Terratree

Level 2 Flora & Vegetation Assessment of Conservation Offset Areas

Prepared for the City of Wanneroo

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ecological assessment
& management

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Executive Summary

The City of Wanneroo (the City) engaged Terratree Pty Ltd (Terratree) to undertake a Level 2 Flora and Vegetation (Flora) assessment of conservation offset areas and proposed road widening envelope associated with proposed development of landholding within the Neerabup Industrial Area. The survey area is located over two separate conservation areas, totalling approximately 59 ha: Lot 9000 Flynn Drive (approx. 55ha) and Lot 24 Mary St (approx. 4ha).

The purpose of the Level 2 flora and vegetation assessment was to:

- Provide baseline information regarding flora and vegetation;
- Map vegetation communities and conditions;
- Identify areas of weed infestation and provide management advice;
- Identify Carnaby's Black Cockatoo habitat;
- List native plant species suitable for rehabilitation of degraded areas; and
- Establish monitoring plots for the purposes of monitoring changes in vegetation composition and condition to inform bushland management strategies.

The Level 2 flora and vegetation assessment was conducted in accordance with EPA Guidance Statement No. 51*, Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia* (EPA 2004a) and *Technical Guide – Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA and Department of Parks and Wildlife, 2016). The Level 2 survey comprised a desktop assessment of Threatened and Priority flora and ecological communities data, aerial imagery analysis and review of relevant biological assessment reports, followed by a comprehensive flora and vegetation field assessment, including quadrat assessment, targeted searches for flora of conservation significance, vegetation community analysis and mapping, and weed identification and population mapping.

The search of the Threatened (Declared Rare) and Priority Flora, Western Australian Herbarium Specimen, and Threatened and Priority Flora List databases, and the EPBC Protected Matters search, identified a total of 43 species of conservation significance recorded within 10km of the survey area.

The DPaW database search identified 32 flora species of conservation significance as being recorded within 10km of the survey area, comprised of four Threatened flora species and twenty-eight Priority species, including five Priority 1, eight Priority 2, eleven Priority 3 and four Priority 4, with the EPBC Protected Matters search identifying an additional eleven federally listed Threatened flora species.

The search of the Threatened Ecological Communities database identified eleven Threatened and Priority ecological communities as being recorded within 10km of the survey area, comprised of one Critically Endangered, three Endangered and seven Priority 3 ecological communities. Threatened and Priority ecological communities identified during the database search are listed in **Appendix 1, Table 2**.

Lot 9000 has been identified as containing the Threatened *Banksia attenuata woodlands over species rich dense shrublands* (EN) ecological community (**Figure 1**). This community is recognised as representative components of the newly listed *Banksia woodlands of the Swan Coastal Plain* community complex (DoEE, 2016).

These communities are recognised as representative components of the newly listed *Banksia woodlands of the Swan Coastal Plain* community complex.

A total of 145 vascular flora taxa, including 22 exotic (weed) species, were recorded within the study area, representing 106 genera from 42 families. Families with the highest representation were Fabaceae (24 taxa, including four weed species), Proteaceae (15 taxa), and Myrtaceae (12 taxa). The full list of vascular flora species recorded within the study area is presented in **Appendix 1, Table 3**.

No Threatened (Declared Rare) flora were recorded during the survey. Three species of Priority flora were recorded: *Acacia benthamii* (Priority 2) *Stylidium maritimum* (Priority 3) and *Jacksonia sericea* (Priority 4).

No Declared Pests for the City of Wanneroo LGA, in accordance with the BAM Act 2007, were identified within the survey area. A small population of the weed species *_Watsonia meriana_* var. _bulbillifera_ (Watsonia) was identified in Lot 24. Watsonia is listed as High Priority for management in the Swan Region NRM weed prioritisation strategy, and has been nominated as a Weed of National Significance.

Analysis of the row fusion dendrogram identifies two vegetation communities as occurring within the survey area, with Community AfHh occurring in Lot 24 and Community AfBmHhMp within Lot 9000. Both these communities are considered representative of the *Banksia Woodlands of the Swan Coastal Plain* TEC, in accordance with the key diagnostic criteria for this community (**Section 6.3.2**).

Terratree identified 157 significant habitat trees within Lot 9000, with 23 (14.7%) containing potential breeding hollows. It is recommended that these hollows be assessed by an experienced zoologist to determine their overall suitability and potential to provide breeding habitat for Black Cockatoo species. Within Lot 24, Terratree recorded 44 significant Jarrah (*Eucalyptus marginata*) trees. No trees containing potential breeding hollows were identified.

Both sites contain high value foraging habitat for Black Cockatoo species, including the Carnaby's Black Cockatoo, with *Banksia attenuata* and *B. menzeisii* comprising a dominant structural component of the vegetation community, with emerging *Allocasuarina fraseriana* and *Eucalyptus marginata* trees also provide foraging value.

Vegetation condition varies between sites, with vegetation condition in Lot 9000 found to be Very Good to Excellent, excluding localized disturbances. The vegetation in Lot 24 was found to be Very Good to Degraded, with encroaching weed invasion degrading bushland condition, especially in the north-east of the site. To manage weed infestation and maintain bushland health in Lot 9000, it is recommended that:

- Illegal soil dumps are removed to minimise the risk of weed species spreading into native vegetation.
- Tracks and boundaries are regularly inspected and maintained to manage weed incursions from populations adjacent to conservation areas.

Given that Lot 24 has recently been subject to a controlled burn, weed emergence and spread is a significant risk to vegetation condition. To manage weed infestation and maintain bushland health, it is recommended that:

- A Weed Management Strategy be prepared and implemented, which includes identification of significant weeds within Lot 24, assesses treatment options and implementation scheduling, reports on the result of weed management activities, and provides recommendations for further treatment and management options as part of an adaptive, ongoing management program.

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1 Introduction

1.1 Background

The City of Wanneroo (the City) engaged Terratree Pty Ltd (Terratree) to undertake a Level 2 Flora and Vegetation (Flora) assessment (EPA, 2004) of two separate proposed conservation offset areas associated with proposed development of landholding within the Neerabup Industrial Area.

The purpose of the Level 2 flora and vegetation assessment was to:

- Provide baseline information regarding flora and vegetation;
- Map vegetation communities and conditions;
- Identify areas of weed infestation and provide management advice;
- Identify Carnaby's Black Cockatoo habitat;
- List native plant species suitable for rehabilitation of degraded areas;
- Establish monitoring plots for the purposes of monitoring changes in vegetation composition; and condition to inform bushland management strategies.

1.2 Project Location and Description

The survey area is located over two separate areas, totalling approximately 59 ha: Lot 9000 Flynn Drive (approx. 55ha) and Lot 24 Mary St (approx. 4ha). Lot 9000 consists of proposed conservation estate, with a small (~1ha) proposed road widening zone along the southern boundary. Lot 24 is proposed conservation estate.

The project areas are located within the City of Wanneroo LGA, approximately 20 km north of Perth, Western Australia (**Figure 1**). Land use in surrounding areas includes industrial estate, intensive horticulture, rural residential property, and infrastructure easements.

2 Regulatory Context

2.1 Flora and Vegetation

2.1.1 Legislation

Current State and Federal Government legislation relevant to environmental impact assessment and the conservation of biodiversity in W.A. include the following:

State:

- *Environmental Protection Act* 1986 (EP Act);
- *Wildlife Conservation Act* 1950 (WC Act); and

Fe*deral:*

- *Environment Protection and Biodiversity Conservation Act* 1999 (EBPC Act).

2.1.2 Government Policy and Guidelines

A number of State policies, EPA position statements, EPA guidance statements and relevant environmental guidelines and codes of practice are relevant to environmental impact assessment of the study area, including:

- EPA Position Statement No. 2 *Environmental Protection of Native Vegetation* (EPA 1999);
- EPA Position Statement No. 3: *Terrestrial Biological Surveys as an element of Biodiversity Protection* (EPA, 2002a);
- EPA Position Statement No. 7 *Principles of Environmental Protection* (EPA 2002b);
- EPA Guidance Statement No. 51 *Terrestrial Flora and Vegetation Surveys* (EPA 2004); and
- Technical Guide – Flora and Vegetation Surveys for Environmental Impact Assessment (EPA and Department of Parks and Wildlife, 2016).

