Cockburn Cement Ltd

Nowergup tenements

Flora & fauna assessment report

February 2014

Executive summary

Cockburn Cement has commissioned GHD Pty Ltd (GHD) to conduct a Level 2 flora and vegetation assessment and Level 1 fauna assessment for two mining tenements at Wesco Road, Nowergup (Study Areas). The flora and fauna assessment for the northern tenement, M 7000141 (Northern Study Area), and southern tenement, M 7000138 (Southern Study Area), will allow for the expansion works within both tenements. It is proposed that the sites will need to be cleared (total of 25.4 hectares (ha)) to facilitate the expansion of the limestone quarries and as such a flora, vegetation and fauna assessment report is required.

This report will be used to assist Cockburn Cement to assess the environmental sensitivity of the Project Area, and define all flora and fauna values associated with the Study Areas, in particular their spatial location and conservation significance. This report includes an assessment of the Ten Clearing Principles.

GHD ecologists conducted the Level 2 flora and Level 1 fauna assessment between the 25th and 27th November 2013 for the Study Areas. The survey assessed the vegetation type and condition, and the presence of any significant flora and fauna in the Study Areas.

This report is subject to, and must be read in conjunction with, the limitations set out in section 1.5 and the assumptions and qualifications contained throughout the Report.

The following is a summary of the findings of the flora and fauna assessment:

Existing Environment

- The Northern Study Area is located within an ESA, which relates to Bush Forever site Hopkins Road Bushland, Nowergup (Site 290). A small ESA is located within the north west section of the Southern Study Area which relates to the location of Threatened flora located adjacent to the Southern Study Area. The ESA is located within a highly disturbed area within the Southern Study Area.
- The Northern Study Area is located within the Department of Parks and Wildlife (DPaW) managed Gnangara-Moore River State Forest. No DPaW-managed reserves were located within the Southern Study Area.
- The Northern Study Area is located within Bush Forever site Hopkins Road Bushland, Nowergup (Site 290). Both Study Areas are within 1 km of Bush Forever site 136 (State Forest 65 – Pinjar Plantation South Bushland, Nowergup/Yanchep/Neerabup).
- There are no Ramsar wetlands or nationally important wetlands located within 5 km of the Study Areas. There are no geomorphic wetlands or Environmental Protection Policy (EPP) lakes located within the Study Areas. There is one Resource Enhancement Dampland, Camel Swamp (UFI 7938), located within approximately 1 km of both the Study Areas.

Flora and Vegetation

- Broadscale vegetation mapping of the area (Beard, 1979 and Shepherd et al., 2002) identified the vegetation association Low woodland; banksia (association 949) present within the Study Areas. The Heddle et al. (1980) mapping identified vegetation complex Cottesloe complex – central and south (complex 52) within the Study Areas.

- Both vegetation associations and complexes identified within the Study Areas (Beard, 1979 and Heddle et al. 1980) are considered to be of least concern as they are well-represented at local, regional and State levels with more than 30 percent of their pre-European extents remaining.
- Three vegetation types were recorded within the Study Areas (not including Highly Degraded areas) and included *Melaleuca huegelii* Tall Open Scrub (1.85 ha), *Banksia sessilis* Tall Shrubland (6.95 ha) and *Melaleuca systena* Open Heath (14.55 ha).
- The field assessment identified GHD vegetation type *Melaleuca huegelii* Tall Open Scrub (1.85 ha) as potentially corresponding to Gibson et al. (1994) vegetation complex Endangered Threatened Ecological Community (TEC), *Melaleuca huegelii - Melaleuca acerosa* (currently *M. systena*) shrublands on limestone ridges, which is listed in Western Australia (FCT 26a). The field assessment also identified GHDs vegetation types *Banksia sessilis* Tall Shrubland (6.95 ha) and *Melaleuca systena* Open Heath (14.55 ha) as potentially corresponding to Gibson et al. (1994) vegetation complex Priority 3 Priority Ecological Community (PEC), Northern Spearwood Shrublands and Woodlands (FCT 24).
- Vegetation condition of the Northern Study Area ranged from *Pristine* (1) to *Completely Degraded* (6). Vegetated areas consisted of native vegetation in predominantly *Excellent* (2) to *Very Good* condition (3) (6.57 ha). The vegetation condition of the Southern Study Area ranged from *Pristine* (1) to *Completely Degraded* (6). The native vegetation within the Southern Study area was predominantly in *Pristine* (1) to *Excellent* (2) condition (10.88 ha).
- The PATN statistical anaylsis showed a weak association of GHD quadrats with DPaW quadrat data for the Priority 3 PEC, Northern Spearwood Shrublands and Woodlands, and the Endangered TEC, *Melaleuca huegelii - Melaleuca acerosa* (currently *M. systena*) shrublands on limestone ridges, which is listed in Western Australia (not listed as a TEC under the EPBC Act).
- A total of 131 flora species from 37 families and 87 genera were recorded within the Study Areas. This number included 97 native species.
- No species listed under the federal Environmental Protection and Biodiversity Conservation (EPBC) Act (1999) or state Wildlife Conservation (WC) Act (1950) were recorded during the survey. The field assessment identified 16 plants from two populations of *Melaleuca* sp. Wanneroo (G.J. Keighery 16705) (P1) within the Northern Study Area. One individual of *Stylidium maritimum* (P3) was recorded within in the Northern Study Area. One individual of *Melaleuca* sp. Wanneroo (G.J. Keighery 16705) (P1) and four plants of *Leucopogon* sp. Yanchep (P3) were recorded within the Southern Study Area during the survey.
- The likelihood of occurrence assessment determined that one species listed under the EPBC Act and WC Act (*Drakaea micrantha*) and five DPaW Priority species (*Acacia benthamii*, *Baeckea* sp. Limestone (N. Gibson & M.N. Lyons 1425), *Hibbertia spicata* subsp. *leptotheca*, *Jacksonia sericea*, *Pimelea calcicola*) may occur within the Study Areas.
- A total of 34 introduced (exotic) species were recorded within the Study Areas. One species, Bridal Creeper (**Asparagus asparagoides*), was recorded within the Southern Study Area. Bridal Creeper is listed as a Declared Pest under Section 22 of the

Biosecurity and Agriculture Management (BAM) Act (2007) and as a Weed of National Significance.

- A preliminary assessment for *Phytophthora* species (Dieback) was conducted during the field assessment. Vegetation within the Southern Study Area was in predominantly Pristine to Excellent condition. No evidence of Dieback was sighted within the Southern Study Area during the field assessment. A small number of dead *Banksia* secies were sighted within the Northern Study Area during the field assessment. The *Banksia* deaths could be related to Dieback infestation. A formal Dieback assessment would need to be undertaken to determine whether Dieback is present within the Northern Study Area.

Fauna

- Desktop investigations reported the known or potential occurance of 22 fauna species of conservation significance within 5kms of the Study Areas including six species listed under the EPBC Act, seven Migratory birds listed under the EPBC Act, five Threatened or other specially protected species listed under the WC Act and six Priority fauna species listed by the DPaW.
- The likelihood of these species occurring in the Study Areas was assessed and the assessment concluded that Baudin's Black Cockatoo and the Carpet Python are present within the Study Areas, seven species are likely to occur, four species may possibly occur and that nine species are unlikely to occur in the Study Areas.
- Most of the habitat within the Study Areas are a mosaic of mixed shrubland habitat; there is 8.45 ha (93%) of the shrubland in the Northern Study Area and 14.33 ha (97%) of the shrubland in the Southern Study Area.
- During the field survey a total of 16 fauna species (13 birds and three mammals) were recorded within the Study Areas.

Recommendations

Flora & vegetation

A clearing permit from the Department of Mines and Petroleum (DMP) will be required as the clearing occurs on mining tenements M 7000138 and M 7000141.The clearing of vegetation within the Study Areas is at variance with Principle (a) and (h) from the 10 Clearing Principles. The clearing of vegetation will impact on the environmental values of the ESAs located within the Study Areas.

Consultation with DPaW as to whether GHD vegetation types are the Endangered TEC, *Melaleuca huegelii - Melaleuca acerosa* (currently *M. systena*) shrublands on limestone ridges (FCT 26a) or the Priority 3 PEC, Northern Spearwood Shrublands and Woodlands (FCT 24) is advised because the field assessment results show similarity between GHD vegetation types and FCT 26a and FCT 24, while the PATN analysis showed only a weak association.

Clearing should be avoided, if possible within GHD vegetation type *Melaleuca huegelii* Tall Open Scrub, as this vegetation type potentially corresponds to Gibson et al. (1994) vegetation complex Endangered TEC, *Melaleuca huegelii - Melaleuca acerosa* (currently *M. systena*) shrublands on limestone ridges, which is listed in Western Australia (FCT 26a).

The clearing will also impact on DPaW Priority species and it is recommended that clearing of the Study Areas is reduced, to minimse the impacts to Priority flora located throughout the Study Areas and the potential Priority 3 PEC, Northern Spearwood Shrublands and Woodlands

or the Endangered TEC, listed in Western Australia, *Melaleuca huegelii - Melaleuca acerosa* (currently *M. systena*) shrublands on limestone ridges.

A formal Dieback assessment would need to be undertaken to determine whether Dieback is present within the Northern and Southern Study Areas. Based on the outcomes of the assessment, management measures should be implemented to reduce the risk of introduction and spread of Dieback.

Potential impacts associated with the Project are likely to be largely restricted to the clearing phase, and should be mitigated through design as much as possible. It is recommended that Cockburn Cement develops an Environmental Management Plan (EMP) to manage the potential impacts from clearing.

Fauna

The Clearing of the Study Areas will trigger referral to the Department of the Envrionment (DotE) due to the clearing of 23.35 ha of quality Black Cockatoo foraging habitat. Referral to, or discussions with, DotE are recommended.

The Project may be at variance with Clearing Principle (b) due to the clearing of Black Cockatoo foraging habitat and the potential impacts on local habitat connectivity. Referral to, or discussions with, DPaW and EPA are recommended.

An EMP to address the potential impacts expected to be experienced during the clearing of native vegetation for the proposed mine should include a general fauna clearance program by qualified fauna relocation personnel.

Table of contents

Table index

Figure index

Appendices

1. Introduction

1.1 Project background

Cockburn Cement requires a flora, vegetation and fauna survey of two mining tenements (M 7000141 and M 7000138) at Wesco Road, Nowergup (Study Areas).

It is proposed that the sites will need to be cleared (total of 25.4 hectares (ha)) to facilitate the expansion of the limestone quarries and as such a flora, vegetation and fauna assessment report is required.

Cockburn Cement has commissioned GHD Pty Ltd (GHD) to conduct a flora, vegetation and fauna assessment for the northern tenement (Northern Study Area) and southern tenement (Southern Study Area) that will allow for the expansion works within both tenements.

1.2 Purpose of this report

The purpose of the survey is to assess the flora and fauna values of both Study Areas, in particular their spatial location and conservation significance. The report will document the potential impacts on flora and fauna from the proposed expansions and provide recommendations to mitigate impacts.

This report will be used to assist Cockburn Cement in assessing the proposed impact of the clearing of native vegetation at both sites to enable works to be undertaken in an environmentally sensitive manner.

1.3 Study Areas

The Study Areas are located in Nowergup, City of Wanneroo, approximately 40 kilometres (km) north of Perth, Western Australia. The Northern Study Area (tenement M 7000141) is 9.08 ha in area and the Southern Study Area (M 7000138) is 16.32 ha in area. The Study Areas are shown in Figure 1, Appendix A.

1.4 Scope of works

The scope of works for the Project is to conduct a flora, vegetation and fauna assessment, in accordance with best practice, within the Study Areas.

The scope of works as per the Project brief and GHD proposal was to:

- Undertake a desktop assessment
- Undertake a Level 2 vegetation and flora survey to provide:
  - Description and mapping of vegetation units and vegetation condition
  - Inventory of vascular flora taxa
  - Location and counts of conservation significant flora (Threatened and Priority Flora) and any Declared taxa
  - Preliminary identification of any Threatened or Priority Ecological Communities (TEC and/or PEC) through a PATN analyses
- Undertake a Dieback assessment based on the presence/absence of typical indicator species and mapping of potential Dieback areas (this is not a formal Dieback assessment consistent with Department of Parks and Wildlife (DPaW) requirements)

- Undertake a Level 1 fauna survey to provide:
  - Description and mapping of fauna habitat
  - Inventory of fauna recorded within the Study Areas
  - Detail of the presence or likelihood of occurrence of conservation significant fauna occurring within the Study Areas
  - Conduct a Black Cockatoo habitat assessment
- Prepare a flora and fauna report including the results of the desktop assessment and field surveys

1.5 Limitations

This report has been prepared by GHD for Cockburn Cement Ltd and may only be used and relied on by Cockburn Cement Ltd for the purpose agreed between GHD and the Cockburn Cement Ltd as set out in section 1.4 of this report.

GHD otherwise disclaims responsibility to any person other than Cockburn Cement Ltd arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services conducted by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by Cockburn Cement Ltd and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

The opinions, conclusions and any recommendations in this report are based on information obtained from, and testing conducted at or in connection with, specific sample points. Site conditions at other parts of the site may be different from the site conditions found at the specific sample points.

Investigations conducted in respect of this report are constrained by the particular site conditions, such as the location of buildings, services and vegetation. As a result, not all relevant site features and conditions may have been identified in this report.

Site conditions may change after the date of this Report. GHD does not accept responsibility arising from, or in connection with, any change to the site conditions. GHD is also not responsible for updating this report if the site conditions change.

1.6 Assumptions

This report has assessed the flora and fauna associated with the Study Areas (Figure 1, Appendix A). Should the Study Areas change, further assessment would be required.

2. Relevant legislation, conservation codes & background information

Table 1 provides a summary of Legislation, conservation codes and background information relevant to the Project. Further details on conservation codes and other background information are provided in Appendix B.

Table 1 Key relevant environmental Legislation

Legislation		Responsible Government agency	Aspect
State Legislation			
Agricultural and Related Resources Protection Act 1976	ARRP Act	Department of Agriculture and Food (WA)	Weeds and feral animals
Biosecurity and Agriculture Management Act (2007)	BAM Act	Department of Agriculture and Food (WA)	Weeds and feral animals
Environmental Protection Act 1986 (Part III) (the Environmental Protection (Swan Coastal Plain Lakes) Policy 1992 (SCPL))	EP Act	Department of Environment Regulation (DER) (formerly Department of Environment and Conservation – DEC)	Swan Coastal Plain Lakes
Environmental Protection Act 1986 (Part IV)	-	Office of the Environmental Protection Authority (OPEA)	Environmental impact assessment and management
Environmental Protection Act 1986 (Part V)	-	OEPA	Works Approvals and Licenses for Prescribed Premises
Environmental Protection (Clearing of Native Vegetation) Regulations 2004	-	Department of Environment Regulation (DER) (formerly DEC)	Clearing of native vegetation
Wildlife Conservation Act 1950	WC Act	Department of Parks and Wildlife (DPaW) (formerly DEC)	Protection of native wildlife
Federal Legislation			
Environment Protection and Biodiversity Conservation Act 1999	EPBC Act	Department of the Environment (DotE) (formerly the Department of Sustainability, Environment, Water, Population and Communities – DSEWPaC)	Matters of National Environmental Significance including listed threatened species, populations and ecological communities and migratory species

3. Methodology

3.1 Desktop assessment

A desktop review was conducted prior to the commencement of field surveys.

- A review of previous studies conducted in the vicinity of the Study Areas (provided by Cockburn Cement – see Table 6)
- A review of the Department of Parks and Wildlife (DPaW) (formerly Department of Environment and Conservation – DEC) NatureMap database (2007–) for flora and fauna species previously recorded within a 5 km buffer of the Study Areas
- A review of the DPaW Threatened Flora Database (DPaW, 2013a) for flora species previously recorded within a 5 km buffer of the Study Areas
- A review of the DPaW TEC and PEC databases to determine the potential for TEC or PEC to be present within the Study Areas (DPaW, 2013b and DPaW, 2013c)
- A review of Department of the Environment (DotE) (formerly the Department of Sustainability, Environment, Water, Population and Communities – DSEWPaC) Protected Matters database (DotE, 2013d) to identify flora and fauna species listed under the EPBC Act potentially occurring within 5 km of the Study Areas (DotE, 2013b)
- A review of the DPaW database of known records of Black Cockatoo roosting and nesting sites on the Swan Coastal Plain

3.2 Field survey

3.2.1 Flora & vegetation

GHD conducted a Level 2 flora and vegetation assessment in accordance with the Environmental Protection Authority (EPA) Guidance Statement 51 (EPA, 2004a) and Position Statement No. 3 (EPA, 2002), of both Study Areas on 25–27 November 2013. The survey was conducted to provide descriptions of the dominant vegetation types present, vegetation condition and flora species present at the time of the survey.

Field assessment methodology involved sampling using quadrats located in representative vegetation types and meandering transects of the Study Areas on foot to record plant species present (visible) at the time of the survey. Grid- based searches were conducted to allow for specific targeted searches for and mapping of the location of any Threatened, Priority Flora and any other flora of local or taxonomic significance. Opportunistic collections of plant species present (visible) at the time of the survey were also recorded.

Vegetation units were identified and boundaries delineated using a combination of aerial photography interpretation, topographical features, previous mapping (Beard, 1979 and Heddle et al., 1980) and field observations and were compared against Floristic Community Types (FCT) identified by Gibson et al., (1994) as present on the Swan Coastal Plain. Quadrat sampling sites were 10 m × 10 m in size and the position of each site was recorded using a handheld Global Positioning System (GPS) unit. The information presented in Table 2 was recorded for each quadrat. Vegetation units were described based on structure, dominant taxa and cover characteristics as defined by quadrat data.

Species that were well known to the survey botanists were identified in the field, while species that were unknown were collected and assigned a unique collection number to facilitate tracking. Plant species were identified by the use of local and regional flora keys and by comparison with the named species held at the Western Australian Herbarium (WA Herbarium). When necessary, plant taxonomists considered to be authorities on particular plant groups were consulted.

The conservation status of all recorded flora was compared against the current lists available on FloraBase (WA Herbarium, 1998–) and the EPBC Act Threatened species database provided by DotE (2013b).

Nomenclature used in the report follows that used by the Western Australian Herbarium as reported on FloraBase (WA Herbarium, 1998–).

Table 2 Data collected during the field survey

Aspect	Measurement
Physical features	Aspect, soil attributes. Percentage surface cover by: rocks, logs and branches, leaf litter, bare ground.
Location of important features	Coordinates recorded in GDA94 datum using a hand-held Global Positioning System (GPS) tool to accuracy approximately ± 5 m.
Vegetation condition	Vegetation condition was assessed using the condition rating scale devised by Keighery (1994).
Disturbance	Level and nature of disturbances (e.g. weed presence, fire and time since last fire, impacts from grazing, exploration activities).
Flora	List of dominant flora from each structural layer.

Vegetation condition

The vegetation condition of the Study Areas was assessed using the vegetation condition rating scale developed by Keighery (1994) that recognises the intactness of vegetation, which is defined by the following:

- Completeness of structural levels
- Extent of weed invasion
- Historical disturbance from tracks and other clearing or dumping
- The potential for natural or assisted regeneration

The scale consists of six rating levels as outlined in Table 3.

Table 3 Vegetation condition rating scale

Vegetation condition rating	Vegetation condition	Description
1	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.
4	Good	Vegetation structure significantly altered by very obvious signs of multiple disturbances retains basic vegetation structure or ability to regenerate it.
5	Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not in a state

Vegetation condition rating	Vegetation condition	Description
		approaching good condition without intensive management.
6	Completely Degraded	The structure of the vegetation is no longer intact and the area is completely or almost without native species.

(Keighery, 1994)

PATN Analysis

PATN analysis (furthest neighbour analysis on Bray–Curtis dissimilarity index) was used to generate an estimate of association between vegetation types by comparing species present within representative quadrats. The PATN classifies the quadrats into groups, condenses the information into three dimensions and displays the patterns graphically.

Data from GHD quadrats was analysed using PATN to assist in the determination of vegetation types, with those quadrats grouped together in PATN being typically assigned to the same vegetation type. The results of the PATN analysis were verified against field observations to derive the final vegetation types. As PATN compares the species present in each quadrat (and GHD has not included dominance) occasionally quadrats are grouped together due to similarities in the species complex which may appear distinctly different in the field (either based on dominance of key species, soils, landform or presence of disturbance factors). As a result, a degree of discretion is required when interpreting PATN outputs. In these instances, GHD has assigned the vegetation type based on field assessment not PATN results.

PATN analysis was used to compare the GHD quadrats to existing data (where available) for TEC/PEC of the Swan Coastal Plain. PATN is limited in use for this purpose as analysis is based on all species recorded in quadrats, includes introduced species and does not take into account dominance of species. Further interpretation of PATN results, coupled with field and desktop information is needed to determine whether the vegetation types are representative of a TEC or PEC.

Information from the Swan Coastal Plain dataset (Gibson et al., 1994) was extracted for each of the TEC/PEC identified during desktop searches. These TEC/PEC align with floristic community types (FCT) described and surveyed by Gibson et al., (1994). A representative sample of the FCT potentially found in the area was selected. The quadrats shown in Table 4 were used for each of the relevant FCT.

Table 4 List of Gibson et al., (1994) quadrats used in PATN analysis

Floristic Community Type	Quadrats
FCT 24, Northern Spearwood shrublands and woodlands	NEER-1, NEER 11
FCT26a, *Melaleuca huegelii - Melaleuca acerosa* (currently *M. systena*) shrublands on limestone ridges	SVH1, SHE-4
FCT 22, *Banksia ilicifolia* woodlands	DEJONG01, ELE- 23
FCT20a, *Banksia attenuata* woodlands over species rich dense shrublands	M53, maida01

3.2.2 Fauna

The fauna assessment was consistent with a Level 1 assessment (reconnaissance survey) in accordance with the EPA Guidance Statement No. 56 *Assessment of Environmental Factors for Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia* (EPA, 2004b). Nomenclature follows that used by the Western Australian Museum and the DPaW NatureMap database, as it is deemed to contain the most up-to-date species information for Western Australia, with the exception of birds, which uses Christidis and Boles (2008).

GHD ecologists conducted a reconnaissance fauna survey of the Study Areas on foot on 25–27th November 2013. A fauna habitat assessment was undertaken which assessed:

- Habitat structure (e.g. vegetation type, presence/absence of overstorey, midstorey, understorey, ground cover)
- Presence/absence of refuge including: fallen timber (coarse woody debris), hollow-bearing trees and stags and rocks/boulder piles, and the type and extent of each refuge
- Presence/absence of waterways including type, extent and habitat quality within waterways
- Land use or disturbance history
- Location of habitat within the surrounding landscape and habitat connectivity
- Identification of wildlife corridors within and immediately adjacent Study Areas
- Evaluation of the likelihood of occurrence of listed fauna occurring within the habitat (based on presence of suitable habitat).

Opportunistic fauna searches were also conducted across the Study Areas. Opportunistic searches involved:

- Searching through microhabitats including turning over logs or rocks, turning over leaf litter and examining tree hollows and hollow logs
- Visual and aural surveys. This accounted for many bird species potentially utilising the Study Areas
- Searching the Study Areas for tracks, scats, bones, diggings and feeding areas for both native and feral fauna

A general assessment of the potential for Black Cockatoo habitat within the Study Areas was also conducted. The Black Cockatoo assessment was undertaken according to the EPBC Act Referral Guidelines for three threatened Black Cockatoo species: Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*), Baudin's Black Cockatoo (*Calyptorhynchus baudinii*) and Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii* subsp. *naso*) (DSEWPaC, 2012). Information collected during the field survey included:

- Identification of foraging habitat: the location and extent of suitable Black Cockatoo foraging habitat was identified and mapped for the Study Areas, based on the vegetation associations and presence/absence of known foraging species. During the field surveys any direct or indirect evidence of foraging by cockatoos was recorded.
- Identification of potential breeding habitat: suitable breeding habitat for Black Cockatoos is defined by DSEWPaC (2012) as trees of species known to support breeding within the range of the species which either have a suitable nest hollow or are of a suitable diameter at breast height (DBH) to develop a nest hollow. For most tree species, suitable DBH is

500 mm. For salmon gum and wandoo, suitable DBH is 300 mm (DSEWPaC, 2012). The location of all suitable breeding trees was recorded in the Study Areas and referred to as 'Significant Trees'. Additionally details of tree species, size and number of hollows observed, evidence of use and any other significant observations were recorded for each tree.

- Identification of night roosting habitat: suitable roosting habitat is defined by (DSEWPaC, 2012). Suitable roosting habitat was identified based on the presence of suitable tall trees, proximity of known roosting sites (Department of Planning Western Australia, 2011) and the presence of suitable foraging habitat.
- Opportunistic observations (both visual and aural) for the presence of Black Cockatoos within the Study Areas and surrounding region were also noted during the survey.

The above information was used to map and calculate the amount of foraging habitat, potential breeding habitat and roost sites within the Study Areas.

3.3 Limitations

3.3.1 Desktop investigation limitations

Queries of the DotE Protected Matters database (the Protected Matters Search Tool – PMST) is used to identify species listed under the EPBC Act and draws on various sources to report on the potential of the species occurrence within an area. The database is based on bioclimatic modelling for the potential presence of species. As such, this does not represent actual records of the species within the area. Additionally, it is broad-scale in its reporting and often the specific habitat requirements of the species do not occur, or are unlikely to occur, within Study Areas. For this reason not all species reported by the search tool need to be considered in management decisions. The DPaW NatureMap database reports on actual records of the species within the designated area and can provide more accurate information of the likelihood of species presence. However, some records of collections, sightings or trappings can be dated and often misrepresent the current range of threatened species. Neither database can be considered exhaustive. Species of conservation significance may be found during surveys that are not listed in the databases.

3.3.2 Field survey limitations

The limitations surrounding the flora and fauna survey are provided in Table 5.

Table 5 Field survey limitations

Limitation	Constraint	Impact on survey outcomes
Sources of information and availability of contextual information	Nil	Adequate flora and vegetation information is available for the Study Areas, this includes: • Broad scale (1:250,000) mapping by Beard (1979) and Shepherd et al. (2002) • Broad scale (1:250,000) mapping by Heddle et al. (1980) • FloraBase records (WA Herbarium, 1998–) • