatened species but is still listed as a Marine Species under the *EPBC Act 1999*.	This species was until recently subject to International Migratory Bird Agreement(s). It winters in Indonesia and northern Australia and migrates south to breed. It digs a burrow in the ground to nest in and favours lighter soils but will use heavier soils and sometimes uses banks of soil. Its population has been decreasing.	**Confirmed** Recorded in survey area during present survey. Likely to be breeding there. Also 1 recorded 1.4km S (1999), 1*3.5km SW (2002), cluster 4-7.5km S associated with Lake Joondalup. And many more records beyond this in all directions.	Burrows may be destroyed by dogs or walkers or by vehicles if used in the area. Could be predated by exotic predators: cats, dogs and foxes. Loss of fauna habitat for feeding and breeding.

SPECIES	CONSERVATION SIGNIFICANCE	REASON SPECIES IS CONSERVATION SIGNIFICANT	PROBABILITY OF PRESENCE IN THE SURVEY AREA AND ECOLOGICAL CONSIDERATIONS	POTENTIAL THREATS THAT WOULD IMPACT THIS SPECIES IF THERE
Peregrine Falcon *(Falco peregrinus)*	Other specially protected fauna (Schedule 7) *Biodiversity Conservation Act 2016*.	In Western Australia, this bird of prey prefers forest or woodland to rest, roost and breed in, near open areas where it can hunt. It tends to be sedentary within its nesting territory. Its population has decreased due to habitat loss (including loss of freshwater wetlands) and possibly poaching. Historical pesticide use has also been implicated causing eggshell thinning.	**Medium-Low** Records - nearest – 1 record 3.8km W (2017), 1 record 3.9km E (2003). Cluster- 9 records 4.3km S (2005-2015). Further records- 1*4.1km SE (2015), 2*5.2km SE (2015), 1*7.5km SE (2012), 1*9.5km S (2017), 1*10.9km (2001), 1* 12.5km (2001). All these records in local area.	Minor loss of foraging and breeding habitat if large trees died or cleared.
Water Rat **(Rakali)** *(Hydromys chrysogaster)*	DBCA Priority 4.	This species lives in permanent, fresh to brackish water bodies in the south-west and, in the north of the State, also lives in marine environments along coastline and offshore islands. It is declining due to habitat loss, disturbance and increased salinity.	**Medium-Low** Habitat not ideal. If present may only be a brief visitor. Records- 1 record 2.6km S (2008) and 1*5.5km S (2014) both on Lake Joondalup, cluster of 16 records 12km S (2004-2009) on Lake Goollelal, 1*19.5km S (2018), cluster of records 18 – 19km NNW (1*2015, 7*2008). Other records south around 30km or greater.	Drainage or polluting of water habitat. However, probably would only be a brief visitor. Could be predated by exotic predators: cats, dogs and foxes.

SPECIES	CONSERVATION SIGNIFICANCE	REASON SPECIES IS CONSERVATION SIGNIFICANT	PROBABILITY OF PRESENCE IN THE SURVEY AREA AND ECOLOGICAL CONSIDERATIONS	POTENTIAL THREATS THAT WOULD IMPACT THIS SPECIES IF THERE
Blue-billed Duck *Oxyura australis*	DBCA Priority 4.	Found on open water wetlands but needs densely vegetated freshwater lakes and swamps to breed. Favours deeper water for diving. Numbers have reduced due to wetland reclamation, clearing and fragmentation, loss of dense wetland vegetation, salinisation, urban and industrial uses of both land and wetlands, and predation.	**Low.** If present probably just a temporary visitor. Records- 49 records 1.9km E (2012-2018) and 1*2.3km SW (2001) (within local area). Cluster of 91 records 4.5km SW (apart of Bird data survey, 2004-2016), 1 record 8.9km NW (2002), 1*10km NW (1990-1991), 1*11.2km NW (1992). Cluster records - 9*6.6km S (1999-2018), 8*8.9km S (2010-2016). All these records are within local area.	Not applicable. If present probably just temporary.
Western Brush Wallaby *(Notamacropus irma)*	DPaW Priority 4.	Habitat has been severely reduced and fragmented due to clearing for agriculture and there is a significant decline in abundance within most remaining habitat, in part due to foxes. Range includes SW from north of Kalbarri to SE at Cape Arid.	**Low-Negligible** Habitat suitable but in a very small reserve bordered with a combination of suburbia and large semi-rural blocks, though there is bushland nearby, and the area is generally well connected to bushland blocks in the north. Records- nearest- 1 record 3.2km N (2003), 1*5kmW (2000), 1*6.5km E (2006). Further away 1*6.5km NW (2003) and 1*7.7km NW (2003) (all local area). Also several records 18 – 21km away to the SE.	Not applicable

SPECIES	CONSERVATION SIGNIFICANCE	REASON SPECIES IS CONSERVATION SIGNIFICANT	PROBABILITY OF PRESENCE IN THE SURVEY AREA AND ECOLOGICAL CONSIDERATIONS	POTENTIAL THREATS THAT WOULD IMPACT THIS SPECIES IF THERE
Woollybush Bee *Hylaeus globuliferus*	DBCA Priority 3.	Declined due to habitat loss. Associated with *Adenanthos* (Woolly Bush) and *Banksia* and possibly other plants. Not well understood. Females found foraging through flowers of Woolly Bush and males seen occupying same area, possibly to attract females.	**Low-Negligible** Habitat did not contain Woolley Bush, but poorly understood, so may not be dependent on this species. Records – 4 records 1.7km E (1995-1996) and 4 records 10.3km NE (1982, 1986, 1996) all within local area. Species not well understood and although no other records, few people would be looking for this species or able to accurately identify it.	Disturbance, death or clearance of *Banksia*-Jarrah-Marri Woodland would cause habitat loss.
Black-striped Snake (*Neelaps calonotos*)	DBCA Priority 3	This species of burrowing snake is restricted to the Swan Coastal Plain near Perth between Mandurah and Lancelin, except for a few records at Cataby. It occurs on dunes and sand-plains vegetated with heaths and/or Eucalypt/*Banksia* woodlands. It is threatened by habitat loss and tends to disappear from areas where urban development occurs.	**Low-Negligible** Records- nearest 2 records 4.8km S (1972), 2*6.5km S (historical), 2*6.8km SW (1978), 2*7km SE (1976), 1*7km W (2015), 2*11km SW (1971). More records beyond this but old. This is an unobvious species and is likely to be present in locations where it has never been collected. However, it tends to disappear from areas where urban development occurs.	Removal or death of sandy *Banksia* woodland fauna habitat. Could be predated by exotic predators: cats, dogs and foxes.
Spiny katydid or Bush Cricket (Swan Coastal Plain) *Austrosaga spinifer*	DBCA Priority 2	This species has a few poorly known populations. Whilst some of these populations are known to occur in conservation estate, others do not. It is thought to be under threat.	**Low-Negligible** Records - 2 old records 3.6km NW of survey area (1981, 1982). However, this is a fairly unobvious species, with very few people likely to have been actively looking for it, or able to identify it accurately.	Clearing, disturbance, burning of habitat, or disease, may have an effect if species was present.

SPECIES	CONSERVATION SIGNIFICANCE	REASON SPECIES IS CONSERVATION SIGNIFICANT	PROBABILITY OF PRESENCE IN THE SURVEY AREA AND ECOLOGICAL CONSIDERATIONS	POTENTIAL THREATS THAT WOULD IMPACT THIS SPECIES IF THERE
Fork-tailed Swift (*Apus pacificus*)	International Migratory Bird Agreement, obliging Australia to conserve habitat for these species.	This species is subject to International Migratory Bird Agreements. It breeds in the northern hemisphere and over winters in the south-west from October.	**High-Medium** Records- 1 recorded for survey area (2009). Nearest other records- 1 record 4.9km S (2003) and 1*6.8km WSW (2005) both within local area. This species spends most of its time in the air and only lands to breed. Eats insects on the wing, which breed on the land. Species will remain relatively independent of the survey	Remains relatively independent of survey area, so impact likely to be negligible.
Western False Pipistrelle (or Western Falsistrelle) *Falsistrellus mackenziei*	DBCA Priority 4.	Poorly known species that may be near Threatened and in need of protection. This uncommon bat is in need of monitoring. It's found in forested areas in SW Australia, preferring high rainfall areas. Its range extends northward barely to Perth, where it prefers higher rainfall areas of Jarrah and Tuart forest. It roosts in tree hollows.	**Negligible** Records- 1 record 25.6km E (1973). Survey area well north of species range.	Not applicable
Coastal Plain Skink *Ctenotus ora*	DBCA Priority 3.	Species recently reviewed/ described (2012). Restricted distribution from Perth (south of river) to Cape Naturaliste (NatureMap/Atlas Living Aust). Inhabits the sand dunes and is threatened by residential development. Found in sandy soil in Eucalypt over *Banksia* and in Eucalypt over heath habitats (Kay and Keogh 2012).	**Negligible** Records- 4 records approx. 30km SSE (1965).	Not applicable

SPECIES	CONSERVATION SIGNIFICANCE	REASON SPECIES IS CONSERVATION SIGNIFICANT	PROBABILITY OF PRESENCE IN THE SURVEY AREA AND ECOLOGICAL CONSIDERATIONS	POTENTIAL THREATS THAT WOULD IMPACT THIS SPECIES IF THERE
Cemetery Springtail or *Australotomurus morbidus* (or Guildford Springtail)	DBCA Priority 3.	Very little known about species. It has a few poorly known populations. Whilst some of these populations are known to occur in conservation estate, others do not. Springtails live in the soil and leaf litter, consuming dead vegetation, and microbes occasionally eating living plants.	**Negligible** Records – all outside local area, 21km SSE (1993) and a few records > 30km SE. Although no other records, few people would be looking for this species or able to accurately identify it.	Not Applicable
Perth Lined Lerista *(Lerista lineata)*	DBCA Priority 3	This species is restricted to the Swan Coastal Plain essentially from the Swan River south to Bunbury, except a single old record in Busselton. However, it occurs on both Garden and Rottnest Islands. It inhabits coastal dunes, *Banksia*/eucalypt woodlands and sometimes-suburban gardens. It is also found in *Melaleuca* forest and scrub. It shelters in the upper layers of loose soils and is reliant on	**Negligible** Habitat suitable but survey area well north of the distribution of this species. Nearest records at the N end of species range is 2 records 28km S near the Swan River (both 1998).	Not applicable
Little Bittern *Ixobrychus dubius*	DBCA Priority 4.	This species lives in freshwater wetlands with dense vegetation, particularly reed or sedge beds. Also brackish – saline mangroves, salt marsh and coastal lagoons. Species not well understood. Numbers have reduced due to wetland reclamation, clearing and fragmentation, loss of dense wetland vegetation, salinisation, urban and industrial uses of land and wetlands, and predation.	**Negligible** Habitat not suitable. Nearest records - Lake Joondalup 4-8km S (1 in 2001,1 in 2010 and 1 in 2012) and 1 record 12km S (at S end of Lake Goollelal) (2009). Also 2 records 7km SE 2 (2001) (Lake Mariginiup).	Not applicable.

SPECIES	CONSERVATION SIGNIFICANCE	REASON SPECIES IS CONSERVATION SIGNIFICANT	PROBABILITY OF PRESENCE IN THE SURVEY AREA AND ECOLOGICAL CONSIDERATIONS	POTENTIAL THREATS THAT WOULD IMPACT THIS SPECIES IF THERE
A Short-tongued bee species *Leioproctus contrarius*	DBCA Priority 3.	Poorly known species with several known populations. Whilst some of these populations are known to occur in conservation estate, others do not. Threatened by known threats but requires monitoring in case circumstances change. May be seen as near threatened.	**Negligible** Records – 1 record 6km E (1982) within local area. Further 1 record 19.9km E (1954) outside local area. However, this is a fairly unobvious species, with very few people likely to have been actively looking for it, or able to identify it accurately.	Not applicable.
Western Swamp Tortoise *Pseudemydura umbrina*	Critically Endangered *EPBC Act 1999*, Critically Endangered (Schedule 1) Biodiversity Conservation Act, 2016.	This species was once thought to be extinct. There are two natural populations left and two relocated populations. It occupies freshwater, shallow, ephemeral swamps that are wet in the winter and spring. They are most active in spring and aestivate in the hotter months. Numbers have reduced due to clearing and fragmentation, urban and industrial uses of land, drainage or pollution of water, predation and drying climate. The species also now has a very restricted genetic pool.	**Negligible** Pond/lake in golf course not ideal habitat. Records- No records within local area. A cluster of records 19-26 km E (some of these are translocated populations). This is now a highly managed species.	Not applicable
A short-tongued bee *Glossurocolletes bilobatus* (southwest)	DBCA Priority 2	This is a plasterer bee that is thought to be under threat. It has a few poorly known populations on conservation lands and several poorly known populations on un-conserved lands.	**Negligible** Records – 2 records outside local area. 1 record 17km NW (2015) and 1*19.3km NW (2015). However, this is a fairly unobvious species, with very few people likely to have been actively looking for it, or able to identify it accurately.	Not applicable

SPECIES	CONSERVATION SIGNIFICANCE	REASON SPECIES IS CONSERVATION SIGNIFICANT	PROBABILITY OF PRESENCE IN THE SURVEY AREA AND ECOLOGICAL CONSIDERATIONS	POTENTIAL THREATS THAT WOULD IMPACT THIS SPECIES IF THERE
McMillan's biting midge *Austroconops mcmillani* (southwest) (Also known as Swan Coastal Plain), biting midge)	DBCA Priority 2	This species appears to be under threat. It has a few poorly known populations on conservation lands and several poorly known populations on un-conserved lands.	**Negligible** Records- cluster of 8 records 20.1km NW (1954, 2001, 2002, 2011). However, this is a fairly unobvious species, with very few people likely to have been actively looking for it, or able to identify it accurately.	Not applicable
Jewelled South-West Ctenotus *Ctenotus gemmula*	DBCA Priority 3. (Swan Coastal Plain population only)	The Swan Coastal Plain population is fairly scarce. It prefers *Banksia* woodland with low vegetation. It tends to be displaced from bush remnants once surrounded by suburbia.	**Negligible** Habitat suitable but tends to be displaced from suburbia and nearest records all old. Records- All old records. 2 records 8km E (1976), 5*14.5km E (1977) and 3* 24km SE (1975).	Not Applicable

5.4 DISCUSSION

5.4.1 Fauna Conservation Values

The Carramar Golf Course, including Tranquil Park on its north-west side (Figure 5), has a number of fauna conservation values:

It helps provide a corridor of reserved vegetation in suburbia. Some of the fauna habitat in the survey area is very good quality, while some is parkland cleared (degraded) but contains valuable large, mature, native trees. Although it is not directly connected to other suburban reserves, it is almost adjacent to the Neerabup National Park and very close to Lake Joondalup and various bushland blocks to the north. It is also bordered on its north side by a large area of semi-rural blocks in Carramar that have been established for a long time and contain many large trees and quite a lot of understory.

It supports a *Banksia* – Jarrah - Marri Woodland which is a State listed Priority Ecological Community (P3) '*Banksia* Dominated Woodlands of the Swan Coastal Plain IBRA Region' and Federally listed Threatened Ecological Community (TEC); 'Banksia Woodlands of the Swan Coastal Plain' (Plate 1). This TEC is located in Tranquil Park and supports its own unique assemblage of fauna. As a fauna habitat, it is in good to very good condition. For more detail on this TEC, refer to the chapters on vegetation earlier in this report.

This *Banksia* – Jarrah – Marri Woodland Fauna Habitat 1 supports a high diversity of plant species and appears to support a high diversity of animal species, which is particularly significant considering that it is a small area located in suburbia.

Out of the 24 conservation significant species listed as potentially being in the nearby region, there is reasonable probability that the survey area supports seven of these. It is important that these are considered carefully in managing the area (see Section 5 and Table 16 for detail). Particularly notable species in this regard are the Carnaby's Black-Cockatoo, Red-tailed Black-Cockatoo, Baudin's Black-Cockatoo, Southern Brown Bandicoot, Graceful Sunmoth, Rainbow Bee-eater and Peregrine Falcon.

The Carramar Golf Course and Tranquil Park may be important for the Carnaby's Black-Cockatoo (classified as Vulnerable under the *EPBC Act 1999*) (recorded in the present survey), the Red-tailed Black-Cockatoo (Endangered, *EPBC Act 1999*) (recorded in the present survey) and the Baudin's Black-Cockatoo (Vulnerable, *EPBC Act 1999*) by providing food and roosts, and potentially providing nesting hollows.

It may also be important for the Southern Brown Bandicoot (DBCA Priority 4) (recorded in the present survey), the Graceful Sunmoth (DBCA Priority 4) which has been previously recorded in the reserve and there is plenty of its host plant *Synemon gratiosa* present, and the Rainbow Bee-eater (classified as a Marine Species under the *EPBC Act 1999*) (recorded in present survey), which may also breed there. The Peregrine Falcon (classified under Other Specially Protected Fauna, Schedule 7, of the *Biodiversity Conservation Act 2016*) may also use the area, taking advantage of the large trees, open areas and pond/lake containing waterbirds.

The survey area supports a high number of large, mature trees, which can provide nest hollows and large canopies for tree dwelling fauna. These can be found in Tranquil Park and the Carramar Golf Course.

Most of Fauna Habitat 1- *Banksia* – Jarrah – Marri Woodland, located in Tranquil Park, is in good to very good condition (see Figure 1). However, rabbits have disrupted this bushland in places as is evidenced by their diggings. There are warrens, that are largely disused. However, this pest species appears to be returning to the area.

The healthiest part of Fauna Habitat 2, which has quite a lot of intact understory and lots of leaf litter, is also in good condition. This area is located within the Carramar Golf Course, immediately south of Tranquil Park, and appears not to be used greatly by the resident kangaroos (see Figure 1).

Tranquil Park appears to be free of disease. Although, this could change with the number of people using it, with the possibility of dieback and other diseases being introduced.

Tranquil Park appears to be appreciated for passive recreation and education. Evidence, including observations made during the present survey, suggests it is well used by the public for walking, and dog walking. It is also potentially used for jogging, looking for wildflowers, bird watching and may be used by families. There are only a few tracks through this area, and pedestrians appear to be adhering to those tracks. It was notably very clean, with no sign of people dumping rubbish or dropping rubbish.

6.0 ACKNOWLEDGEMENTS

Specialist taxonomists kindly provided advice on a number of matters. These were:

Mike Hislop (WA Herbarium) confirmed the identity of *Jacksonia sericea*.

Mark Brundrett provided advice on the status of *Drosera paleacea* sens. lat.

7.0 REFERENCES

ATA Environmental (2007). Flora, vegetation and vertebrate fauna assessment. Lot 4, Part lots 1002 and 2692 Neerabup. Unpublished report to the City of Wanneroo and Landcorp, March 2007.

Astron Environmental Services (2017a). Pinjar Road targeted flora survey and Level 1 fauna survey. Unpublished report to the City of Wanneroo, November 2017.

Astron Environmental Services (2017b). Badgerup Reserve flora and fauna survey. Unpublished report to the City of Wanneroo, September 2017.

Astron Environmental Services (2018). Carramar and Marangaroo Golf Courses – Black-Cockatoo Tree Assessment. Unpublished letter report, January 2018.

Barrett, G., Silcocks, A., Barry, S., Cunningham, R. and Poulter, R. (2003). *The new atlas of Australian birds.* Birds Australia, Melbourne.

Barrett, R.L. (2012). Poranthera moorokatta (Phyllanthaceae), a rare new species from Perth, Western Australia. *Nuytsia* 22 (6): 399–407. Department of Biodiversity, Conservation and Attractions. ISSN 0085-4417 (print); ISSN 2200-2790 (online).

Beard, J.S. (1979). The Vegetation of the Perth Area, Western Australia. Map and Explanatory Memoir 1:250,000 Series. Vegetation Survey of Western Australia. Vegmap Publications, Perth.

Birdata (2017). *Birdata: distribution maps*. Online: www.birdata.com.au/maps.vm.

Bureau of Meteorology. (2018). Climate Data Monthly Rainfall, Wanneroo Accessed Nov 2018. Bureau of Meteorology, Melbourne.

Bush, B., Maryan, B., Browne-Cooper, R. and Robinson, D. (2010). *Field guide to reptiles and frogs of the Perth region.* Western Australian Museum, Perth.

Churchill, S. (2008). *Australian bats.* 2nd Edition. Allen and Unwin Publishers, Crows Nest NSW.

Churchward, H.M. and McArthur, W.M. (1980). Atlas of Natural Resources Darling System Western Australia: Landforms and Soils of the Darling System, Western Australia. Department of Conservation and Environment, Perth.

Coffey Environments (2009a). Flora and fauna assessment, Hester Avenue, Neerabup Unpublished report to the City of Wanneroo, December 2009.

Coffey Environments (2009b). Flora and fauna assessment, Wesco Road, Nowergup. Unpublished report to the City of Wanneroo, December 2009.

Council of Heads of Australasian Herbaria (2013). Australia's Virtual Herbarium. Accessed November 2018 at http://avh.chah.org.au.

Davey Shearer Golf Design (2015). Carramar Golf Course master plan report. Unpublished report to the City of Wanneroo, December 2015.

Department of Biodiversity, Conservation and Attractions (2017). *Western Australian threatened fauna database.* Department of Biodiversity, Conservation and Attractions. Available from http://DBCA.wa.gov.au/.

Department of Biodiversity Conservation and Attractions (2018). Biodiversity Conservation Act. Available from https://www.dpaw.wa.gov.au/plants-and-animals. Department of Biodiversity Conservation and Attractions, Kensington.

Department of Biodiversity, Conservation and Attractions (2017). *NatureMap: mapping Western Australia's biodiversity.* Department of Biodiversity, Conservation and Attractions and Western Australian Museum. Available from: http://naturemap.DBCA.wa.gov.au/.

Department of Conservation and Land Management (1999). Environmental Weeds Strategy for Western Australia. Department of Conservation and Land Management, Perth.

Department of Environment and Conservation (2008). Forest Black Cockatoo (Baudin's Cockatoo *Calyptorhynchus baudinii* and Forest Red-tailed Black Cockatoo *Calyptorhynchus banksii naso*) Recovery Plan. Department of Environment and Conservation, Perth.

Department of Environment and Energy (2017). *Leipoa ocellata* in species profile and threats database. Available from http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=934.

Department of Environment and Energy (2018). *EPBC Act protected matters search tool*. Available from: www.environment.gov.au/erin/ert/epbc/index.html.

Department of Environment and Heritage. (2000). Version 5.1 update of An Interim Biogeographical Regionalisation for Australia: a framework for setting priority in the National Reserves System. Government of Australia, Canberra.

Department of Parks and Wildlife (2013a). Carnaby's Cockatoo *(Calyptorhynchus latirostris)* Recovery Plan. Western Australian Wildlife Management Program No. 52. Department of Parks and Wildlife, Perth.

Department of Parks and Wildlife (2013b). Definitions, Categories and Criteria for Threatened and Priority Ecological Communities. Accessed online https://www.dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities/wa-s-threatened-ecological-communities. Department of Parks and Wildlife, Perth.

Department of Parks and Wildlife (2017a). Conservation Codes for Western Australian Flora and Fauna. Accessed at https://www.dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities. Department of Parks and Wildlife, Perth.

Department of Biodiversity Conservation and Attractions (2017b). Priority Ecological Communities for Western Australia Version 27 (June 2017). Species and Communities Branch, Department of Biodiversity Conservation and Attractions, Perth.

Department of Biodiversity Conservation and Attractions (2018). List of Threatened Ecological Communities (TECs) endorsed by the Western Australian Minister for Environment (June 2018). Species and Communities Branch, Department of Biodiversity Conservation and Attractions, Perth.

Department of Sustainability and Environment, Water, Population and Communities (2012). EPBC Act 1999 referral guidelines for three threatened black cockatoo species. Australian Government, 2012. Department of Sustainability and Environment, Water, Population and Communities.

Eco-logical Australia (2016). Romeo Road flora and fauna survey. Unpublished report to the City of Wanneroo, November 2016.

Eco-logical Australia (2017). Flora and fauna survey for the proposed Butler North District open space project. Unpublished report to the City of Wanneroo, January 2017.

Ecoscape Australia (2007a). Old Yanchep Road flora survey. Unpublished report to the City of Wanneroo, November 2007.

Ecoscape Australia (2007b). Old Yanchep Road flora survey – Pederick Road component. Unpublished report to the City of Wanneroo, November 2007.

Ecoscape Australia (2015). Hardcastle Park biological survey. Unpublished report to the City of Wanneroo, October 2015.

Environmental Protection Authority (2016a) *Environmental factor guideline-terrestrial fauna*. EPA Environmental Factor Guideline, Perth Western Australia.

Environmental Protection Authority (2016b). *Technical guidance terrestrial fauna surveys*. EPA Technical Guidance, Perth, Western Australia.

Environmental Protection Authority (2016c). *Technical guidance – sampling methods for terrestrial vertebrate fauna*. EPA Technical Guidance, Perth, Western Australia.

Environmental Protection Authority (2016d). *Technical guidance – sampling of short range endemic vertebrate fauna.* EPA Technical Guidance, Perth, Western Australia.

Environmental Protection Authority (2016e). *Technical Guide – Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment*. Environmental Protection Authority, Perth.

ESCAVI (2003). *Australian Vegetation Attribute Manual: National Vegetation Information System, Version 6.0.* Executive Steering Committee for Australian Vegetation Information (ESCAVI). Department of the Environment and Heritage, Canberra.

Garnett, S.T., Szabo, J.K. and Dutson, G. (2010). *The action plan for Australian birds 2010.* CSIRO Publishing, Victoria.

GHD (2010). Report for Franklin Park environmental appraisal. Level 2 flora survey and Level 1 fauna assessment. Unpublished report to the City of Wanneroo, December 2010.

Gibson, N., Keighery, B.J., Keighery, G.J., Burbidge, A.H. and Lyons, M.N. (1994). *A Floristic Survey of the southern Swan Coastal Plain.* Unpublished Report for the Australian Heritage Commission prepared By Department of Conservation and Land Management and the Conservation council of Western Australia Inc., Perth.

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

Heddle, E.M., Loneragan, O.W. and Havel, J.J. (1980). *Atlas of Natural Resources Darling System Western Australia: Geology, Mineral Resources and Hydrogeology of the Darling System, Western Australia*. Department of Conservation and Environment, Perth.

Higgins, P. J. (Ed.) (1999). *Handbook of Australian, New Zealand and Antarctic Birds.* Oxford University Press, Melbourne.

Johnstone R.E. and Storr, G.M. (1998). *Handbook of Western Australian birds. Volume I –nonpasserines (Emu to Dollarbird).* Western Australian Museum, Perth WA.

Local Biodiversity Project (2013). *Native Vegetation extent by Vegetation complexes on the Swan Coastal Plain south of Moore River*. Perth Biodiversity Programme. Western Australian Local Government Association, Perth.

Menkhorst, P. and Knight, F. (2011). *A field guide to the mammals of Australia (3rd ed.)*. Oxford University Press, South Melbourne.

Morcombe, M. (2004). *Field guide to Australian birds*. Steve Parish Publishing, Archerfield, Queensland.

Moseby, K., Nano, T. and Southgate, R. (2011). *Tales in the sand: a guide to identifying Australian arid zone fauna using spoor and other signs.* Ecological Horizons Pty Ltd, South Australia.

R Development Core Team (2007). R: *A Language and Environment for Statistical Computing*. R Foundation for Statistical Computing Vienna, Austria. ISBN 3-900051-07-0, http//www.R-project.org.

Rayner, K. (2009). An investigation into the ecology of Chuditch (*Dasyurus geoffroii*) occurring naturally in a semi-arid climate zone.

Shepherd, D.P., Beeston, G.R. and Hopkins, A.J.M. (2002) *Native Vegetation in Western Australia: Extent, types and status*. Department of Agriculture, Western Australia.

Storr, G.M. and Johnstone, R.E. (1988). Birds of the Swan Coastal Plain and adjacent seas and islands. *Records of the Western Australian Museum*. Supplement No. 28.

Storr, G.M., Smith, L.A. and Johnstone, R.E. (1983). *Lizards of Western Australia. II Dragons and monitors.* Western Australian Museum, Perth.

Storr, G.M., Smith, L.A. and Johnstone, R.E. (1990). *Lizards of Western Australia. III Geckos and pygopods.* Western Australian Museum, Perth.

Storr, G.M., Smith, L.A. and Johnstone, R.E. (1999). *Lizards of Western Australia. I Skinks.* Western Australian Museum, Perth.

Storr, G.M., Smith, L.A. and Johnstone, R.E. (2002). *Snakes of Western Australia*. Western Australian Museum, Perth.

Terratree (2016). Level 2 flora and vegetation assessment of conservation offset areas. Unpublished report to the City of Wanneroo, November 2016.

Terrestrial Ecology (2018). City of Wanneroo Black-Cockatoo habitat survey in the Neerabup Industrial Area. Unpublished letter report, July 2018.

Thackway, R and Cresswell, I. (1995). *An Interim Biogeographic Regionalisation for Australia: A Framework for Setting Priorities in the National Reserves System* (as amended). Australian Nature Conservation Agency, Canberra.

Thompson, G. G., and Thompson, S. A. (2010*). Terrestrial vertebrate fauna assessments for ecological impact assessment.* (Terrestrial Ecosystems, Mt Claremont, W.A., Perth.).

Triggs, B. (1996). *Tracks, scats and other traces:* a *field guide to Australian mammals*. Oxford University Press, Melbourne.

Tyler, M.J, and Doughty, P. (2009). *Field guide to frogs of Western Australia*. Western Australian Museum, Perth.

Western Australian Herbarium (1998–). *Florabase - the Western Australian Flora*. Accessed online November 2018 https://florabase.dpaw.wa.gov.au. Department of Biodiversity Conservation and Attractions, Perth.

Wilson, S. and Swan, G. (2008). *Reptiles of Australia*, Second Edition, New Holland Publishers, Sydney.

van Dyck, S. and Strahan, R. (2008). *The Mammals of Australia* (3rd Ed) New Holland Publishers, Sydney

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APPENDIX A

Flora Species List

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APPENDIX A

Flora Species List

FAMILY		SPECIES
042	ZAMIACEAE	*Macrozamia fraseri*
052	CUPRESSACEAE	*Callitris preissii*
109	COLCHICACEAE	*Burchardia congesta*
115	ORCHIDACEAE	*Caladenia arenicola*
115	ORCHIDACEAE	*Caladenia flava* subsp. *flava*
115	ORCHIDACEAE	*Diuris magnifica*
115	ORCHIDACEAE	*Elythranthera brunonis*
115	ORCHIDACEAE	*Leporella fimbriata*
115	ORCHIDACEAE	*Microtis media* var. *media*
115	ORCHIDACEAE	*Pterostylis recurva*
115	ORCHIDACEAE	*Pyrorchis nigricans*
115	ORCHIDACEAE	*Thelymitra* sp. (immature)
124	IRIDACEAE	**Freesia alba × leichtlinii*
124	IRIDACEAE	**Gladiolus caryophyllaceous*
124	IRIDACEAE	**Moraea flaccida*
124	IRIDACEAE	*Orthrosanthus laxus* var. *laxus*
124	IRIDACEAE	*Patersonia occidentalis* var. *occidentalis*
124	IRIDACEAE	**Romulea rosea*
126	XANTHORRHOEACEAE	*Xanthorrhoea ?preissii* (unusual habit)
126	XANTHORRHOEACEAE	*Xanthorrhoea brunonis* subsp. *brunonis*
126	XANTHORRHOEACEAE	*Xanthorrhoea preissii*
128	ASPARAGACEAE	**Asparagus asparagoides*
128	ASPARAGACEAE	**Asparagus declinatus*
128	ASPARAGACEAE	*Lomandra caespitosa*
128	ASPARAGACEAE	*Lomandra hermaphrodita*
128	ASPARAGACEAE	*Lomandra preissii*
128	ASPARAGACEAE	*Lomandra sericea*
128	ASPARAGACEAE	*Sowerbaea laxiflora*
128	ASPARAGACEAE	*Thysanotus manglesianus*
128	ASPARAGACEAE	*Thysanotus sparteus*
128	ASPARAGACEAE	*Thysanotus thyrsoideus*
130	HEMERCALLIDACEAE	*Caesia micrantha*
130	HEMERCALLIDACEAE	*Corynotheca micrantha* var. *micrantha*
130	HEMERCALLIDACEAE	*Dianella revoluta* var. *divaricata*
130	HEMEROCALIDACEAE	*Tricoryne elatior*
147	DASYPOGONACEAE	*Calectasia narragara*
157	ANARTHRIACEAE	*Lyginia imberbis*
158	CENTROLEPIDACEAE	*Centrolepis drummondiana*
175	PROTEACEAE	*Banksia attenuata*
175	PROTEACEAE	*Banksia dallanneyi* var. *dallanneyi*
175	PROTEACEAE	*Banksia grandis*
175	PROTEACEAE	*Banksia menziesii*
175	PROTEACEAE	*Banksia prionotes*
175	PROTEACEAE	*Banksia sessilis* var. *cygnorum*
175	PROTEACEAE	*Grevillea crithmifolia*
175	PROTEACEAE	**Grevillea thelemanniana*
175	PROTEACEAE	**Hakea laurina*

FAMILY		SPECIES
175	PROTEACEAE	*Hakea lissocarpha*
175	PROTEACEAE	*Hakea prostrata*
175	PROTEACEAE	*Petrophile linearis*
175	PROTEACEAE	*Petrophile macrostachya*
175	PROTEACEAE	*Stirlingia latifolia*
201	FABACEAE	*Acacia cyclops*
201	FABACEAE	*Acacia huegelii*
201	FABACEAE	**Acacia iteaphylla*
201	FABACEAE	**Acacia longifolia* var. *sophorae*
201	FABACEAE	**Acacia podalyriifolia*
201	FABACEAE	*Acacia pulchella* var. *glaberrima*
201	FABACEAE	*Acacia saligna*
201	FABACEAE	*Acacia willdenowiana*
201	FABACEAE	*Bossiaea eriocarpa*
201	FABACEAE	*Daviesia decurrens* subsp. *decurrens*
201	FABACEAE	*Daviesia nudiflora* subsp. *nudiflora*
201	FABACEAE	*Daviesia triflora*
201	FABACEAE	*Gompholobium tomentosa*
201	FABACEAE	*Hardenbergia comptoniana*
201	FABACEAE	*Hovea trisperma* var. *trisperma*
201	FABACEAE	*Isotropis cuneifolia* subsp. *cuneifolia*
201	FABACEAE	*Jacksonia furcellata*
201	FABACEAE	*Jacksonia sericea* P4
201	FABACEAE	*Jacksonia sternbergiana*
201	FABACEAE	*Kennedia prostrata*
201	FABACEAE	**Lupinus angustifolius*
201	FABACEAE	**Lupinus cosentinii*
201	FABACEAE	**Medicago polymorpha*
201	FABACEAE	**Trifolium campestre*
201	FABACEAE	**Vicia sativa*
217	CASUARINACEAE	*Allocasuarina fraseriana*
261	VIOLACEAE	*Hybanthus calycinus*
274	GERANIACEAE	**Erodium botrys*
274	GERANIACEAE	**Geranium molle*
274	GERANIACEAE	**Pelargonium capitatum*
300	RUTACEAE	*Philotheca spicata*
357	AMARANTHACEAE	*Ptilotus ?drummondii* (sterile)
357	AMARANTHACEAE	*Ptilotus manglesii*
357	AMARANTHACEAE	*Ptilotus polycephala*
364	AIZOACEAE	**Carpobrotus edulis*
392	PRIMULACEAE	**Lysmachia arvensis*
403	ERICACEAE	*Astroloma pallidum*
403	ERICACEAE	*Conostephium pendulum*
403	ERICACEAE	*Leucopogon propinquus*
403	ERICACEAE	*Leucopogon racemulosus*
411	LOGANIACEAE	*Phyllangium paradoxum*
438	BIGNONIACEAE	**Jacaranda mimosifolia*
458	GOODENIACEAE	*Dampiera linearis*
458	GOODENIACEAE	*Lechenaultia floribunda*
458	GOODENIACEAE	*Scaevola canescens*
460	ASTERACEAE	*Craspedia* sp. Yalgorup National Park (G.J. Keighery 14449)

FAMILY		SPECIES
460	ASTERACEAE	**Hypochaeris glabra*
460	ASTERACEAE	**Hypochaeris radicata*
460	ASTERACEAE	*Lagenophora huegelii*
460	ASTERACEAE	**Leontodon rhagadioloides*
460	ASTERACEAE	**Monoculus monstrosus*
460	ASTERACEAE	*Olearia lehmanniana*
460	ASTERACEAE	*Podotheca angustifolia*
460	ASTERACEAE	*Podotheca chrysantha*
460	ASTERACEAE	*Podotheca gnaphalioides*
460	ASTERACEAE	*Quinetia urvillei*
460	ASTERACEAE	**Senecio iriops*
460	ASTERACEAE	**Senecio vulgaris*
460	ASTERACEAE	**Sonchus oleraceus*
460	ASTERACEAE	**Ursinia anthemoides* subsp*. anthemoides*
460	ASTERACEAE	*Waitzia nitida*
472	ARALIACEAE	*Trachymene pilosa*
474	APIACEAE	*Daucus glochidiatus*
474	APIACEAE	*Eryngium pinnatifidum* subsp*. pinnatifidum* ms
474	APIACEAE	**Foeniculum vulgare*
474	APIACEAE	*Homalosciadium homalocarpum*
474	APIACEAE	*Xanthosia huegelii*

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APPENDIX B

Flora and Vegetation Species by Site Table

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APPENDIX B

Flora and Vegetation Species by Site Table

H = Height (cm); **C** = Cover (% of quadrat area); **T** = transect; **R** = releve, **X** = outside quadrat but within 10m of quadrat; **+** = present at very low cover value; CR = creeper; * = introduced flora.

SPECIES	CG01	CG01	CG02	CG02	CG03	CG03	CG04	CG04	OPPORTUNISTIC
	(cm)	(%)	(cm)	(%)	(cm)	(%)	(cm)	(%)	(CRT=Transect CGR=Releve. See Appendix D for Locations)
Acacia cyclops									CGR-01
Acacia huegelii					X	X	50	1	CRT04
**Acacia iteaphylla*			60	1	X	X			CRT01, CRT03, CRT04, CGR-01, CGR-02, CGR-06, CGR-07, CGR-08
**Acacia longifolia* var. *sophorae*									CGR-01, CGR-02, CGR-05
**Acacia podalyriifolia*									CGR-01
Acacia pulchella var. *glaberrima*	120	1	X	X	X	X	X	X	CGR-02, CGR-06, CGR-08
Acacia saligna	X	X					X	X	CGR-06, CGR-08
Acacia willdenowiana			40	<1					
**Agonis flexuosus*									CGR-01, CGR-06, CGR-10
**Aira caryophyllea*	5	<1			10	3	10	0.5	CGR-01, CGR-02, CGR-06, CGR-07, CGR-08
Alexgeorgea nitens	10	<1			10	<1	10	<1	CRT02
Allocasuarina fraseriana	700	5	700	3	600	10	200	1	CGR-02, CGR-04, CGR-06, CGR-08,
Amphipogon turbinatus									CRT04
Anigozanthos humilis subsp. *humilis*					10	<1			
Anigozanthos manglesii subsp. *manglesii*					5	<1	X	X	CRT04
**Arctotheca calendula*									CRT08, CGR-06, CGR-08
**Asparagus asparagoides*			X	X					CGR-07
**Asparagus declinatus*			40	<1					
**Asphodelus fistulosus*									384147 6491699
Astroloma pallidum							10	<1	CRT03
Austrostipa compressa	10	<1							
Austrostipa flavescens									CRT08
**Avena* sp.									CRT05
Banksia attenuata	500	4	X	X	350	1	400	2	CGR-01, CGR-02, CGR-03, CGR-04, CGR-06, CGR-08
Banksia dallanneyi var. *dallanneyi*					20	<1			CGR-01
Banksia grandis									CGR-07, CRT08
Banksia menziesii	600	5			300	2	400	2	CGR-01, CGR-04, CGR-06, CGR-08, CGR-02, CGR-03

SPECIES	CG01	CG01	CG02	CG02	CG03	CG03	CG04	CG04	OPPORTUNISTIC
	(cm)	(%)	(cm)	(%)	(cm)	(%)	(cm)	(%)	(CRT=Transect CGR=Releve. See Appendix D for Locations)
Banksia prionotes									CRT02, CGR-01
Banksia sessilis var. *cygnorum*									CRT08
Beaufortia elegans									CGR-08
**Bellardia viscosa*									CGR-08
Billardiera fraseri							X	X	
Bossiaea eriocarpa	40	2	40	2	20	<1	20	2	CGR-02
**Brassica tournefortii*									CRT03N, CGR-08
**Briza maxima*	20	2	20	5	10	<1	15	1	CGR-06, CGR-07, CGR-08
**Briza minor*									CGR-06, CGR-07
Burchardia congesta	70	1	50	0.5	20	<1	50	0.5	
Caesia micrantha	50	2	40	25			30	1	
Caladenia arenicola	60	<1							CGR-02, CGR-05
Caladenia flava subsp. *flava*	20	<1	15	<1			30	<1	CRT03, CGR-02, CGR-06, CGR-08
Calandrinia corrigioloides									CRT02, CRT03, CGR-06, CGR-02
Calectasia narragara	30	<1			30	1			CGR-02
Callitris preissii									CGR-01
Calothamnus quadrifidus subsp. *quadrifidus*									CRT05
Calothamnus sanguineus					50	5			CGR-02
Calytrix flavescens					15	<1			CGR-05
**Carpobrotus edulis*	20	<1					20	<1	CRT04, CGR-01
**Centranthus ruber* subsp. *ruber*									CGR-01
Centrolepis drummondiana	5	<1			5	<1	5	<1	CGR-08, CGR-01, CGR-06
**Chamelaucium uncinatum*					250	1			CGR-02, CGR-11
Conostephium pendulum	40	0.5					40	2	CGR-07, CGR-08, CGR-08
Conostylis aculeata subsp. *aculeata*	30	<1	30	1	X	X	20	1	
Conostylis juncea									CRT03
Conostylis setigera subsp. *setigera*	20	<1					15	0.3	
**Conyza bonariensis*									CGR-02
**Cortaderia selloana*									
Corymbia calophylla			1400	55					CGR-07, CRT05, CGR-08
Corynotheca micrantha var. *micrantha*			40	2			30	<1	
**Cotula turbinata*									CGR-01, CGR-02, CGR-06, CGR-07, CGR-08

SPECIES	CG01	CG01	CG02	CG02	CG03	CG03	CG04	CG04	OPPORTUNISTIC (CRT=Transect CGR=Releve. See Appendix D for Locations)
	(cm)	(%)	(cm)	(%)	(cm)	(%)	(cm)	(%)	
Craspedia sp. Yalgorup National Park (G.J. Keighery 14449)									CGR-07, CRT03, 50 J 384133 6492058
Crassula colorata var. *colorata*	2	<1			2	0.1	3	<1	CGR-01, CGR-02, CGR-06, CGR-07
**Crassula decumbens* var. *decumbens*									CGR-02 50 J 385150 6491670
Dampiera linearis					X	X	20	<1	CRT02
Daucus glochidiatus			X	X					CGR-04, CGR-07, CGR-08
Daviesia decurrens subsp. *decurrens*									CGR-01
Daviesia nudiflora subsp. *nudiflora*	X	X					50	1	CGR-02
Daviesia triflora	40	<1	X	X			70	3	
Desmocladus asper	10	2			10	1			CGR-02, CGR-06, CGR-08, CGR-01
Desmocladus flexuosus			30	10	10	<1	20	2	
Dianella revoluta var. *divaricata*	X	X					X	X	
**Dischisma arenarium*									CGR-01
Diuris magnifica	50	<1	40	0.5					
Drosera drummondii	X	X			CR	<1	CR	<1	CRT02
Drosera erythrorhiza	1	<1			1	1	1	1	CGR-01, CGR-02, CGR-07, CGR-08
Drosera paleacea sens. lat.					3	1			
**Ehrharta calycinus*							70	<1	CRT02
**Ehrharta longiflora*			40	<1					CGR-07, CGR-07
Elatine gratioloides									
Elythranthera brunonis	30	0.1			30	<1	25	<1	CGR-02, CGR-08
Eremaea pauciflora subsp. *pauciflora*									CGR-01, CGR-02, CGR-05
**Erodium botrys*									CGR-06
Eryngium pinnatifidum subsp. *pinnatifidum* ms									CRT04, CRT01, CGR-07
**Eucalyptus leucoxylon* var. *rosea*									CGR-10
Eucalyptus marginata subsp. marginata	400	8	1500	1	200	1	700	15	CGR-02, CGR-03, CGR-06, CGR-08
**Eucalyptus* sp. (planted)									CGR-01
Eucalyptus todtiana									CGR-01, CGR-05
**Euphorbia peplus*									CGR-06, CRT05, CGR-04, CGR-06, CGR-07
**Euphorbia terracina*	20	<1	20	<1					CRT05, 51 J 384200 6492100, 51 J 384120 6492115
**Ficus cairica*									CGR-05, CGR-10, CGR-05
**Foeniculum vulgare*									CGR-05, 50 J 384147 6491699
**Freesia alba × leichtlinii*									CGR-07

SPECIES	CG01	CG01	CG02	CG02	CG03	CG03	CG04	CG04	OPPORTUNISTIC (CRT=Transect CGR=Releve. See Appendix D for Locations)
	(cm)	(%)	(cm)	(%)	(cm)	(%)	(cm)	(%)	
**Fumaria capreolata*									CGR-02
**Fumaria muralis*									CGR-11
**Galium murale*									CRT08, CGR-06, CGR-08
**Gazania linearis*									51 J 384120 6492115
**Geranium molle*									CGR-07
**Gladiolus caryophyllaceous*	70	1	70	0.5	30	0.2	70	<1	
**Gomphocarpus fruticosus*									CGR-01
Gompholobium tomentosa	20	<1	30	<1			60	1	
Grevillea crithmifolia									CRT03, CGR-01
**Grevillea thelemanniana*									50 J 384216 6491534
Haemodorum laxum	60	0.5	70	<1			120	<1	CGR-08
Haemodorum sp. (grazed)					10	<1			
**Hakea laurina*									CGR-01, CGR-02
Hakea lissocarpha	X	X	X	X					
Hakea prostrata									CRT07, CGR-08
Hardenbergia comptoniana	CR	<1			CR	<1	CR	<1	CGR-02, CGR-07
**Heliophila pusilla*					10	<1	20	<1	CGR-07, CRT05
Hibbertia cuneifolius									CGR-01
Hibbertia hypericoides subsp. *hypericoides*	50	20	40	2	50	10	50	18	CGR-01, CGR-02, CGR-03, CGR-06, CGR-07, CGR-08
Hibbertia racemosa									CRT06
Hibbertia sericocephala (prev. H. huegelii)	40	<1			20	1	20	<1	CGR-02
Hibbertia subvaginata									CGR-05
Homalosciadium homalocarpum	2	<1					10	<1	CGR-08
Hovea trisperma var. *trisperma*	50	<1					40	0.5	
Hyalosperma cotula									CGR-02
Hybanthus calycinus	X	X			X	X	20	<1	CGR-02, CGR-08, CGR-08
Hypocalymma robustum	40	<1			60	<1	45	1	CGR-01, CGR-07, CGR-08
**Hypochaeris glabra*	10	<1			10	3	20	1	CRT02, CGR-02, CGR-06, CGR-07, CGR-08
**Hypochaeris radicata*			30	1					
**Ipomoea cairica*									CGR-06, CGR-10
**Isolepis marginata*	3	<1			5	0.1	3	<1	CGR-01, CGR-02, CGR-07
Isotropis cuneifolia subsp. *cuneifolia*	40	<1			20	<1	X	X	

SPECIES	CG01	CG01	CG02	CG02	CG03	CG03	CG04	CG04	OPPORTUNISTIC (CRT=Transect CGR=Releve. See Appendix D for Locations)
	(cm)	(%)	(cm)	(%)	(cm)	(%)	(cm)	(%)	
**Jacaranda mimosifolia*									CGR-01
Jacksonia furcellata									CGR-01, CGR-05, CRT03
Jacksonia sericea P4									
Jacksonia sp.									CGR-08
Jacksonia sternbergiana	X	X	X	X	X	X	120	<1	CGR-01
Juncus pallidus									50 J 384779 6491869
Kennedia prostrata	CR	<1	CR	<1	CR	<1			CGR-02
Kunzea glabrescens									CGR-03, CGR-05, CGR-08
Lagenophora huegelii	30	<1					20	0.5	CGR-02, CGR-06, CGR-07, CGR-08
**Lavandula* sp.									CGR-01
Lechenaultia floribunda									CRT06
**Leontodon rhagadioloides*			20	<1	10	<1			
Lepidosperma calcicola			40	1					
Lepidosperma scabrum	40	<1					45	<1	
Leporella fimbriata	20	<1	20	<1	1	<1	10	<1	CGR-02, CRT02
**Leptospermum laevigatum*									CGR-01, CGR-05
Leptospermum spinescens					X	X			
Leucopogon propinquus	40	<1	50	<1					
Leucopogon racemulosus	120	<1							CRT05
Lomandra caespitosa	20	<1			10	<1	30	<1	
Lomandra hermaphrodita	20	<1					20	1	
Lomandra preissii							35	<1	
Lomandra sericea	60	<1	50	<1	X	X	40	<1	
**Lupinus angustifolius*									CGR-01
**Lupinus cosentinii*									CGR-07
Lyginia imberbis					15	<1	60	<1	CRT04, CGR-02
**Lysmachia arvensis*	10	<1							CGR-02, CGR-08, CGR-07
Macrozamia fraseri	X	X							CGR-06, CGR-08
**Medicago polymorpha*									CRT05, CGR-07
Melaleuca huegelii									CGR-01
Mesomelaena pseudostygia	60	15	70	2	20	<1	70	12	CGR-01, CGR-02, CGR-08
Microlaena stipoides var. *stipoides*	50	<1	40	1			20	1	CGR-06, CGR-07, CGR-08

SPECIES	CG01	CG01	CG02	CG02	CG03	CG03	CG04	CG04	OPPORTUNISTIC (CRT=Transect CGR=Releve. See Appendix D for Locations)
	(cm)	(%)	(cm)	(%)	(cm)	(%)	(cm)	(%)	
Microtis media var. media	40	<1	40	<1					
**Monoculus monstrosus*									CGR-07
Monotaxis grandiflora var. *grandiflora*	X	X					10	<1	
**Moraea flaccida*							X	X	CGR-08, CGR-05, CRT05, CGR-01, CGR-06, CGR-07
Olearia lehmanniana									CRT06
Opercularia vaginata	40	<1					30	1	
**Orobanche minor*			20	<1					
Orthrosanthus laxus var. *laxus*	40	1	40	<1					CGR-07
**Osteospermum ecklonis*									CGR-01, CGR-05
**Oxalis pes-caprae*			10	<1					CGR-07
Patersonia occidentalis var. *occidentalis*					X	X			CGR-01
**Pelargonium capitatum*	70	<1			2	<1			CGR-01, CGR-02
Petrophile linearis					30	<1			CRT04
Petrophile macrostachya	70	2					50	3	CGR-02
**Petrorhagia dubia*									CRT01, CRT02, CGR-07
Philotheca spicata	40	1			30	1	30	<1	CGR-02
Phyllangium paradoxum					10	<1			
Phyllanthus calycinus	X	X	40	<1					CGR-07, CGR-08
Pimelea sulphurea	40	<1			40	<1	50	<1	CGR-02, CGR-08
**Pittosporum undulatum*									CGR-10
Podotheca angustifolia									CGR-02
Podotheca chrysantha	10	<1							CGR-05
Podotheca gnaphalioides	5	<1			20	<1	20	<1	CGR-05, CGR-01, CGR-08
Poranthera microphylla							3	<1	CGR-02, CGR-08
Poranthera moorokatta P2					2	<1			CRT05
Pterostylis recurva	40	<1	30	<1			40	<1	
Ptilotus ?drummondii (sterile)	40	<1							
Ptilotus manglesii	2	<1	5	<1			10	<1	CGR-08, CGR-06, CGR-07
Ptilotus polycephala									CRT02, CGR-08
Pyrorchis nigricans									CGR-08, CRT01, CGR-06
Quinetia urvillei	2	<1			5	1			CGR-08, CGR-01, CGR-06
Rhytidosperma occidentale									CRT04, 384220 6492100

SPECIES	CG01	CG01	CG02	CG02	CG03	CG03	CG04	CG04	OPPORTUNISTIC
	(cm)	(%)	(cm)	(%)	(cm)	(%)	(cm)	(%)	(CRT=Transect CGR=Releve. See Appendix D for Locations)
**Romulea rosea*									CRT01, CGR-07
**Rosmarinus officinalis*									CGR-01
Scaevola canescens	30	1	20	<1			20	1	
Schoenus curvifolius									CRT03
**Senecio iriops*									CGR-01
**Senecio vulgaris*									CGR-03
**Silene gallica*									CRT01, CGR-06, CGR-08
**Solanum nigrum*									CGR-02, CGR-07, CGR-08
**Sonchus oleraceus*					3	<1			CRT08, CGR-08
Sowerbaea laxiflora	40	<1	40	2			30	<1	CGR-02, CGR-07, CGR-08
Spyridium globulosum									50J 384151 6491617
**Stellaria media*									CGR-07, CGR-08
Stirlingia latifolia					50	<1	30	<1	CRT01, CGR-01, CGR-02, CGR-08
Stylidium androsaceum	10	1			10	2	10	<1	CGR-02, CGR-08
Stylidium neurophyllum ms	30	<1			30	<1	X	X	
Stylidium piliferum	30	<1			30	<1	10	<1	CGR-02
Stylidium scariosum									CRT03
Stylidium schoenoides							20	<1	CGR-02, CRT06
Tetraria octandra	40	3	40	15	10	<1	30	2	CGR-01
Thelymitra sp. (immature)									CRT01
Thysanotus manglesianus	CR	<1					CR	<1	CGR-05
Thysanotus sparteus	70	<1					70	<1	CGR-01
Thysanotus thyrsoideus	X	X							
**Trachyandra divaricata*									CGR-02
Trachymene pilosa	5	1			10	2	10	1	CGR-02, CGR-06, CGR-07
Tricoryne elatior									CRT09
**Trifolium campestre*									CRT08
**Ursinia anthemoides* subsp. *anthemoides*	20	1			30	1	20	<1	CRT02, CGR-02, CGR-06, CGR-08
**Vicia sativa*									CRT02, CGR-07
**Vulpia bromoides*	10	<1			10	3			CGR-02, CGR-06
Wahlenbergia preissii	5	<1					15	<1	CGR-01, CGR-08
Waitzia nitida	10	0.2			10	3	10	1	CGR-02, CGR-08

SPECIES	CG01	CG01	CG02	CG02	CG03	CG03	CG04	CG04	OPPORTUNISTIC
	(cm)	(%)	(cm)	(%)	(cm)	(%)	(cm)	(%)	(CRT=Transect CGR=Releve. See Appendix D for Locations)
Xanthorrhoea ?preissii (unusual habit)(sterile)							120	1	CRT04
Xanthorrhoea brunonis subsp. *brunonis*	120	<1	100	1	120	1	80	<1	CGR-02
Xanthorrhoea preissii	150	6	150	7	180	8	180	6	CGR-01, CGR-02, CGR-03, CGR-06, CGR-07, CGR-08, CGR-10
Xanthosia huegelii	20	<1			10	<1	X	X	

APPENDIX C

Vegetation Detailed Site Quadrat Data

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SITE: CG01

Survey Date 1:	27 September 2018			**Surveyors Date 1:**	Kelli McCreery
Quadrat Location:	NW	384244	6492066	**Quadrat Size:**	10m X 10m (100m^2)
	NE	384255	6492068	**AMG Zone**	50J
	SE	384255	6492061	**Accuracy**	±3m
	SW	384247	6492059	**Datum:**	WGS84
Landform Type:	H: Hillock			**Landform Element:**	DUN: Dune
Aspect:	SE			**Altitude:**	44m
Soil Type:	Sand			**Soil Colour:**	White (Yellow at depth)
Leaf Litter:	35% cover; 1 – 30 cm depth.			**Fire History:**	>10 years
Condition:	VG	Details: Weeds, Disease (Jarrah not well), Logs (<1% cover)			
Vegetation Description:	Open Forest *Allocasuarina fraseriana, Eucalyptus marginata* subsp. *marginata*, *Banksia attenuata* and *B. menziesii* over species-rich Shrubland dominated by *Xanthorrhoea preissii, Hibbertia hypericoides* subsp. *hypericoides*, *Acacia pulchella* var. *glaberrima*, *Petrophile macrostachya*, *Bossiaea eriocarpa*, *Philotheca spicata*, Open Sedgeland *Tetraria octandra* and *Mesomelaena pseudostygia* and species-rich Open Forbland (mixed as recorded).				
Species:	*Acacia pulchella* var. *glaberrima, *Aira caryophyllea, Alexgeorgea nitens, Allocasuarina fraseriana, Austrostipa compressa, Banksia attenuata, Banksia menziesii, Bossiaea eriocarpa, *Briza maxima, Burchardia congesta, Caesia micrantha, Caladenia arenicola, Caladenia flava* subsp. *flava, Calectasia narragara, *Carpobrotus edulis, Centrolepis drummondiana, Conostephium pendulum, Conostylis aculeata* subsp. *aculeata, Conostylis setigera* subsp. *setigera, Crassula colorata* var. *colorata, Daviesia triflora, Desmocladus asper, Diuris magnifica, Drosera erythrorhiza, Elythranthera brunonis, Eucalyptus marginata* subsp. *marginata, *Euphorbia terracina, *Gladiolus caryophyllaceous, Gompholobium tomentosa, Haemodorum laxum, Hardenbergia comptoniana, Hibbertia hypericoides* subsp. *hypericoides, Hibbertia sericocephala (*prev. *H. huegelii), Homalosciadium homalocarpum, Hovea trisperma var. trisperma, Hypocalymma robustum, *Hypochaeris glabra, *Isolepis marginata, Isotropis cuneifolia* subsp. *cuneifolia, Kennedia prostrata, Lagenophora huegelii, Lepidosperma scabrum, Leporella fimbriata, Leucopogon propinquus, Leucopogon racemulosus, Lomandra caespitosa, Lomandra hermaphrodita, Lomandra sericea, *Lysmachia arvensis, Mesomelaena pseudostygia, Microlaena stipoides var. stipoides, Microtis media* var. *media, Opercularia vaginata, Orthrosanthus laxus var. laxus, *Pelargonium capitatum, Petrophile macrostachya, Philotheca spicata, Pimelea sulphurea, Podotheca chrysantha, Podotheca gnaphalioides, Pterostylis recurva, Ptilotus ?drummondii* (sterile), *Ptilotus manglesii, Quinetia urvillei, Scaevola canescens, Sowerbaea laxiflora, Stylidium androsaceum, Stylidium neurophyllum* ms, *Stylidium piliferum, Tetraria octandra, Thysanotus manglesianus, Thysanotus sparteus, Trachymene pilosa, *Ursinia anthemoides subsp. anthemoides, *Vulpia bromoides, Wahlenbergia preissii, Waitzia nitida, Xanthorrhoea brunonis* subsp. *brunonis, Xanthorrhoea preissii, Xanthosia huegelii.*				
Photo (NW Corner):					

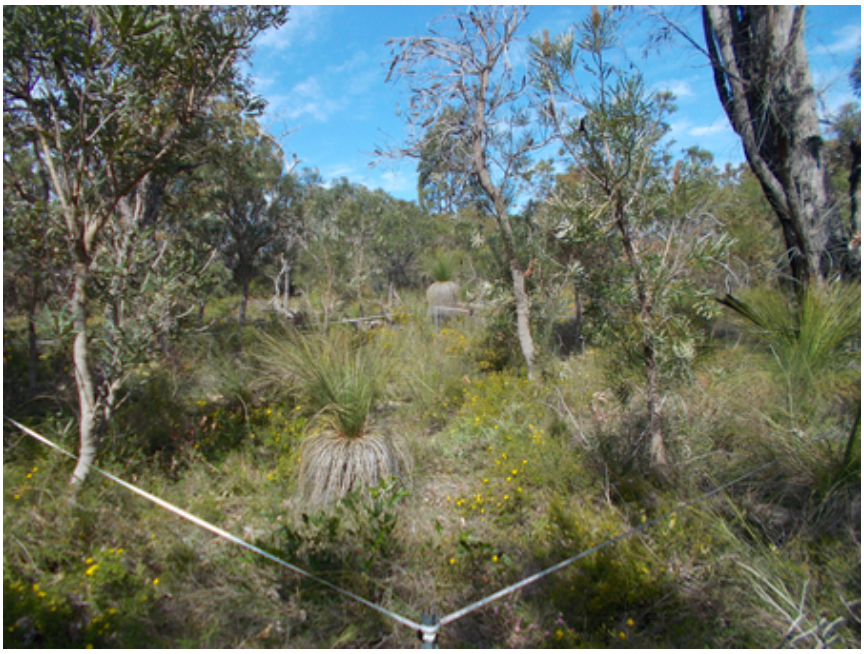
SITE: CG02

Survey Date 1:	27 September 2018			**Surveyors Date 1:**	Kelli McCreery
Quadrat Location:	NW	384111	6492041	**Quadrat Size:**	10m X 10m (100m^2)
	NE	384115	6492040	**AMG Zone**	50J
	SE	384124	6492029	**Accuracy**	±3m
	SW	384115	6492031	**Datum:**	WGS84
Landform Type:	H: Hillock			**Landform Element:**	DUN: Dune
Aspect:	SW			**Altitude:**	48m
Soil Type:	Peaty Sand			**Soil Colour:**	Pale Brown
Leaf Litter:	100% cover; 5 – 20 cm depth.			**Fire History:**	>10 years
Condition:	VG	Details: Weeds, Logs (1% cover)			
Vegetation Description:	Open Forest *Corymbia calophylla* over Sparse Shrubland *Xanthorrhoea preissii* and *X. brunonis* over Forbland dominated by *Caesia micrantha* and Sparse Tussock Grassland *Microlaena stipoides* (and **Briza maxima*).				
Species:	**Acacia iteaphylla, Acacia willdenowiana, Allocasuarina fraseriana, *Asparagus declinatus, Bossiaea eriocarpa, *Briza maxima, Burchardia congesta, Caesia micrantha, Caladenia flava* subsp. *flava, Conostylis aculeata* subsp. *aculeata, Corymbia calophylla, Corynotheca micrantha var. micrantha, Desmocladus flexuosus, Diuris magnifica, *Ehrharta longiflora, Eucalyptus marginata subsp. marginata, *Euphorbia terracina, *Gladiolus caryophyllaceous, Gompholobium tomentosa, Haemodorum laxum, Hibbertia hypericoides subsp. hypericoides, *Hypochaeris radicata, Kennedia prostrata, *Leontodon rhagadioloides, Lepidosperma calcicola, Leporella fimbriata, Leucopogon propinquus, Lomandra sericea, Mesomelaena pseudostygia, Microlaena stipoides* var. *stipoides, Microtis media* var. *media, *Orobanche minor, Orthrosanthus laxus* var. *laxus, *Oxalis pes-caprae, Phyllanthus calycinus, Pterostylis recurva, Ptilotus manglesii, Scaevola canescens, Sowerbaea laxiflora, Tetraria octandra, Xanthorrhoea brunonis* subsp. *brunonis, Xanthorrhoea preissii.*				
Photo (NW Corner):					

SITE: CG03

Survey Date 1:	28 September 2018			**Surveyors Date 1:**	Kelli McCreery
Quadrat Location:	NW	385140	6492102	**Quadrat Size:**	10m X 10m (100m^2)
	NE	385150	6492103	**AMG Zone**	50J
	SE	385153	6492094	**Accuracy**	±3m
	SW	385142	6492094	**Datum:**	WGS84
Landform Type:	H: Hillock			**Landform Element:**	DUN: Dune
Aspect:	S			**Altitude:**	60m
Soil Type:	Sand			**Soil Colour:**	Beige (Yellow at depth)
Leaf Litter:	40% cover; 1 – 30 cm depth.			**Fire History:**	>10 years
Condition:	G	Details: Weeds (5-10%) grazing (Kangaroo?) sedges etc grazed to stumps, Logs (<1% cover)			
Vegetation Description:	Woodland *Eucalyptus marginata* subsp. *marginata*, *Allocasuarina fraseriana, Banksia attenuata* and *B. menziesii* over Open Shrubland dominated by *Xanthorrhoea preissii, X. brunonis* subsp. *brunonis*, *Hibbertia hypericoides subsp. hypericoides, H. sericocephala, Calothamnus sanguineus, Philotheca spicata, Calectasia narragara* over Open Forbland (mixed as recorded) and Sparse Grassland (weeds).				
Species:	**Aira caryophyllea, Alexgeorgea nitens, Allocasuarina fraseriana, Anigozanthos humilis* subsp. *humilis, Anigozanthos manglesii* subsp. *manglesii, Banksia attenuata, Banksia dallanneyi* var. *dallanneyi, Banksia menziesii, Bossiaea eriocarpa, *Briza maxima, Burchardia congesta, Calectasia narragara, Calothamnus sanguineus, Calytrix flavescens, Centrolepis drummondiana, *Chamelaucium uncinatum, Crassula colorata* var. *colorata, Desmocladus asper, Desmocladus flexuosus, Drosera drummondii, Drosera erythrorhiza, Drosera paleacea* sens. lat., *Elythranthera brunonis, Eucalyptus marginata* subsp. *marginata, *Gladiolus caryophyllaceous, Haemodorum* sp. (grazed), *Hardenbergia comptoniana, *Heliophila pusilla, Hibbertia hypericoides subsp. hypericoides, Hibbertia sericocephala* (prev. *H. huegelii), Hypocalymma robustum, *Hypochaeris glabra, *Isolepis marginata, Isotropis cuneifolia* subsp. *cuneifolia, Kennedia prostrata, *Leontodon rhagadioloides, Leporella fimbriata, Lomandra caespitosa, Lyginia imberbis, Mesomelaena pseudostygia, *Pelargonium capitatum, Petrophile linearis, Philotheca spicata, Phyllangium paradoxum, Pimelea sulphurea, Podotheca gnaphalioides, Poranthera moorokatta* P2, *Quinetia urvillei, *Sonchus oleraceus, Stirlingia latifolia, Stylidium androsaceum, Stylidium neurophyllum ms, Stylidium piliferum, Tetraria octandra, Trachymene pilosa, *Ursinia anthemoides* subsp. *anthemoides, *Vulpia bromoides, Waitzia nitida, Xanthorrhoea brunonis* subsp. *brunonis, Xanthorrhoea preissii, Xanthosia huegelii.*				
Photo (NW Corner):					

SITE: CG04

Survey Date 1:	28 September 2018			**Surveyors Date 1:**	Kelli McCreery
Quadrat Location:	NW	384225	6491933	**Quadrat Size:**	10m X 10m (100m^2)
	NE	384233	6491937	**AMG Zone**	50J
	SE	384235	6491927	**Accuracy**	±3m
	SW	384225	6491924	**Datum:**	WGS84
Landform Type:	H: Hillock			**Landform Element:**	DUN: Dune
Aspect:	NW?			**Altitude:**	52m
Soil Type:	Sand			**Soil Colour:**	Grey
Leaf Litter:	60% cover; 1 – 20 cm depth.			**Fire History:**	>10 years
Condition:	VG	Details: Weeds (2 – 3%), Logs (<1% cover)			
Vegetation Description:	Woodland *Eucalyptus marginata* subsp. *marginata, Banksia attenuata* and *B. menziesii* over species-rich Shrubland dominated by *Xanthorrhoea brunonis* subsp. *brunonis, X. preissii, Hibbertia hypericoides* subsp. *hypericoides, Petrophile macrostachya, Conostephium pendulum, Daviesia triflora, Bossiaea eriocarpa.* Sparse Sedgeland *Mesomelaena pseudostygia* and *Tetraria octandra,* Sparse Rushland *Desmocladus flexuosus* and species-rich Forbland (mixed as recorded).				
Species:	*Acacia huegelii, *Aira caryophyllea, Alexgeorgea nitens, Allocasuarina fraseriana, Astroloma pallidum, Banksia attenuata, Bossiaea eriocarpa, *Briza maxima, Burchardia congesta, Caesia micrantha, Caladenia flava* subsp. *flava, *Carpobrotus edulis, Centrolepis drummondiana, Conostephium pendulum, Conostylis aculeata* subsp. *aculeata, Conostylis setigera* subsp. *setigera, Corynotheca micrantha* var. *micrantha, Crassula colorata* var. *colorata, Dampiera linearis, Daviesia nudiflora subsp. nudiflora, Daviesia triflora, Desmocladus flexuosus, Drosera drummondii, Drosera erythrorhiza, *Ehrharta calycinus, Elythranthera brunonis, Eucalyptus marginata* subsp. *marginata, *Gladiolus caryophyllaceous, Gompholobium tomentosa, Haemodorum laxum, Hardenbergia comptoniana, *Heliophila pusilla, Hibbertia hypericoides* subsp. *hypericoides, Hibbertia sericocephala, Homalosciadium homalocarpum, Hovea trisperma* var. *trisperma, Hybanthus calycinus, Hypocalymma robustum, *Hypochaeris glabra, *Isolepis marginata, Jacksonia sternbergiana, Lagenophora huegelii, Lepidosperma scabrum, Leporella fimbriata, Lomandra caespitosa, Lomandra hermaphrodita, Lomandra preissii, Lomandra sericea, Lyginia imberbis, Mesomelaena pseudostygia, Microlaena stipoides* var. *stipoides, Monotaxis grandiflora* var. *grandiflora, Opercularia vaginata, Petrophile macrostachya, Philotheca spicata, Pimelea sulphurea, Podotheca gnaphalioides, Poranthera microphylla, Pterostylis recurva, Ptilotus manglesii, Scaevola canescens, Sowerbaea laxiflora, Stirlingia latifolia, Stylidium androsaceum, Stylidium piliferum, Stylidium schoenoides, Tetraria octandra, Thysanotus manglesianus, Thysanotus sparteus, Trachymene pilosa, *Ursinia anthemoides* subsp. *anthemoides, Wahlenbergia preissii, Waitzia nitida, Xanthorrhoea ?preissii* (unusual habit), *Xanthorrhoea brunonis* subsp. *brunonis, Xanthorrhoea preissii.*				
Photo (NW Corner):					

APPENDIX D

Flora and Vegetation Location Data

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APPENDIX D

Flora and Vegetation Location Data

CATEGORY	FEATURE	COORDINATE (WGS84)
Notable Native Flora	*Craspedia* sp. Yalgorup National Park (G.J. Keighery 14449)	50 J 384133 6492058
Notable Native Flora	*Jacksonia sericea* P4	50 J 384246 6492102
Notable Native Flora	*Poranthera moorokatta* P2	50 J 385150 6492103
Notable Native Flora	*Poranthera moorokatta* P2	51 J 384198 6491923
Notable Native Flora	*Poranthera moorokatta* P2	51 J 384194 6492004
Notable Native Flora	*Poranthera moorokatta* P2	51 J 384198 6491923
Notable Weeds	**Acacia longifolia* var. *sophorae*	50 J 384759 6491404
Notable Weeds	**Acacia longifolia* var. *sophorae*	50 J 385150 6491670
Notable Weeds	**Acacia longifolia* var. *sophorae*	50 J 384969 6492104
Notable Weeds	**Acacia podalyriifolia*	50 J 384759 6491404
Notable Weeds	**Asparagus asparagoides*	50 J 384168 6491792
Notable Weeds	**Asparagus asparagoides*	50 J 384168 6491792
Notable Weeds	**Asparagus declinatus*	50 J 384111 6492041
Notable Weeds	**Brassica tournefortii*	50 J 384179 6491837
Notable Weeds	**Brassica tournefortii*	50 J 384240 6492102
Notable Weeds	**Chamelaucium uncinatum*	50 J 384232 6491937
Notable Weeds	**Chamelaucium uncinatum*	50 J 385150 6491670
Notable Weeds	**Chamelaucium uncinatum*	50 J 384665 6492144
Notable Weeds	**Cortaderia selloana*	50 J 384779 6491869
Notable Weeds	**Euphorbia terracina*	50 J 384244 6492066
Notable Weeds	**Euphorbia terracina*	50 J 384111 6492041
Notable Weeds	**Euphorbia terracina*	51 J 384200 6492100
Notable Weeds	**Euphorbia terracina*	51 J 384120 6492115
Notable Weeds	**Ficus cairica*	50 J 384610 6492139
Notable Weeds	**Gomphocarpus fruticosus*	50 J 384759 6491404
Notable Weeds	**Leptospermum laevigatum*	50 J 384759 6491404
Notable Weeds	**Leptospermum laevigatum*	50 J 384577 6491930
Notable Weeds	**Leptospermum laevigatum*	50 J 384580 6491967
Notable Weeds	**Leptospermum laevigatum*	50 J 384216 6491534
Notable Weeds	**Moraea flaccida*	50 J 384759 6491404
Notable Weeds	**Moraea flaccida*	50 J 384969 6492104
Notable Weeds	**Moraea flaccida*	50 J 384417 6491644
Notable Weeds	**Moraea flaccida*	50 J 384168 6491792
Notable Weeds	**Moraea flaccida*	50 J 384179 6491837
Notable Weeds	**Moraea flaccida*	51 J 384194 6492004
Notable Weeds	**Pelargonium capitatum*	50 J 384244 6492066
Notable Weeds	**Pelargonium capitatum*	50 J 385150 6492103
Notable Weeds	**Pelargonium capitatum*	50 J 384759 6491404
Notable Weeds	**Trachyandra divaricata*	50 J 385150 6491670
Notable Weeds	**Acacia iteaphylla*	50 J 384111 6492041
Notable Weeds	**Acacia iteaphylla*	50 J 385150 6492103
Notable Weeds	**Acacia iteaphylla*	50 J 384590 6491370
Notable Weeds	**Acacia iteaphylla*	50 J 385150 6491670
Notable Weeds	**Acacia iteaphylla*	50 J 384417 6491644
Notable Weeds	**Acacia iteaphylla*	50 J 384417 6491644
Notable Weeds	**Acacia iteaphylla*	50 J 384168 6491792
Notable Weeds	**Acacia iteaphylla*	50 J 384179 6491837
Notable Weeds	**Acacia iteaphylla*	50 J 384283 6491984
Notable Weeds	**Acacia iteaphylla*	50 J 384285 6492091
Notable Weeds	**Acacia iteaphylla*	50 J 384239 6491975
Notable Weeds	**Acacia iteaphylla*	50 J 384222 6492026

CATEGORY	FEATURE	COORDINATE (WGS84)
Notable Weeds	**Asphodelus fistulosus*	50 J 384147 6491699
Quadrat	CG01NE	50 J 384255 6492068
Quadrat	CG01NW	50 J 384244 6492066
Quadrat	CG01SE	50 J 384255 6492061
Quadrat	CG01SW	50 J 384247 6492059
Quadrat	CG02NE	50 J 384115 6492040
Quadrat	CG02NW	50 J 384111 6492041
Quadrat	CG02SE	50 J 384124 6492029
Quadrat	CG02SW	50 J 384115 6492031
Quadrat	CG03NE	50 J 385150 6492103
Quadrat	CG03NW	50 J 385140 6492102
Quadrat	CG03SE	50 J 385152 6492094
Quadrat	CG03SW	50 J 385142 6492094
Quadrat	CG04NE	50 J 384232 6491937
Quadrat	CG04NW	50 J 384225 6491933
Quadrat	CG04SE	50 J 384235 6491927
Quadrat	CG04SW	50 J 384226 6491924
Releve	CGCR-01E	50 J 385070 6491550
Releve	CGCR-01W	50 J 384590 6491370
Releve	CGCR-02S	50 J 385150 6491670
Releve	CGCR-03	50 J 385067 6491987
Releve	CGCR-04	
Releve	CGCR-05	50 J 384969 6492104
Releve	CGCR-05	50 J 384580 6491967
Releve	CGCR-06	50 J 384417 6491644
Releve	CGCR-07	50 J 384168 6491792
Releve	CGCR-08	50 J 384179 6491837
Releve	CGCR-09	
Releve	CGCR-10	50 J 384610 6492139
Releve	CGCR-11	50 J 384665 6492144
Transect	CRT01N	50 J 384280 6492107
Transect	CRT01S	50 J 384280 6491929
Transect	CRT02N	50 J 384260 6492110
Transect	CRT02S	50 J 384260 6491887
Transect	CRT03N	50 J 384240 6492102
Transect	CRT03S	50 J 384240 6491890
Transect	CRT04N	50 J 384220 6492100
Transect	CRT04S	50 J 384220 6491874
Transect	CRT05N	51 J 384200 6492100
Transect	CRT05S	51 J 384200 6491880
Transect	CRT06N	51 J 384180 6492100
Transect	CRT06S	51 J 384180 6491830
Transect	CRT07N	51 J 384160 6492111
Transect	CRT07S	51 J 384160 6491870
Transect	CRT08N	51 J 384140 6492115
Transect	CRT08S	51 J 384140 6491890
Transect	CRT09N	51 J 384120 6492115
Transect	CRT09S	51 J 384120 6491950

APPENDIX E

Results of Fauna Desktop Study and Level 1 Reconnaissance Fauna Survey

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APPENDIX E

Results of Fauna Desktop Study and on-site Level 1 Reconnaissance Fauna Survey

DATA SOURCES

Combined data from DBCA NatureMap, which includes data from Birds Australia Databases and the Western Australian Museum, supplemented by data from the EPBC Protected Matters Search Tool, data from other surveys conducted in the City of Wanneroo (see Methods section) and information collected from the present on-site Level 1 Reconnaissance Fauna Survey.

*** - Species recorded during on-site Level 1 Reconnaissance Fauna Survey.**

+ - Introduced species.

KEY – ***Environmental Protection Biodiversity Conservation (EPBC) Act 1999*** **(Commonwealth) categories based on the International Union for Conservation of Nature (IUCN).**

T = Threatened (Extinct, Extinct in the wild, Critically Endangered, Endangered or Vulnerable).
X = Extinct. Taxa not recorded in the wild for the past 50 years.
XW = Extinct in the wild. Taxa survive only in captivity.
C = Critically Endangered. Taxa facing extremely high risk of extinction in the wild in the immediate future.
E = Endangered. Taxa facing extinction in the wild in the near future.
V = Vulnerable. Taxa facing high risk of extinction in the wild in the medium-term future.
CD = Conservation Dependent. Taxa dependent on conservation measures to prevent them becoming Vulnerable.
DD = Data Deficient. Taxa insufficiently known but suspected of being in one of the above categories.
LC = Least Concern. Taxa are not threatened.
IA = Taxa subject to International Migratory Species Agreements.

KEY - ***Biodiversity Conservation Act 2016*** **(Western Australia) Specially Protected Fauna Schedules**

S1 Critically Endangered
S2 Endangered
S3 Vulnerable
S4 Presumed Extinct
S5 Migratory birds under International Agreement
S6 Conservation Dependent
S7 Other Specially Protected Fauna

KEY - Department of Biodiversity, Conservation and Attractions Priority Species List

P1 = Taxa with few poorly known locations on threatened lands. Under immediate threat.
P2 = Taxa with few poorly known populations on conservation lands/several poorly known populations not on conservation lands. Appear to be under threat.
P3 = Taxa with several poorly known populations, some on conservation lands. Known threats could affect them but require monitoring in case circumstances change, or Near threatened or recently removed from Threatened list.
P4 = Taxa in need of monitoring. Taxa sufficiently known and not currently in need of protection, but require monitoring in case circumstances change, or Near threatened or recently removed from Threatened list.

Amphibians

Crinia georgiana Quacking Frog
Crinia glauerti Clicking Frog
Crinia insignifera Squelching Froglet
Crinia pseudinsignifera Bleating Froglet
Heleioporus albopunctatus Western Spotted Frog
Heleioporus barycragus Hooting Frog
Heleioporus eyrei Moaning Frog
Heleioporus psammophilus Sand Frog
Limnodynastes dorsalis Western Banjo Frog
Litoria adelaidensis Slender Tree Frog
***Litoria moorei* Motorbike Frog
Myobatrachus gouldii Turtle Frog
Neobatrachus pelobatoides Humming Frog
Pseudophryne guentheri Crawling Toadlet
Pseudophryne occidentalis Western Toadlet

Birds

Acanthagenys rufogularis Spiny-cheeked Honeyeater
**Acanthiza apicalis* Broad-tailed Thornbill, Inland Thornbill
Acanthiza chrysorrhoa Yellow-rumped Thornbill
Acanthiza inornata Western Thornbill
**Acanthorhynchus superciliosus* Western Spinebill
Accipiter cirrocephalus Collared Sparrowhawk
Accipiter cirrocephalus subsp. cirrocephalus Collared Sparrowhawk
Accipiter fasciatus subsp. didimus Brown Goshawk
Accipiter fasciatus subsp. fasciatus Brown Goshawk
Acrocephalus australis Australian Reed Warbler
Acrocephalus australis subsp. gouldi Australian Reed Warbler
Aegotheles cristatus subsp. cristatus Australian Owlet-nightjar
Agapornis sp.
Amazona auropalliata
Anas castanea Chestnut Teal
Anas gracilis Grey Teal
Anas platyrhynchos subsp. domesticus
Anas rhynchotis Australasian Shoveler
**Anas superciliosa* Pacific Black Duck
Anser anser
**Anthochaera carunculata* Red Wattlebird
Anthochaera lunulata Western Little Wattlebird
Anthus australis subsp. australis Australian Pipit

Apus pacificus subsp. pacificus Fork-tailed Swift, Pacific Swift **IA**
Aquila audax Wedge-tailed Eagle
Ara ararauna
Ardea garzetta subsp. nigripes Little Egret
Ardea ibis subsp. coromanda Cattle Egret
Ardea intermedia Intermediate Egret
Ardea modesta great egret, white egret
Ardea novaehollandiae White-faced Heron
Ardea pacifica White-necked Heron
Ardeotis australis Australian Bustard
Argusianus argus
Artamus cinereus subsp. melanops Black-faced Woodswallow
Artamus cyanopterus Dusky Woodswallow
Artamus personatus Masked Woodswallow
Aythya australis Hardhead
Barnardius zonarius
Biziura lobata Musk Duck
Burhinus grallarius Bush Stone-curlew
Cacatua galerita subsp. galerita Sulphur-crested Cockatoo
Cacatua leadbeateri Major Mitchell's Cockatoo
Cacatua pastinator subsp. butleri Butler's Corella
Cacatua pastinator subsp. pastinator Muir's Corella, Muir's Corella (Western Corella SW WA) **S**
**Cacatua roseicapilla* Galah
Cacatua sanguinea subsp. westralensis Little Corella
Cacatua sulphurea subsp. galerita
Cacatua tenuirostris Eastern Long-billed Corella
Cacomantis flabelliformis subsp. flabelliformis Fan-tailed Cuckoo
Cacomantis pallidus Pallid Cuckoo
Calyptorhynchus banksii subsp. naso* Forest Red-tailed Black Cockatoo **T
Calyptorhynchus baudinii Baudin's Cockatoo, White-tailed Long-billed Black Cockatoo **T**
Calyptorhynchus latirostris Carnaby's Cockatoo, White-tailed Short-billed Black Cockatoo **T**
**Chenonetta jubata* Australian Wood Duck, Wood Duck
Cheramoeca leucosterna White-backed Swallow
Chroicocephalus novaehollandiae
Chrysococcyx basalis Horsfield's Bronze Cuckoo
Chrysococcyx lucidus subsp. plagosus Shining Bronze Cuckoo
Circus approximans Swamp Harrier
Circus assimilis Spotted Harrier
Collocalia esculenta
**Colluricincla harmonica subsp. rufiventris* Grey Shrike-thrush
Columba livia Domestic Pigeon
Coracina maxima Ground Cuckoo-shrike

**Coracina novaehollandiae subsp. novaehollandiae* Black-faced Cuckoo-shrike
**Corvus coronoides subsp. perplexus* Australian Raven
Coturnix pectoralis Stubble Quail
Coturnix ypsilophora Brown Quail
Cracticus nigrogularis Pied Butcherbird
**Cracticus tibicen* Australian Magpie
**Cracticus tibicen subsp. dorsalis* White-backed Magpie
Cracticus torquatus subsp. torquatus Grey Butcherbird
Cyanorhamphus auriceps
Cygnus atratus Black Swan
**Dacelo novaeguineae subsp. novaeguineae* Laughing Kookaburra
Daphoenositta chrysoptera subsp. pileata Varied Sittella, Black-capped Sitella
**Dicaeum hirundinaceum* Mistletoebird
Dromaius novaehollandiae Emu
Egretta garzetta
Egretta novaehollandiae
Elanus axillaris
Elanus caeruleus subsp. axillaris Australian Black-shouldered Kite
Elseyornis melanops Black-fronted Dotterel
Eolophus roseicapillus
Eopsaltria australis subsp. griseogularis Western Yellow Robin
Eopsaltria georgiana White-breasted Robin
Epthianura albifrons White-fronted Chat
Eurostopodus argus Spotted Nightjar
Falco berigora Brown Falcon
Falco berigora subsp. berigora Brown Falcon
Falco cenchroides Australian Kestrel, Nankeen Kestrel
Falco cenchroides subsp. cenchroides Australian Kestrel, Nankeen Kestrel
Falco longipennis Australian Hobby
Falco longipennis subsp. longipennis Australian Hobby
Falco peregrinus Peregrine Falcon **S**
Falco peregrinus subsp. macropus Australian Peregrine Falcon **S**
Falcunculus frontatus subsp. leucogaster Western Shrike-tit, Crested Shrike-tit
**Fulica atra* Eurasian Coot
Fulica atra subsp. australis Eurasian Coot
Gallicolumba jobiensis
Gallinula tenebrosa Dusky Moorhen
Gallinula tenebrosa subsp. tenebrosa Dusky Moorhen
Gallirallus philippensis Buff-banded Rail
Gallirallus philippensis subsp. mellori Buff-banded Rail
Gallus gallus
Gavicalis virescens Singing Honeyeater

Geopelia cuneata Diamond Dove
**Gerygone fusca* Western Gerygone
Gerygone fusca subsp. fusca Western Gerygone
Glossopsitta concinna Musk Lorikeet
Glyciphila melanops Tawny-crowned Honeyeater
Gracula religiosa
**Grallina cyanoleuca* Magpie-lark
Haematopus fuliginosus Sooty Oystercatcher
Haematopus longirostris Pied Oystercatcher
Haliaeetus leucogaster White-bellied Sea-Eagle
Haliastur sphenurus Whistling Kite
Hamirostra isura Square-tailed Kite
Hieraaetus morphnoides Little Eagle
Himantopus himantopus Black-winged Stilt
**Hirundo neoxena* Welcome Swallow
Hylacola cauta subsp. whitlocki Shy Groundwren
Ixobrychus dubius Australian Little Bittern **P4**
Lalage tricolor White-winged Triller
Larus dominicanus Kelp Gull
Larus novaehollandiae Silver Gull
Larus novaehollandiae subsp. novaehollandiae Silver Gull
Lichenostomus leucotis White-eared Honeyeater
Lichmera indistincta Brown Honeyeater
**Lichmera indistincta subsp. indistincta* Brown Honeyeater
Lophoictinia isura
Malacorhynchus membranaceus Pink-eared Duck
Malurus elegans Red-winged Fairy-wren
Malurus lamberti Variegated Fairy-wren
Malurus lamberti subsp. assimilis Variegated Fairy-wren
Malurus leucopterus White-winged Fairy-wren
Malurus leucopterus subsp. leuconotus White-winged Fairy-wren
Malurus pulcherrimus Blue-breasted Fairy-wren
Malurus splendens Splendid Fairy-wren
Malurus splendens subsp. splendens Splendid Fairy-wren
Manorina flavigula Yellow-throated Miner
Megalurus gramineus Little Grassbird
Megalurus gramineus subsp. gramineus Little Grassbird
Melanodryas cucullata Hooded Robin
Melithreptus brevirostris Brown-headed Honeyeater
Melithreptus brevirostris subsp. leucogenys Brown-headed Honeyeater
Melithreptus chloropsis Western White-naped Honeyeater
Melopsittacus undulatus Budgerigar

Merops ornatus Rainbow Bee-eater
Microcarbo melanoleucos
Microeca fascinans Jacky Winter
**Motacilla alba* White Wagtail
Myiagra inquieta Restless Flycatcher
Neophema elegans Elegant Parrot
Ninox novaeseelandiae subsp. rufigaster
Nycticorax caledonicus Rufous Night Heron
Nymphicus hollandicus Cockatiel
**Ocyphaps lophotes* Crested Pigeon
Oxyura australis Blue-billed Duck **P4**
Pachycephala rufiventris Rufous Whistler
**Pachycephala rufiventris subsp. rufiventris* Rufous Whistler
Padda oryzivora
Pardalotus punctatus Spotted Pardalote
Pardalotus punctatus subsp. punctatus Spotted Pardalote
Pardalotus punctatus subsp. xanthopyge Yellow-rumped Pardalote
**Pardalotus striatus* Striated Pardalote
Pardalotus striatus subsp. westraliensis Striated Pardalote
Paroaria coronata
Petrochelidon ariel Fairy Martin
**Petrochelidon nigricans* Tree Martin
Petroica boodang Scarlet Robin
Petroica goodenovii Red-capped Robin
Phalacrocorax carbo Great Cormorant
Phalacrocorax carbo subsp. novaehollandiae Great Cormorant
Phalacrocorax fuscescens Black-faced Cormorant
Phalacrocorax melanoleucos Little Pied Cormorant
Phalacrocorax melanoleucos subsp. melanoleucos Little Pied Cormorant
Phalacrocorax sulcirostris Little Black Cormorant
Phalacrocorax varius Pied Cormorant
Phalacrocorax varius subsp. hypoleucos Pied Cormorant
**Phaps chalcoptera* Common Bronzewing
Phaps elegans Brush Bronzewing
Phylidonyris niger White-cheeked Honeyeater
**Phylidonyris novaehollandiae* New Holland Honeyeater
Platalea flavipes Yellow-billed Spoonbill
Platalea regia Royal Spoonbill
Platycercus icterotis Western Rosella
Platycercus icterotis subsp. icterotis Western Rosella
**Platycercus spurius* Red-capped Parrot
**Platycercus zonarius* Australian Ringneck, Ring-necked Parrot

Platycercus zonarius subsp. semitorquatus Twenty-eight Parrot
Platycercus zonarius subsp. zonarius Port Lincoln Parrot
Podargus strigoides Tawny Frogmouth
Podargus strigoides subsp. brachypterus Tawny Frogmouth
Podiceps cristatus Great Crested Grebe
Podiceps cristatus subsp. australis Great Crested Grebe
Poephila bichenovii
Poephila cincta
Poliocephalus poliocephalus Hoary-headed Grebe
Polytelis anthopeplus Regent Parrot
Polytelis anthopeplus subsp. westralis Regent Parrot
Polytelis swainsonii
Porphyrio porphyrio Purple Swamphen
Porphyrio porphyrio subsp. bellus Purple Swamphen
Porzana fluminea Australian Spotted Crake
Porzana pusilla Baillon's Crake
Porzana pusilla subsp. palustris Baillon's Crake
Porzana tabuensis Spotless Crake
Psephotus dissimilis
Psittacula eupatria
Psittacula krameri Indian Ringnecked Parrot, Rose-ringed Parakeet
Psittacus erithacus
Purnella albifrons White-fronted Honeyeater
Purpureicephalus spurius
**Rhipidura albiscapa* Grey Fantail
**Rhipidura leucophrys* Willie Wagtail
Rhipidura leucophrys subsp. leucophrys Willie Wagtail
Sericornis frontalis White-browed Scrubwren
Sericornis frontalis subsp. maculatus White-browed Scrubwren
Serinus canarius
**Smicrornis brevirostris* Weebill
Stagonopleura oculata Red-eared Firetail
Strepera versicolor Grey Currawong
**Streptopelia chinensis* Spotted Turtle-Dove
Streptopelia chinensis subsp. tigrina Spotted Turtle-Dove
**Streptopelia senegalensis* Laughing Turtle-Dove
Streptopelia senegalensis subsp. senegalensis Laughing Turtle-Dove
Sturnus vulgaris Common Starling
Tachybaptus novaehollandiae Australasian Grebe, Black-throated Grebe
**Tachybaptus novaehollandiae subsp. novaehollandiae* Australasian Grebe, Black-throated Grebe
Tadorna radjah Radjah Shelduck
Tadorna tadornoides Australian Shelduck, Mountain Duck

Taeniopygia guttata subsp. castanotis Zebra Finch
Threskiornis spinicollis Straw-necked Ibis
Todiramphus sanctus Sacred Kingfisher
Todiramphus sanctus subsp. sanctus Sacred Kingfisher
Tribonyx ventralis Black-tailed Native-hen
Trichoglossus chlorolepidotus
Trichoglossus haematodus Rainbow Lorikeet
**Trichoglossus haematodus subsp. moluccanus* Rainbow Lorikeet
Trichoglossus haematodus subsp. rubritorquis Red-collared Lorikeet
Turnix varius Painted Button-quail
Turnix velox Little Button-quail
Tyto alba Barn Owl
Tyto alba subsp. delicatula Barn Owl
Vanellus miles Masked Lapwing
Vanellus miles subsp. miles Masked Lapwing
Vanellus tricolor Banded Lapwing
**Zosterops lateralis* Grey-breasted White-eye, Silvereye

Invertebrates

Acariformes sp.
Acercella falcipes
Achaearanea convexa
Aganippe rhaphiduca
Akamptogonus novarae
Allothereua maculata
Amblyomma albolimbatum
Amblyomma triguttatum
Aname mainae
Aname tepperi
Anisops hyperion
Arachnura higginsi
Araneus cyphoxis
Araneus eburneiventris
Araneus eburnus
Araneus senicaudatus
Araneus talipedatus
Argiope protensa
Argiope trifasciata
Argoctenus bidentatus
Artoria linnaei
Artoria taeniifera
Artoriopsis eccentrica
Artoriopsis expolita
Austracantha minax
Australomimetus aurioculatus
Australomimetus ovidi
Australotomurus morbidus cemetery springtail, Guildford springtail **P3**
Austrammo harveyi
Austrogomphus (Zephyrogomphus) lateralis
Austrosaga spinifer spiny katydid (Swan Coastal Plain), bush cricket (Swan Coastal Plain) **P2**
Backobourkia brounii
Backobourkia heroine
Badumna insignis
Ballarra longipalpus
Bianor maculatus
Billima attrita
Celaenia excavata
Ceratopogonidae sp.
Cercophonius granulosus
Cercophonius sulcatus
Cherax cainii Marron
Cherax destructor
Cherax quinquecarinatus
Cherax sp.
Cladocera (unident.)
Clinohelea sp. 1 (SAP)
Copidognathus cooki
Corixidae sp.
Cormocephalus aurantiipes
Cormocephalus hartmeyeri
Cormocephalus novaehollandiae
Cormocephalus rubriceps
Cormocephalus strigosus
Cormocephalus turneri
Crustulina bicruciata
Cryptoerithus quobba
Cyclosa trilobata
Deinopis unicolor
Delena cancerides
Dingosa serrata
Dinocambala ingens
Dytiscidae sp.
Ecnomina F group
Eodelena convexa
Erigone prominens
Eriophora biapicata
Eriophora pustulosa
Ero aphana
Erythracarus decoris
Ethmostigmus rubripes
Eulimnadia sp.
Eupograpta kottae
Gea theridioides
Geogarypus taylori
Glossiphoniidae sp.

Harpacticoida sp
Hasarius adansoni
Hemicloea sublimbata
Hemicordulia tau
Hemicorduliidae sp.
Henicops dentatus
Heurodes turritus
Hogna crispipes
Hogna immansueta
Hogna kuyani
Holconia insignis
Holconia westralia
Holocnemus pluchei
Holoplatys dejongi
Hylaeus globuliferus woolybush bee **P3**
Hypoblemum sp.
Idiommata blackwalli
Idiosoma hirsutum
Isometroides vescus
Isopeda leishmanni
Isopedella cana
Isopedella tindalei
Ixodes tasmani
Karaops jarrit
Lampona brevipes
Lampona cylindrata
Lampona punctigera
Lamponella kimba
Lamponina elongata
Lamprochernes savignyi
Latrodectus hasselti
Leioproctus contrarius a short-tongued bee **P3**
Lepidoptera sp.
Leptoceridae sp.
Libellulidae sp.
Limnochares australica
Linyphia cupidinea
Longepi woodman
Lycosa ariadnae
Lycosa austicola
Lycosa australicola
Lycosa gilberta
Lycosa godeffroyi
Lymnaeidae sp.
Lynceus sp.
Maratus chrysomelas
Maratus pavonis
Maratus speciosus
Masasteron mas
Masasteron sampeyae
Masasteron tuart
Mecistocephalus tahitiensis
Meedo harveyi
Microvelia sp.
Missulena granulosa
Missulena occatoria
Mituliodon tarantulinus
Mitzoruga insularis
Molycria quadricauda
Molycria vokes
Monohelea sp. 4 (SAP)
Myandra bicincta
Myandra cambridgei
Myialges ancistronae
Nematoda sp.
Nephila edulis
Nicodamus mainae
Notiasemus glauerti
Nunciella aspera
Ocrisiona leucocomis
Ocrisiona parmeliae
Oecobius navus
Oligochaeta sp.
Ommatoiulus moreleti
Ommatoiulus moreletii
Oniscidae sp.
Opopaea sp.
Oratemnus curtus
Ornithonyssus bacoti
Orthocladiinae SO3 sp. A (SAP)
Orthocladiinae sp.
Ostearius melanopygius
Ostracoda (unident.)
Oxidus gracilis

Oxyethira sp.
Oxyopes gracilipes
Oxyopes rubicundus
Ozarchaea westraliensis
Paracyclops sp.
Paralampona marangaroo
Paralimnophyes pullulus (V42)
Parapallene haddoni
Paraplectanoides crassipes
Pediana occidentalis
Phenasteron longiconductor
Phenasteron machinosum
Pholcus phalangioides
Phryganoporus candidus
Physidae sp.
Physocyclus globosus
Pinkfloydia harveii
Piona murleyi
Planorbidae sp.
Podykipus collinus
Polygonarea imparata
Prionosternum nitidiceps
Prionosternum scutatum
Procladius paludicola
Protogarypinus giganteus
Pseudolampona woodman
Pycnothea flynni
Raveniella arenacea
Raveniella cirrata
Raveniella peckorum
Raveniella subcirrata
Richardsonianidae sp.
Rotifera sp.
Scirtidae sp.
Scolopendra laeta
Scolopendra morsitans
Scytodes thoracica
Servaea melaina
Servaea spinibarbis
Simaetha tenuior
Simonus lineatus
Siphonotus flavomarginatus
Smeringopus natalensis
Smeringopus natalensis?
Solaenodolichopus pruvoti
Steatoda capensis
Steatoda grossa
Sternopriscus sp.
Storena formosa
Stylopallene cheilorhynchus
Supunna funerea
Supunna picta
Synemon gratiosa Graceful Sunmoth **P4**
Synothele durokoppin
Synothele michaelseni
Synothele mullaloo
Synothele rastelloides
Synsphyronus magnus
Tabanidae sp.
Talitridae sp.
Tamopsis facialis
Tamopsis perthensis
Tanypodinae sp.
Tanytarsus barbitarsis
Tasmanicosa leuckartii
Tetragnatha demissa
Tetragnatha luteocincta
Tetralycosa oraria
Thereuopoda lesueurii
Urodacus armatus
Urodacus hartmeyeri
Urodacus novaehollandiae
Urodacus planimanus
Urodacus woodwardii
Venator immansueta
Venatrix pullastra
Westrarchaea pusilla
Westrarchaea sinuosa
Westrarchaea spinosa
Xysticus periscelis
Zachria flavicoma
Zebraplatys fractivittata

Mammals

Bos taurus European Cattle
Canis lupus Dog, Dingo
Canis lupus subsp. dingo Dingo
**Canis lupus subsp. familiaris* Dog
Cercartetus concinnus Western Pygmy-possum, Mundarda
Chalinolobus gouldii Gould's Wattled Bat
Chalinolobus morio Chocolate Wattled Bat
Dasyurus geoffroii Chuditch, Western Quoll **T**
Equus caballus Horse
Falsistrellus mackenziei Western False Pipistrelle, Western Falsistrelle **P4**
Felis catus Cat
Hydromys chrysogaster Water-rat, Rakali **P4**
Isoodon fusciventer Quenda, southwestern brown bandicoot **P4**
**Macropus fuliginosus* Western Grey Kangaroo
Mus musculus House Mouse
Notamacropus irma Western Brush Wallaby **P4**
Nyctophilus geoffroyi Lesser Long-eared Bat
Nyctophilus gouldi Gould's Long-eared Bat
**Oryctolagus cuniculus* Rabbit
Ovis aries Sheep
Rattus fuscipes Western Bush Rat
Rattus rattus Black Rat
Sminthopsis murina
Sus scrofa Pig
Tachyglossus aculeatus Short-beaked Echidna
Tarsipes rostratus Honey Possum, Noolbenger
Trichosurus vulpecula Common Brushtail Possum
Trichosurus vulpecula subsp. vulpecula Common Brushtail Possum
Vespadelus regulus Southern Forest Bat
**Vulpes vulpes* Red Fox

Reptiles

Acritoscincus trilineatus Western Three-lined Skink
Anilios australis
Antaresia stimsoni subsp. stimsoni Stimson's Python
Aprasia pulchella Granite Worm-lizard
Aprasia repens Sand-plain Worm-lizard
Brachyurophis fasciolatus subsp. fasciolatus Narrow-banded Shovel-nosed Snake
Brachyurophis semifasciatus Southern Shovel-nosed Snake
**Christinus marmoratus* Marbled Gecko

Crenadactylus ocellatus subsp. ocellatus Clawless Gecko
**Cryptoblepharus buchananii* Fence Skink
Cryptoblepharus plagiocephalus
Ctenophorus adelaidensis Southern Heath Dragon, Western Heath Dragon
Ctenotus australis
Ctenotus fallens
Ctenotus gemmula Jewelled South-west Ctenotus (Swan Coastal Plain subpop P3
Ctenotus impar
Ctenotus labillardieri
Ctenotus ora Coastal Plains Skink **P3**
Cyclodomorphus celatus Western Slender Blue-tongue
Delma concinna subsp. concinna Javelin Legless Lizard
Delma fraseri Fraser's Legless Lizard
Delma grayii
Demansia psammophis subsp. reticulata Yellow-faced Whipsnake
Diplodactylus granariensis subsp. granariensis
Diplodactylus polyophthalmus
Echiopsis curta Bardick
Egernia kingii King's Skink
Egernia napoleonis
Elapognathus coronatus Crowned Snake
Gehyra variegata
Hemidactylus frenatus Asian House Gecko
Hemiergis initialis subsp. initialis
Hemiergis peronii
Hemiergis quadrilineata
Lerista christinae
Lerista distinguenda
Lerista elegans
Lerista gerrardii
Lerista lineata Perth Slider, Lined Skink **P3**
Lerista lineopunctulata
Lerista praepedita
Lialis burtonis
Lissolepis luctuosa Western Swamp Skink
Lucasium alboguttatum
Menetia greyii
Morelia spilota subsp. imbricata Carpet Python
Morethia lineoocellata
Morethia obscura
Neelaps bimaculatus Black-naped Snake
Neelaps calonotos Black-striped Snake, black-striped burrowing snake **P3**

Notechis scutatus Tiger Snake
Parasuta gouldii
Parasuta nigriceps
Pletholax gracilis Keeled Legless Lizard
Pletholax gracilis subsp. gracilis Keeled Legless Lizard
Pogona minor Dwarf Bearded Dragon
Pogona minor subsp. minor Dwarf Bearded Dragon
Pseudechis australis Mulga Snake
Pseudemydura umbrina Western Swamp Tortoise, Western Swamp Turtle **T**
Pseudonaja affinis Dugite
Pseudonaja affinis subsp. affinis Dugite
Pseudonaja mengdeni Western Brown Snake
Pseudonaja modesta Ringed Brown Snake
Pygopus lepidopodus Common Scaly Foot
Simoselaps bertholdi Jan's Banded Snake
Strophurus michaelseni
Strophurus spinigerus
Strophurus spinigerus subsp. inornatus
Strophurus spinigerus subsp. spinigerus
Testudo sp.
Tiliqua occipitalis Western Bluetongue
Tiliqua rugosa
Tiliqua rugosa subsp. aspera
**Tiliqua rugosa subsp. rugosa*
Underwoodisaurus milii Barking Gecko
Varanus gouldii Bungarra or Sand Monitor
Varanus rosenbergi Heath Monitor
Varanus tristis Racehorse Monitor

APPENDIX F

Level 1 Reconnaissance Fauna Survey Compliance with EPA Technical Guidance

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APPENDIX F

Assessment of the present Level 1 Reconnaissance Fauna Survey for compliance to EPA Technical Guidance, Terrestrial Fauna Surveys (2016b).

These guidelines help define the limitations and effectiveness of fauna assessments.

POSSIBLE LIMITATION	COMMENT
Level and scope of survey.	Level 1 appropriate and more than adequate.
Competency/experience of the consultant(s) in carrying out the survey.	Survey carried out by senior zoologist with over 30 years of experience in vertebrate ecology.
What faunal groups were sampled and were some sampling methods not able to be employed because of constraints?	Sampling quite appropriate for Level 1 reconnaissance survey, which focuses on identifying fauna habitat, and its condition, with opportunistic observations on fauna and their sign.
Proportion of fauna identified, recorded and/or collected.	All fauna seen and sign of fauna were identified to species.
Sources of information. **Contextual information.**	Sources include a range of previous records from the area, species distribution information, data from surveys conducted previously in the survey area and newer observations. Results put into wider context.
The proportion of the task achieved and further work that might be needed.	Site inspection completed and all fauna habitat types identified and sampled.
Timing/weather/season/cycle.	Appropriate for a Level 1 reconnaissance survey which focuses on habitat and identifying signs of the presence of fauna species particularly significant species. Weather good.
Disturbances (e.g. fire, flood, accidental human intervention etc.) which affected results of survey.	No disturbances affected the surveys.
Intensity. In retrospect, was the intensity adequate?	Survey intensity was suitable for a Level 1 reconnaissance survey in this type of habitat and for this type of project.
Completeness (e.g. was relevant area fully surveyed). **Remoteness and access.**	Desktop study covered survey area and adjacent habitats. Site inspection covered fauna habitats from within the study site.
Resources (e.g. degree of expertise available in animal identification to taxon level).	Survey well resourced. All vertebrate fauna species identified to taxon level by experienced personnel.