2.1.3 Threatened and Priority Flora

All Australian native flora is protected under the WC Act, where flora is defined as any plant (including wildflower, palm, shrub, tree, fern, creeper or vine) which is either native to Western Australia or declared to be flora under the Act, and includes any part of flora and all seed and spores thereof. Any activity in Western Australia that involves taking part of or the whole of a WA native plant may require a licence or permit to do so.

Species of flora may be listed as 'Threatened', pursuant to Schedule 1 of the EPBC Act. Any action likely to have a significant impact on a species listed under the EPBC Act requires referral to the Commonwealth Department of the Environment (DotE) and potentially the approval of the Commonwealth Minister for the Environment.

A flora species may be designated 'Declared Rare' species under subsection 2 of section 23F of the WC Act and it is an offence to 'take' or damage rare flora without Ministerial approval. Section 23F of the Act defines 'to take' as "… to gather, pluck, cut, pull up, destroy, dig up, remove or injure the flora to cause or permit the same to be done by any means". The WA State Minister for the Environment can declare taxa (species, subspecies or variety) as 'Declared Rare Flora' (DRF) if they are considered to be in danger of extinction, rare or otherwise in need of special protection. At the State level, the term Threatened Flora is now commonly used to refer to DRF regardless of their Commonwealth status.

Species of flora acquire a 'Declared Rare' or 'Priority' conservation status when populations are restricted geographically or threatened by local processes (**Table 1**). The Department of Parks and Wildlife (DPaW) recognises these threats and applies regulations towards population protection and species conservation. DPaW enforces regulations under the WC Act to conserve Declared Rare Flora (DRF) and Priority Flora and protect significant populations.

The list of Threatened (Declared Rare) flora is reviewed annually by a scientific panel that assess a taxon's conservation status and ranks them into categories. The Priority Flora list is dynamic, as new information becomes available conservation status is reviewed and changes to the listing may result. The categories for Priority Flora give an indication of the priority for undertaking further surveys based on the number of known sites, and degree of threat to those populations.

Table 1: Definition of Threatened and Priority Flora Species (DPaW, 2015)

Code	Definition
T	**Threatened Flora – (Declared Rare Flora – Extant)** Taxa which have been adequately searched for and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection and have been gazetted as such (Schedule 1 under the *Wildlife Conservation Act 1950*).
X	**Presumed Extinct Flora (Declared Rare Flora - Extinct)** Taxa which have been adequately searched for and there is no reasonable doubt that the last individual has died, and have been gazetted as such Schedule 2 under the *Wildlife Conservation Act 1950*).
P1	**Priority One – Poorly Known Species** Species that are known from one or a few collections or sight records (generally less than five), all on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, Shire, Westrail and Main Roads WA road, gravel and soil reserves, and active mineral leases and under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes.
P2	**Priority Two – Poorly Known Species** Species that are known from one or a few collections or sight records, some of which are on lands not under imminent threat of habitat destruction or degradation, e.g. national parks, conservation parks, nature reserves, State forest, vacant Crown land, water reserves, etc. Species may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes.
P3	**Priority Three – Poorly Known Species** Species that are known from collections or sight records from several localities not under imminent threat, or from few but widespread localities 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 localities but do not meet adequacy of survey requirements and known threatening processes exist that could affect them.
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 do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable. (c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.
P5	**Priority Five - Conservation Dependent species** Species that are not threatened but are subject to a specific conservation program, the cessation of which would result in the species becoming threatened within five years.

2.1.4 Local and Regionally Significant Flora

In addition to plant taxa being recognised as significant through their Declared Rare or Priority Flora status, they can also be significant for a number of other reasons. Guidance Statement No. 51, *Terrestrial flora and vegetation surveys for environmental impact assessment in Western Australia* (EPA 2004) states that "significant flora" may include taxa that have:

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

Similarly, plant communities or vegetation may be considered "significant vegetation" for reasons other than a listing as a Threatened Ecological Community. The EPA (EPA 2004a) states that these reasons include:

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

2.1.5 Threatened and Priority Ecological Communities

In Western Australia "Threatened Ecological Communities" (TECs) are defined by the Western Australian Threatened Ecological Communities Scientific Advisory Committee (within DPaW) and are assigned to one of the categories outlined below (**Table 2**). While they are not afforded direct statutory protection at a State level (unlike Threatened Flora) under the WC Act their significance is acknowledged through other State environmental approval processes (i.e. Environmental Impact Assessment process pursuant to Part IV of the EP Act.

Table 2: Definition of Codes for Threatened Ecological Communities (DEC, 2013)

Code	Definition
PD: Presumed Totally Destroyed	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
CR: Critically Endangered	An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or that was originally of limited distribution and is facing severe modification or destruction throughout its range in the immediate future, or is already severely degraded throughout its range but capable of being substantially restored or rehabilitated. 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.
EN: Endangered	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.
VU: Vulnerable	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 to long-term future.

Selected TECs are also afforded statutory protection at a Federal level pursuant to the *EPBC* Act. Not all State listed TECs are given Federal protection, only a select few. The *EPBC Act* provides for the strong protection of TECs, which are listed under section 181 of the *EPBC Act,* and are defined as "Critically Endangered", "Endangered" or "Vulnerable" under Section 182 of the *EPBC Act*.

The EPBC Act provides protection for TECs under federal legislation, which are defined as communities which are:

- **Critically Endangered** (if, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future);
- **Endangered** (if, at that time, it is not critically endangered and is facing a very high risk of extinction in the wild in the near future); or
- **Vulnerable** (if, at that time, it is not critically endangered or endangered, and is facing a high risk of extinction in the wild in the medium term future).

A community that is not listed as a TEC may be listed as a Priority Ecological Community (PEC). DPaW (DEC 2010) describes a PEC as an ecological community that is under consideration for listing as a TEC, but does not yet meet the criteria or has not been adequately defined. It is placed in either Category 1, 2, or 3 of the PEC list. Ecological communities that are adequately known, and are rare but not threatened, or meet criteria for Near Threatened, or those who have recently been removed from the threatened list, are

placed in Priority 4. These ecological communities require monitoring. Conservation dependent ecological communities are placed in Priority 5. Categories and definitions of PEC are listed in **Table 3**.

Table 3: Definition of Codes for Priority Ecological Communities (DEC, 2013)

Code	Definition
P1: Priority One	Ecological communities with apparently few, small occurrences, all or most not actively managed for conservation (e.g. within agricultural or Pastoral lands, urban areas, active mineral leases) and for which current threats exist. Communities may be included if they are comparatively well-known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range.
P2: Priority Two	Communities that are known from few small occurrences, all or most of which are actively managed for conservation (e.g. within national parks, conservation parks, nature reserves, State forest, unallocated Crown land, water reserves, etc.) and not under imminent threat of destruction or degradation. Communities may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under threat from known threatening processes.
P3: Priority Three	(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 within 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 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.
P4: 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. (a) 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. (b) 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. (c) Ecological communities that have been removed from the list of threatened communities during the past five years. P5: Priority Five 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.
P5: Priority Five	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.

2.1.6 Environmentally Sensitive Areas

Under section 51B of the EP Act, the Minister can, by notice, declare an area of the State specified in the notice or an area of the State to be an Environmentally Sensitive Area (ESAs). ESAs are protected under the *Environmental Protection (Clearing of Native Vegetation) Regulation 2004* and are selected for their environmental values at state or national levels. Some of the reasons for assigning this status include:

- Protection of rare or threatened species of native plants;
- Protection of wetlands and water courses;
- Protection of sites that have other high conservation, scientific or aesthetic values; and
- Protection of Aboriginal or European cultural sites.

2.1.7 Introduced Flora (Weeds)

At a national level, there are 32 weed species listed as Weeds of National Significance (WONS)(Department of Environment, 2016). *The Commonwealth National Weeds Strategy: A Strategic Approach to Weed Problems of National Significance* (2012) describes broad goals and objectives to manage these species.

Within Western Australia, the *Biosecurity and Agriculture Management Act 2007* (BAM Act, DAFWA, 2007) seeks to prevent serious animal and plant pests and diseases from entering the State and becoming established, and to minimise the spread and impact of any that are already present. The BAM Act (and associated regulations) replaces the *Agriculture and Related Resources Protection Act 1976* (and associated regulations). The BAM regulations were enacted on 1 May 2013, placing organisms into four categories:

- Permitted organism (listed under Section 11) – permitted in Western Australia subject to regulations;
- Prohibited organism (listed under Section 12) – prohibited in Western Australia subject to regulations (i.e. is a Declared Pest for the whole of State);
- Permitted organism: permit required (under regulation 73) – must not be imported unless in accordance with an import permit ; and
- Permitted organism: Declared Pests (under Section 22) – can apply to part of or the whole of the State.

The current Western Australian Organism List (WAOL) (DAFWA, 2016), lists organisms in each of these categories. Unlisted organisms must not be imported (unless in accordance with an import permit and regulations). The BAM Act further categorises Declared Pests in one of three control categories (**Table 4**):

- C1 – Exclusion;
- C2 – Eradication; or
- C3 – Management.

Table 4: Control categories for Declared Pests

Declared Plant Category	Description
C1 - Exclusion	Pests assigned to this category 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.
C2 - Eradication	Pests assigned to this category are present in Western Australia in low enough numbers or in sufficiently limited areas that their eradication is still a possibility.
C3 - Management	Pests assigned to this category 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.

3 Existing Environment

3.1 Biogeography

The study area is located within the Swan Coastal Plain 2 (SWA2) subregion, in accordance with the Interim Biogeographic Regionalisation for Australia (IBRA). The IBRA system identifies 89 bioregions and 419 subregions across Australia, based on climate, geology, landforms and characteristic vegetation and fauna.

Mitchell, Williams and Desmond (2002) describe the SWA2 subregion (1,333,901 ha) as a low lying coastal plain, dominated by Banksia or Tuart on sandy soils, *Casuarina obesa* on outwash plains and paperbark in swampy areas. The plain rises to duricrusted Mesozoic sediments dominated by Jarrah woodland in the east, with three phases of marine sand dune development providing relief to the west.

The Perth subregion is composed of colluvial and Aeolian sands, alluvial river flats and coastal limestone. Vegetation comprises heath and/or Tuart woodlands on limestone, Banksia and Jarrah/Banksia woodlands on Quaternary marine dunes and Marri on colluvials and alluvials. The climate is Mediterranean, with annual rainfall ranging between 600 to 1000mm.

Dominant land uses mainly include urban development, dryland agriculture, Unallocated Crown Land and Crown reserves, conservation, forestry plantations, and road easements and infrastructure.

3.2 Regional Vegetation

3.2.1 Beard (1990)

In accordance with Plant Life of Western Australia (Beard, 1990), the survey areas lie within the Swan Coastal Plain Subregion of the Drummond Botanical Subdistrict. The Drummond Botanical Subdistrict is described as 'Mainly *Banksia* low woodland on leached sands with Melaleuca swamps where ill-drained; woodland of Tuart (*Eucalyptus gomocephala*), Jarrah (*E. marginata*) and Marri (*Corymbia calophylla*) on less leached soils. The climate is described as 'warm Mediterranean', with winter precipitation of 600-1000mm with 5-6 dry months per year.

Pre-European vegetation mapping data (Department of Agriculture, 2005), based on Beards vegetation mapping, places the project areas within the Spearwood land system, with typical vegetation described, in accordance with NVIS Level 6, as:

> "U1+Eucalyptus gomphocephala,+Eucalyptus marginata, Corymbia calophylla, Eucalyptus decipiens\tree\7\i;U2 Agonis flexuosa, Allocasuarina fraseriana, Banksia attenuata, Banksia menziesii\tree\6\i;M1 Acacia cyanophylla, Acacia cyclops, Dodonaea aptera, Dryan (sic)"

3.2.2 Heddle (1980)

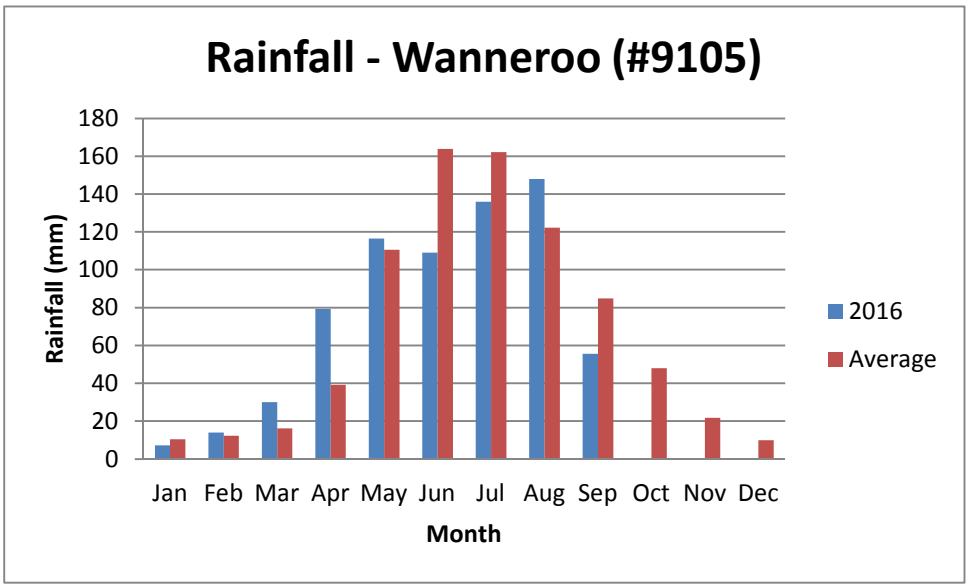
Mapping of the vegetation systems of the Swan Coastal Plain conducted by Heddle (1980) place the survey area within the Karrakata complex-Central and South, which is described as predominately open forest of *Eucalyptus gomocephala-E. marginata-Corymbia calophylla* and woodland of *E. marginata-Banksia* spp.

This vegetation complex has been heavily impacted by clearing for intensive horticulture, resource extraction and urban development. Only 49% of its pre-European extent remains, with 11% within formal or informal reserves.

3.3 Climate

The study area experiences an Interior Mediterranean climate under the Köppen climate classification system, characterised as mild, with dry, hot summers, where the warmest month averages >22^{0}C, with a winter-dominant rainfall (Pidwirny, 2011).

Bureau of Meteorology (BoM) weather station Wanneroo (#9105) receives an average annual rainfall of 798mm, with the majority of rainfall occurring between April-September (**Graph 1**). Recorded rainfall for 2016 is broadly consistent with historical levels, with cumulative rainfall to September 2016 (695mm) representing 96% of the historical average of 722mm.



Graph 1: Rainfall Data (BoM, 2016)

4 Methods

4.1 Regulatory Requirements

The Level 2 flora and vegetation assessment was conducted in accordance with EPA Guidance Statement No. 51*, Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia* (EPA 2004a) and *Technical Guide – Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA and Department of Parks and Wildlife, 2016).

4.2 Desktop Assessment

A database search was submitted to DPaW Species and Communities Branch for records of Threatened and Priority flora, and Threatened and Priority Ecological Communities occurring within 10km of the survey area, as defined by shapefiles supplied by the City. These database searches include data from the Threatened (Declared Rare) and Priority Flora, Western Australian Herbarium Specimen, the Threatened and Priority Flora List and the Threatened Ecological Communities databases.

Additionally, an EPBC Protected Matters search was conducted for federally listed Threatened flora species and Environmentally Sensitive Areas recorded within 15km of the study area.

These species were assessed with regard to their range and habitat requirements to determine the likelihood of their occurrence within the survey area.

Previous biological assessments conducted within the survey areas, provided by CoW, were assessed and reviewed during the desktop assessment to provide local context and inform, in conjunction with aerial imaging, the field survey sampling strategy.

4.3 Field Survey

The Level 2 Flora and Vegetation field survey was conducted 22-29 September 2016, and was implemented concurrently with the comprehensive *Phytophthora* Dieback assessments, with Principal Ecologist Joseph Grehan, conducting the Dieback assessment; and Senior Botanist Kelby Jennings conducting the flora and vegetation assessment and assisting in Dieback transect assessment.

The study area was assessed on foot, and consisted of several reconnaissance transects to identify and delineate vegetation units and dominant flora species, followed by installation of eight permanent monitoring quadrats measuring 10m x 10m, with a minimum of two quadrats per vegetation unit.

The northwest corner of each quadrat was recorded using handheld GPS units, and a photographic representation of the quadrat captured from this location. Biophysical data recorded during quadrat assessment includes:

- Landscape position and aspect;
- Soil characteristics;
- Time since fire;
- Litter cover;
- Vegetation condition and observed disturbances;
- Vegetation community description;
- Flora species, including height and percentage foliage cover; and
- Other relevant information observed.

Specimens of observed flora species, especially containing flowers, seeds and/or fruit were collected and preserved for formal identification by experienced taxonomists.

Flora species observed opportunistically outside of permanent quadrats, including during Dieback assessment operations, were collected and recorded throughout the survey. Due to the intensive nature of the Dieback assessment, involving comprehensive assessment of the project area using 50m transect

corridors, the intensity of assessment is considered to be significantly higher than a sampling program based solely on quadrat assessment.

Vegetation community mapping was conducted by delineating plant communities based on distinctive characteristics such as vegetation structure, dominant species and species composition. A combination of aerial photography analysis, ground truthing and statistical analysis was used to delineate the vegetation complexes of the study area. Vegetation data was analysed using PATN row fusion dendrogram analysis to identify vegetation similarities and groupings.

Vegetation condition was determined in relation to the (perceived) ability of the bushland to maintain itself, based on the condition scale developed by Keighery (1994) (**Table 5**). This is commonly interpreted primarily on the ratio of visible introduced species to native species; however, disturbance (e.g. grazing, erosion), degree of alteration to community and habitat structure, the presence of Dieback and other plant pathogens, site ecology and other factors are also considered.

Table 5: Vegetation Condition Scale (Keighery, 1994)

Scale		Condition
1	Pristine	Pristine or nearly so, no obvious signs of disturbance.
2	Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species.
3	Very Good	Vegetation structure altered, obvious signs of disturbance. For example, disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.
4	Good	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it. For example, disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds at high density, partial clearing, dieback and grazing.
5	Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. For example, disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.
6	Completely Degraded	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often described as "parkland cleared" with the flora comprising weed or crop species with isolated native trees or shrubs.

5 Results

5.1 Desktop Review

5.1.1 Literature Review

Eco Logical Australia (ELA) conducted an assessment of environmental values within Lot 4 Flynn Drive (which includes the Lot 9000 survey area) in August 2012 (Eco Logical Australia, 2012), followed by a targeted flora and fauna assessment (Eco Logical Australia, 2012(b)). The assessment included a desktop review of previous reports and government databases, ground-truthing field assessments, targeted searches for Threatened and Priority flora, and assessments of habitat values for fauna of conservation significance.

The survey did not identify any Threatened or Priority Flora species occurring in the project area.

The vegetation community assessment identified vegetation community EmBaBmA as being representative of the TEC *FCT SCP 20a – Banksia attenuata woodlands over species rich dense shrublands*. This TEC is mapped as occurring over 27.2ha within the Lot 9000 survey area.

The survey also identified approximately 694 significant habitat trees, of which 126 were located within the Lot 9000 survey area, including 19 with potential breeding hollows.

5.1.2 Threatened and Priority Flora

The search of the Threatened (Declared Rare) and Priority Flora, Western Australian Herbarium Specimen, and Threatened and Priority Flora List databases, and the EPBC Protected Matters search, identified a total of 43 species of conservation significance recorded within 10km of the survey area.

The DPaW database search identified 32 flora species of conservation significance as being recorded within 10km of the survey area, comprised of four Threatened flora species and twenty-eight Priority species, including five Priority 1, eight Priority 2, eleven Priority 3 and four Priority 4.

The EPBC Protected Matters search identified an additional eleven federally listed Threatened flora species (**Appendix 2**).

The assessment against range and habitat requirements identified four species as possessing a High likelihood of occurrence, based on survey area location, local flora records and expected environmental conditions: *Caladenia huegelii* (T), *Acacia benthamii* (P2), *Stenanthemum sublineare* (P2) and *Jacksonia sericea* (P4).

All species of conservation significance identified during the desktop review, including their likelihood of occurrence, are listed in **Appendix 1, Table 1**.

5.1.3 Threatened and Priority Ecological Communities

The search of the Threatened Ecological Communities database identified eleven Threatened and Priority ecological communities as being recorded within 10km of the survey area, comprised of one Critically Endangered, three Endangered and seven Priority 3 ecological communities. Threatened and Priority ecological communities identified during the database search are listed in **Appendix 1, Table 2**.

Lot 9000 has been identified as containing the Threatened *Banksia attenuata woodlands over species rich dense shrublands* (EN) ecological community (**Figure 1**). This community is recognised as representative components of the newly listed *Banksia woodlands of the Swan Coastal Plain* community complex (DoEE, 2016).

The EPBC Protected Matters search did not identify and Threatened Ecological Communities. However, the Threatened (Endangered) ecological community *Banksia woodlands of the Swan Coastal Plain* was recently listed under Section 184 of the EPBC Act, effective from 16 September 2016 (**Appendix 3**), but was not identified by the search engine.

5.2 Field Assessment

5.2.1 Flora

A total of 149 vascular flora taxa, including 22 exotic (weed) species, were recorded within the study area, representing 106 genera from 42 families. Families with the highest representation were Fabaceae (24 taxa, including four weed species), Proteaceae (15 taxa), and Myrtaceae (12 taxa). The full list of vascular flora species recorded within the study area is presented in **Appendix 1, Table 3**.

No Threatened (Declared Rare) flora were recorded during the survey. Three species of Priority flora were recorded: *Acacia benthamii* (Priority 2) *Stylidium maritimum* (Priority 3) and *Jacksonia sericea* (Priority 4).

No flora species were identified as possessing Local or Regional Significance, in accordance with the criteria detailed in **2.1.4**.

5.2.2 Introduced Flora (Weeds)

The survey identified 22 weed species within the survey area, representing 15.5% of total floristic diversity. Commonly represented were species of the Asteraceae, Fabaceae and Poaceae families.

A small population of the weed species **Watsonia meriana* var. *bulbillifera* (Watsonia) was identified in Lot 24. Watsonia is listed as High Priority for management in the Swan Region NRM weed prioritisation strategy, and has been nominated as a Weed of National Significance.

No Weeds of National Significance were identified within the survey area. However, **Watsonia meriana* var. *bulbillifera* has been nominated for inclusion, and therefore may be listed in the future.

No Declared Pests for the City of Wanneroo LGA, in accordance with the BAM Act 2007, were identified within the survey area.

5.2.3 Vegetation

Analysis of the row fusion dendrogram identifies two vegetation communities as occurring within the survey area, with Community AfHh occurring in Lot 24 and Community AfBmHhMp within Lot 9000. Quadrat 6 was differentiated from other quadrats within Community AfBmHhMp, but this is likely due to species and structural composition being affected by fire. Both vegetation communities are broadly described as Banksia woodland communities, with differentiation based on understory species composition. Vegetation community descriptions are listed in **Table 6**.

Table 6: Vegetation community descriptions

Vegetation Community	Vegetation Community Description
AfBmHhMp	Open Forest to Woodland of *Allocasuarina fraseriana* and *Eucalyptus marginata* over Low Woodland to Low Open Woodland of *Banksia menzeisii* and *Banksia attenuata* over *Xanthorrhoea preissii* and *Stirlingia latifolia* Shrubland over *Hibbertia hypericoides*, *Eremaea pauciflora* var. *pauciflora* and *Bossiaea eriocarpa* Low Shrubland over *Mesomelaena pseudostygia*, *Hyalosperma cotula* and *Podotheca gnaphalioides* Open Sedge/Herbland. Occurs on flat to gently undulating dunes of Bassendean sands.
AfHh	Woodland of *Allocasuarina fraseriana*, *Banksia attenuata* and *Banksia menzeisii* over *Hibbertia hypericoides*, *Hovea stricta* and *Billardiera fraseri* Closed Low Heath. Occurs on flat to gently undulating dunes of Bassendean sands.

5.2.4 Black Cockatoo Habitat Assessment

Lot 24 and Lot 9000 were both assessed as containing high value foraging habitat for Black Cockatoo species, including the Carnaby's Black Cockatoo, with areas of 4ha and 54ha respectively. This is based on the presence of *Banksia attenuata* and *B. menzeisii* as a dominant structural species throughout the vegetation communities within the survey areas, with *Allocasuarina fraseriana* and *Eucalyptus marginata* also providing foraging value.

Terratree validated the results of the significant tree assessment conducted within Lot 9000 by ELA (2012), and also recorded an additional 31 significant trees, including four with potential breeding hollows. This increases the number of significant habitat trees within Lot 9000 to 157, with 23 (14.7%) containing potential breeding hollows.

Terratree recorded 44 significant Jarrah (*Eucalyptus marginata*) trees within Lot 24. No trees containing potential breeding hollows were identified during the survey.

6 Discussion

6.1 Lot 9000 Flynn Drive

The survey identified 132 vascular plant species occurring within Lot 9000, including 18 weed species. Species diversity ranged from 0.30-0.46 species/m2, with an average of 0.37 species/m^2.

The Priority 2 species *Acacia benthamii* was identified as occurring within Lot 9000. Only one individual of this species was observed during the survey, and is unlikely to occur in significant numbers within Lot 9000.

One individual of the Priority 3 species *Stylidium maritimum* was observed within Lot 9000, adjacent to a track on the eastern boundary. Only one individual of this species was observed, and it is unlikely to be widespread within Lot 9000.

Lot 9000 (54ha) is covered by vegetation community AfBmHhMp, which is considered representative of the *Banksia Woodlands of the Swan Coastal Plain* TEC based on the presence of key diagnostic species *Banksia attenuata* and *B. menziesii* as a dominant component of the vegetation composition throughout this community.

Although the flora and vegetation survey by ELA (2012) mapped two vegetation communities within Lot 9000, differences were considered to be minor variations in structure due to landscape position, rather than a definitive change is vegetation composition. This analysis was supported by the results of the row fusion dendrogram analysis (**Appendix 4**).

Vegetation condition throughout Lot 9000 was mostly Very Good to Excellent (excluding tracks), with disturbances mostly restricted to the boundaries and tracks of the project area (edge effect), and the localised dumping of soil, greenwaste and general household waste. A number of potential asbestos dumps were also identified, with the waypoint location of these areas communicated to the City of Wanneroo. Vegetation in the southern portion of Lot 9000 was observed to be impacted by several environmental factors, including drought, *Phytophthora* Dieback, canker species, or combination of these factors. Vegetation in the northern portion of the site has been burnt within the last three years, but is recovering well and generally demonstrates Excellent vegetation condition.

Weed species occurred at low densities throughout the majority of Lot 9000, generally consisting of non-aggressive species such as **Briza maxima* and **Gladiolus caryophyllaceus*. The aggressive weed species **Arctotheca calendula* (Cape Weed) was observed to be emerging from introduced soil dumps (**Plate 9**), but so far have not spread beyond these areas. **Leptospermum laevigatum* (Victorian Tea Tree) was not observed within the survey area, but occurs in roadside vegetation adjacent to the survey area.

6.2 Lot 24 Mary St

The survey identified 94 vascular plant species occurring within Lot 24, including 16 weed species. Species diversity ranged from 0.36-0.41 species/m^2. The Priority 4 species *Jacksonia sericea* was identified as occurring within Lot 24. Only one individual of this species was observed during the survey, and is unlikely to occur in significant numbers within Lot 24.

Lot 24 (4ha) is covered by vegetation community AfHh, which is considered representative of the *Banksia Woodlands of the Swan Coastal Plain* TEC, based on the presence of key diagnostic species *Banksia attenuata* and *B. menziesii* as a dominant component of the vegetation composition throughout this community.

Vegetation condition throughout the project area ranged from Good to Excellent (excluding tracks), with weed encroachment spreading from the boundaries and tracks of the project area (edge effect) into areas of intact native vegetation, which can affect community diversity, composition and structure. Aggressive weed species observed to be impacting native vegetation condition include **Ehrharta calycina* (Veldt Grass), **Watsonia meriana* var. *bulbillifera* (Watsonia) and **Pelargonium capitatum* (Pelargonium). Non-aggressive weed species observed to be widespread throughout Lot 24 include **Briza maxima* and **Gladiolus caryophyllaceus*.

Localised dumping of soil, greenwaste and general household waste are also factors contributing to decreased vegetation condition.

6.3 Significant Species and Communities

6.3.1 Banksia Woodlands on the Swan Coastal Plain (EN)

Approved conservation advice, issued by the Department of Environment and Energy (2016), describes the *Banksia Woodlands on the Swan Coastal Plain* TEC as:

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

The principal structural features of the ecological community is a distinctive upper sclerophyllous layer of low trees (occasionally large shrubs more than 2 m tall), typically dominated or co-dominated by *Banksia attenuata* (Candlestick Banksia, Slender Banksia) and/or *B. menziesii* (Firewood Banksia). Other *Banksia* species that dominate in some examples of the ecological community are *B. prionotes* (Acorn Banksia) or *B.ilicifolia* (Holly-leaved Banksia).

An emergent tree layer of medium or tall (>10 m) height *Eucalyptus* or *Allocasuarina* species may sometimes be present , with an often highly species-rich understory consisting of sclerophyllous shrubs of various heights and a herbaceous ground layer of cord rushes, sedges and perennial and ephemeral forbs, that sometimes includes grasses.

The primary threat to this ecological community is clearing and fragmentation arising from urban development, agriculture and resource extraction. Other threats to this community include *Phytophthora* Dieback, invasive species, altered fire regimes, hydrological degradation, grazing and climate change.

In accordance with the approved conservation advice, EPBC Act referral is required prior to clearing if the following minimum patch size criteria are met:

- Pristine – No minimum patch size applies
- Excellent – 0.5ha (5,000m^2)
- Very Good – 1.0ha (10,000m^2)

Good – 2ha (20,000m^2)

Plate 1: Banksia Woodlands on the Swan Coastal Plain, with a dominant *Banksia menzeisii* overstory

6.3.2 Assessment Against Key Diagnostic Characteristics

Conservation advice for the Banksia Woodland on the Swan Coastal Plain community list the key diagnostic characteristics, including potential contra-indicators, to enable identification of this ecological community based on flora and vegetation survey data. **Table 7** contains an assessment of vegetation communities AfBmHhMP and AfHh against these key diagnostic characteristics.

Table 7: Assessment of vegetation communities AfBmHhMp and AfHhagainst key diagnostic characteristics for the *Banksia Woodland on the Swan Coastal Plain* Threatened Ecological Community (DoEE, 2016)

Step	Key diagnostic characteristics (DotE 2016c)	Outcome
1	Location and physical environment - the Banksia Woodlands ecological community primarily occurs in the Swan Coastal Plain IBRA bioregion: and	Yes – the study area is located on the Swan Coastal Plain
	Soil and landform - the Banksia Woodlands typically occurs on well drained, low nutrient soils on sandplain landforms, particularly deep Bassendean and Spearwood sands and occasionally on Quindalup sands; and	Yes – the study area is located on Bassendean Dune System
	Structure - the structure of the Banksia Woodlands is a low woodland to forest with these features: • A distinctive upper sclerophyllous layer of low trees* (occasionally large shrubs more than 2 m tall), typically dominated or co-dominated by one or more of the Banksia species identified under composition; and • Emergent trees of medium or tall (>10 m) height Eucalyptus or Allocasuarina species may sometimes be present above the Banksia canopy; and • An often highly species-rich understorey that consists of: o a layer of sclerophyllous shrubs of various heights; and, o a herbaceous ground layer of cord rushes, sedges and perennial and ephemeral forbs, that sometimes includes grasses. The development of a ground layer may vary depending on the density of the shrub layer and disturbance history.	Vegetation communities AfBmHhMp and AfHh consist of a Woodland to Low Woodland, dominated by the key diagnostic species *Banksia attenuata* and *Banksia menziesii*. There is also the presence of *Eucalyptus marginata* subsp. *marginata* and *Allocasuarina fraseriana*, and the community has a diverse ground layer consisting of shrubs, sedges and forbs, which is considered representative of the described 'sclerophyllous shrubs' and 'herbaceous ground layer'. Refer to **Appendix 5** for the site by species matrix.
	Composition – • The canopy is most commonly dominated or co-dominated by *Banksia attenuata* (candlestick banksia, slender banksia) and/or *B. menziesii* (firewood banksia). Other Banksia species that dominate in some examples of the ecological community are *B. prionotes* (acorn banksia) or *B.ilicifolia* (holly-leaved banksia); and • The patch must include at least one of the following diagnostic species: o *Banksia attenuata* (candlestick banksia) o *Banksia menziesii* (firewood banksia) o *Banksia prionotes* (acorn banksia) o *Banksia ilicifolia* (holly-leaved banksia); and • If present, the emergent tree layer often includes *Corymbia calophylla* (marri), *E. marginata* (jarrah), or less commonly *Eucalyptus gomphocephala* (tuart); and	The canopy is dominated by the key diagnostic species *Banksia attenuata* and *Banksia menziesii*. There is also the presence of co-dominant species *Eucalyptus marginata* subsp. *marginata* and *Allocasuarina fraseriana*. Other observed indicator species for this community include *Nuytsia floribunda* and *Eucalyptus todtiana*. The community had a medium diversity of shrubs and herb species, with many indicator species recorded. The contra-

Step	Key diagnostic characteristics (DotE 2016c)	Outcome
	) Other trees of a medium height that may be present, and may be codominant with the Banksia species across a patch, include *Eucalyptus todtiana* (blackbutt, pricklybark), *Nuytsia floribunda* (Western Australian Christmas tree), *Allocasuarina fraseriana* (western sheoak), *Callitris arenaria* (sandplain cypress), *Callitris pyramidalis* (swamp cypress) and *Xylomelum occidentale* (woody pear); and) The understorey typically contains a high to very high diversity of shrub and herb species that often vary from patch to patch***) Contra-indicators: o Patches clearly dominated by *Banksia littoralis* are not part of the Banksia Woodlands ecological community but indicates a different, dampland community is present. o Patches clearly dominated by *Bankia burdettii* are not part of the Banksia Woodlands ecological community but indicates a tall shrubland and not the Banksia Woodlands ecological community. o FCT 20c – Eastern shrublands and woodlands, corresponds with a separate EPBC ecological community listing, Shrublands and Woodlands of the eastern Swan Coastal Plain. Occurrences of this FCT should be considered under that separate listing.)	indicators of *Banksia littoralis* and *Banksia burdettii* were not recorded. The community does not represent FCT 20c – Eastern shrublands and woodlands, as it is not located on the Forrestfield unit of the Ridge Hill Shelf (Endangered Species Scientific Subcommittee, 2000).
2	Condition thresholds –) Assessments of a patch should initially be centered on the area of highest native floristic diversity and/or cover, i.e. the best condition area of the patch.) Consideration must be given to the timing of surveys and recent disturbance. Ideally surveys should be undertaken in spring with two sampling periods to capture early and late flowering species.) The surrounding context of a patch must also be taken into account when considering factors that add to the importance of a patch that meets the condition thresholds.) Certain vegetation components of the Banksia Woodlands ecological community merit consideration as critical elements to protect. Three components are recognised as threatened in their own right in WA and, as such, are priorities for protection; refer to Table 1 in the Approved Conservation Advice (DotE 2016c).) A relevant expert (e.g. ecological consultant, local NRM or environment agency) may be useful to help identify the ecological community and its condition	The patches are of sufficient size (54ha and 4 ha respectively) and condition (Very Good to Excellent) to meet the minimum patch criteria for consideration as the Banksia Woodland TEC. The survey was undertaken during the optimal survey period for flora identification purposes. The patch is surrounded by a variety of land uses, including industrial estate, intensive horticulture and remnant native bushland. The survey area is contiguous with adjacent Banksia woodland. Vegetation communities AfBmHhMp and AfHh are not considered representative of the Banksia attenuata woodlands over species rich

Step	Key diagnostic characteristics (DotE 2016c)	Outcome
		dense shrublands, the Eastern Banksia attenuata and/or Eucalyptus marginata woodlands, or the Eastern shrublands and woodlands threatened ecological communities.
3	Minimum patch size - Minimum patch sizes apply for consideration of a patch as part of the listed ecological community for EPBC Act referral, assessment and compliance purposes. Where patches meet different levels of condition, different minimum patch sizes apply: • 'Pristine' – no minimum patch size applies • 'Excellent' – 0.5 ha or 5,000 m2 (e.g. 50 m x 100 m) • 'Very Good' – 1 ha or 10,000 m2 (e.g. 100 m x 100 m) • 'Good' – 2 ha or 20,000 m2 (e.g. 200 m x 100 m) • To be considered as part of the EPBC Act ecological community a patch should meet at least the Good Condition category.	With an area of approximately 54ha, and vegetation condition recorded as Very Good to Excellent throughout the vegetation community, this patch meets the minimum size and condition thresholds required for consideration as representative of the Banksia Woodlands TEC (Department of Environment and Energy, 2016).
4	Further information to assist in determining the presence of the ecological community and significant impacts. The landscape position of the patch, including its position relative to surrounding vegetation also influences how important it is in the broader landscape. For example, if it enables movement of native fauna or plant material or supports other ecological processes: • A patch is a discrete and mostly continuous area of the ecological community. A patch may include small-scale (<30 m) variations, gaps and disturbances, such as tracks, paths or breaks. Where there is a break in native vegetation cover, from the edge of the tree canopy of 30 m or more (e.g. due to permanent artificial structures, wide roads or other barriers; or due to water bodies typically more than 30m wide) then the gap typically indicates that separate patches are present. • Variation in canopy cover, quality or condition of vegetation across a patch should not initially be considered to be evidence of multiple patches. Patches can be spatially variable and are often characterised by one or more areas within a patch that meet the key diagnostic characteristics and condition threshold criteria amongst areas of lower condition. Average canopy cover and quality across the broadest area that meets the general description of the ecological community should be used initially in determining overall canopy cover and vegetation condition. Also note any areas that are either significantly higher or lower in quality, gaps in canopy cover and the condition categories that would apply across different parts of the site respectively. Where the average canopy cover or quality falls below the minimum thresholds, the next largest area or areas that meet key diagnostics (including minimum canopy cover requirements) and minimum condition thresholds should be specified and protected. This may result in multiple patches being identified	Vegetation communities AfBmHhMP and AfHh are found throughout the assessment area. Several tracks dissect the area, but disturbances are restricted and local, and do not affect the overall integrity of the patch. Some areas exhibit a dominance of *Allocasuarina fraseriana* at the expense of *Banksia* menzeisii and *B. attenuata*; however, these areas are limited in extent, and are incorporated into, and considered representative of, the overall vegetation community. It is likely that vegetation communities AfBmHhMp and AfHh represent the TEC Banksia Woodlands of the Swan Coastal Plain, as they are of sufficient size and condition to meet the minimum patch criteria for this listing.

Step	Key diagnostic characteristics (DotE 2016c)	Outcome
	within the overall area first considered. J A buffer zone is a contiguous area immediately adjacent to a patch of the ecological community that is important for protecting its integrity. The purpose of the buffer zone is to help protect and manage the national threatened ecological community. The edges of a patch are considered particularly susceptible to disturbance and the presence of a buffer zone is intended to act as a barrier to further direct disturbance. J The recommended minimum buffer zone for the ecological community is 20–50 metres from the outer edge of a patch, and the appropriate size depends on the nature of the buffer and local context (e.g. slope). A larger buffer zone should be applied, where practical, to protect patches that are of particularly high conservation value, or if patches are down slope of drainage lines or a source of nutrient enrichment, or groundwater drawdown.	

6.3.3 *Acacia benthamii* (P2)

Acacia benthamii (Family Fabaceae, sub-family Mimosaceae) is a small to medium shrub up 1 m high. Flowers are yellow and are visible August to September. It typically occurs on sand and limestone breakaways in the LGA's of Dandaragan, Gingin, Gosnells, Joondalup, Murray, Rockingham, Subiaco, Swan and Wanneroo (Florabase, 2016).

Plate 2: *Acacia benthamii* distribution and image

This species was collected in Lot 9000 Flynn Dr, within vegetation community AfBmHhMp. This species was not identified in the field due to a lack of flowering material, but was only observed and collected once opportunistically. The closest database record for this species is located approximately 4km south of Lot 9000. *Acacia benthamii* is unlikely to occur in significant numbers within Lot 9000, give the lack of recorded observations and the absence of its preferred limestone habitat within the survey area.

6.3.4 *Jacksonia sericea* (P4)

Jacksonia sericea (Family Fabaceae, sub-family Papilionaceae) is a perennial, low spreading shrub to 0.6 m high. Flowers are orange, usually emerging in December or January to February. It occurs on calcareous and sandy soils within the LGA's of Cambridge, Claremont, Fremantle, Joondalup, Mandurah, Melville, Murray, Nedlands, Perth, Rockingham, Stirling, Subiaco, Swan and Wanneroo (Florabase, 2016).

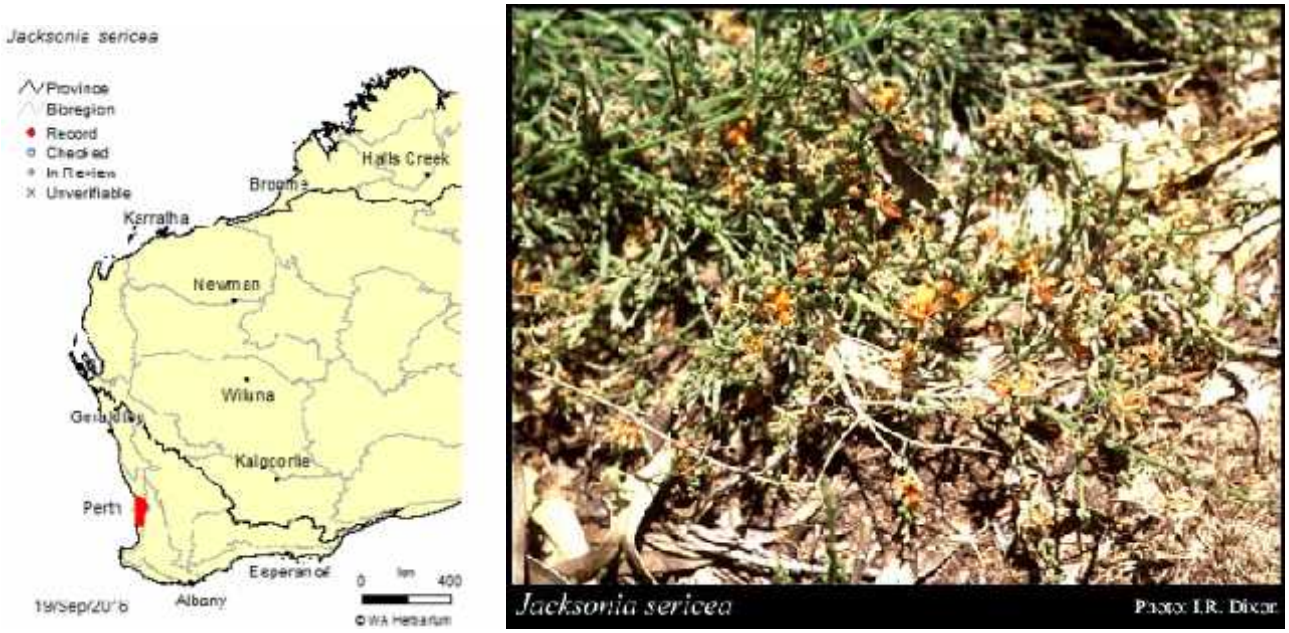


Plate 3: *Jacksonia sericea* distribution and image

One individual of *Jacksonia sericea* was identified near the northern boundary of Lot 24 Mary St. This species was confirmed despite a lack of identifying material, as the survey was conducted outside the flowering period for this species. The nearest database records for this species are located approximately 5.5km north-west of Lot 24. Given the intensive levels of assessment during Dieback survey for this area, it is unlikely that *Jacksonia sericea* occurs in significant numbers within Lot 24.

6.3.5 *Stylidium maritimum* (P3)

Stylidium maritimum (Family Stylidiaceae) is a caespitose, perennial herb, from 0.3-0.7 m high. It produces a white/purple inflorescence from September to November. It inhabits sandy soils over limestone on dune slopes and flats. It occurs in coastal heath and shrubland and open Banksia woodland in the Lesueur Sandplain and Perth IBRA subregions (Florabase, 2016).

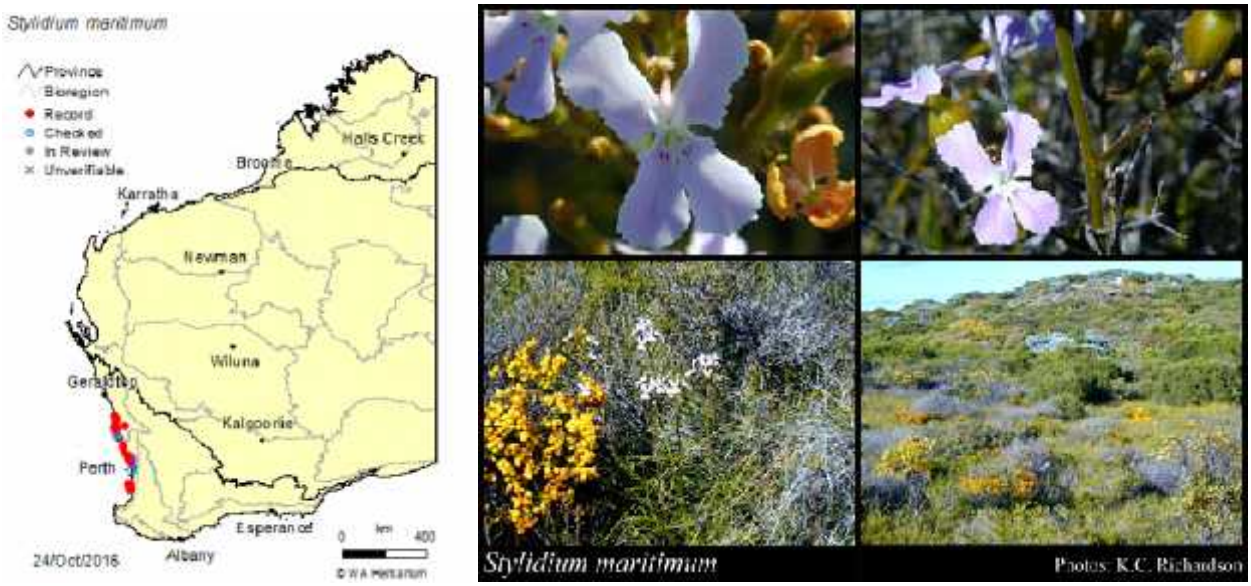


Plate 4: *Stylidium maritimum* distribution and image

One individual of *Stylidium maritimum* was observed during the survey, adjacent to a track on the eastern boundary of Lot 9000. This species is unlikely to be widespread within the study area, as this species usually occurs in more coastal areas, with the nearest database records located approximately 10km west of Lot 9000.

6.3.6 Black Cockatoo Habitat Assessment

Lot 24 and Lot 9000 were both assessed as containing high value foraging habitat for Black Cockatoo species, including the Threatened (EN) Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*), with areas of 4ha and 54ha respectively. This is based on the dominant presence of *Banksia attenuata* and *B. menzeisii* throughout the vegetation communities within the survey areas, with emerging *Allocasuarina fraseriana* and *Eucalyptus marginata* also providing foraging value.

Terratree identified 157 significant habitat trees within Lot 9000, with 23 (14.7%) containing potential breeding hollows.

Terratree recorded 44 significant Jarrah (*Eucalyptus marginata*) trees within Lot 24. No trees containing potential breeding hollows were identified.

Plate 5: Significant Jarrah (*Eucalyptus marginata*) Black Cockatoo habitat tree

6.4 Limitations

6.4.1 Level 2 Flora and Vegetation Survey

EPA Guidance Statement No. 51 (EPA 2004a) describes potential survey limitations that can affect the reliability and comprehensiveness of the field assessment. **Table 8** details these limitations with regard to the study area and the conditions experienced at the time of survey.

No limitations were identified as potentially impacting the results of the desktop assessment and Level 2 flora and vegetation field survey.

Table 8: Assessment of potential limitations

Potential Limitation	Discussion	Limitation? (Yes/No)
Availability of contextual information	All appropriate desktop assessments, including DPaW database searches and review of relevant literature, including unpublished reports, were conducted prior to the field survey and were used to inform and direct the survey effort.	No
Scope (e.g. what life forms, etc., were sampled)	There were no inappropriate limitations on the scope. The survey assessed all vascular plant species, vegetation types, floristic diversity and vegetation condition.	No
Proportion of flora collected and identified (based on sampling, timing and intensity)	The survey occurred during late September, 2016, during the optimal survey period for SW Western Australia. Rainfall for the months prior to field survey was consistent with historical averages, with numerous annual species evident, including species from the Stylidiaceae, Orchidaceae and Asteraceae families. The survey area was comprehensively assessed during both botanical and Dieback assessment operations.	No
Completeness and further work which might be needed	The field survey addressed all requirements of the Scope of Works, and was implemented in accordance with the relevant EPA Guidance Statements and Technical Guides.	No
Taxonomic certainty	There were no significant limitations on taxonomic certainty. Species profiles, descriptions and photographs were compiled from specimens and information available on Florabase and resources in the WA Herbarium. These were used for field identification of any species with potential to be a threatened or priority species. Specimens were collected for all potential threatened and priority species and all unidentified plants from relevés for identification by a taxonomic expert in the laboratory.	No
Mapping reliability	The vegetation mapping has been based on a Level 2 survey, using permanent quadrats. Current and detailed aerial photography was available for the purposes of mapping.	No
Timing, weather, season, cycle	Timing of the survey, in late September, is within the optimal period for flora surveys in the SW of Western Australia.	No
Disturbances (fire, flood, accidental human intervention etc.)	Numerous impacts to vegetation were noted during the course of the field survey, including recreational vehicle use, illegal dumping and fire. However, survey efforts were directed towards areas with native vegetation in Good or better condition, and impacts in these areas were not deemed to be significant in the context of the survey. The northern portion of Lot 9000 was burnt 2-3 years ago. Vegetation was recovering well post-fire, with high diversity of understory species, few weeds and generally Excellent vegetation condition. Although localised areas were more severely affected, as evidenced by the outlying dendrogram result for Quadrat 6, the majority of vegetation was deemed to be assessable.	No
Intensity (in retrospect, was the intensity adequate)	The intensity of the Level 2, flora and vegetation assessment were adequate for the purpose of the survey, with all areas of native vegetation assessed during transect passes, and all observed flora identified to species level.	No
Resources	The field survey, plant identification and reporting were all adequately resourced.	No
Experience levels (e.g. degree of expertise in plant identification to taxon level).	The field survey was carried out by suitably qualified and experienced personnel. Plant identification undertaken by an independent taxonomist with extensive experience in the flora of Southwest WA.	No

7 Conclusions and Recommendations

No Threatened (Declared Rare) flora species were identified as occurring within the study area. Three Priority Flora species were recorded within the study area: *Acacia benthamii* (P2) *Stylidium maritimum* (P3) and *Jacksonia sericea* (P4). Only one individual of each species was observed, and they are unlikely to occur in significant numbers within the study area.

The vegetation communities within the survey area are considered representative of the *Banksia Woodlands of the Swan Coastal Plain* ecological community, which is listed as Endangered under the EPBC Act.

7.1 Lot 9000 Flynn Drive

The survey identified 132 vascular plant species occurring within Lot 9000, including the Priority 2 species *Acacia benthamii* and the Priority 3 *Stylidium maritimum*. Lot 9000 (54ha) is covered by vegetation community AfBmHhMp, which is considered representative of the *Banksia Woodlands of the Swan Coastal Plain* TEC, as determined by the assessment against the key diagnostic characteristics for this ecological community (**Section 6.3.2**).

The vegetation condition over Lot 9000 is Very Good to Excellent. Weed infestation of native vegetation is minimal, and is predominately restricted to boundaries and tracks. Several illegal soil dumps have emergent weed species which have not yet spread into native vegetation.

To manage weed infestation and maintain bushland health, it is recommended that:

- Illegal soil dumps are removed to minimise the risk of weed species spreading into native vegetation
- Tracks and boundaries are regularly inspected and maintained to manage weed incursions from populations adjacent to conservation areas

Outside of access tracks, no areas in Lot 9000 were identified as requiring revegetation to maintain or improve bushland health, as native vegetation is intact, in Very Good to Excellent condition, and largely free of aggressive weed species. However, should the City wish to undertake such operations in the future, consideration should be given to the provenance and suitability of revegetation species and relative planting densities to reflect native vegetation composition. A list of potential revegetation species suitable for use within Lot 9000 is provided in **Appendix 1, Table 4**.

7.1.1 Black Cockatoo Habitat

Lot 9000 represents high value foraging habitat for Black Cockatoo species, including the Carnaby's Black Cockatoo, with *Banksia attenuata* and *B. menzeisii* comprising a dominant structural component of the vegetation community. Emerging *Allocasuarina fraseriana* and *Eucalyptus marginata* trees also provide foraging value.

Terratree validated the results of the significant tree assessment conducted with Lot 9000 by ELA (2012), and also recorded an additional 31 significant trees, including four with potential breeding hollows. This increases the number of significant trees within Lot 9000 to 157, with 23 (14.7%) containing potential breeding hollows. However, it is recommended that these hollows be assessed by an experienced zoologist to determine their overall suitability and potential to provide breeding habitat for Black Cockatoo species.

7.2 Lot 24 Mary Street

The survey identified 94 vascular plant species occurring within Lot 24, including the Priority 4 species *Jacksonia sericea*. Lot 24 (4ha) is covered by vegetation community AfHh, which is considered representative of the *Banksia Woodlands of the Swan Coastal Plain* TEC.

The vegetation condition over Lot 24 ranged from Good to Excellent. Weed infestation of native vegetation is a significant degrading factor, with aggressive species, including Veldt Grass, Watsonia and Fumitory. Weed infestations are spreading from boundaries and tracks, with vegetation in the east and north-east areas experiencing loss in vegetation condition arising from weed impacts, while other areas contain localised weed infestations amongst otherwise healthy vegetation. Although Watsonia has been identified as High priority for management under the Swan Region NRM weed prioritisation strategy, its occurrence within Lot 24 is currently localised and restricted, likely due to sub-optimal environmental conditions.

Given that Lot 24 has recently been subject to a controlled burn, weed emergence and spread is a significant risk to vegetation condition. To manage weed infestation and maintain bushland health, it is recommended that a Weed Management Strategy be prepared and implemented, which includes identification of significant weeds within Lot 24, assesses treatment options develops an implementation schedule, reports on the result of weed management activities, and provides recommendations as part of an adaptive, ongoing management program.

Although weed control is a priority for management and maintenance of bushland health, revegetation may be required to address localised disturbance and supress weed emergence in areas subject to weed control actions. However, should the City wish to undertake such operations in the future, consideration should be given to the provenance and suitability of revegetation species and relative planting densities to reflect native vegetation composition. A list of potential revegetation species suitable for use within Lot 24 is provided in **Appendix 1, Table 4**.

7.2.1 Black Cockatoo Habitat

Lot 24 represents high value foraging habitat for Black Cockatoo species, including the Carnaby's Black Cockatoo, with *Banksia attenuata* and *B. menzeisii* comprising a dominant structural component of the vegetation community. Emerging *Allocasuarina fraseriana* and *Eucalyptus marginata* trees also provide foraging value.

Terratree recorded 44 significant Jarrah (*Eucalyptus marginata*) trees within Lot 24. No trees containing potential breeding hollows were identified during the survey. Generally speaking, Jarrah trees within Lot 24 are relatively young, with insufficient development to support nesting hollows. Several Jarrah individuals on the eastern boundary of Lot 24 are of sufficient size to potentially develop breeding hollows in the future.

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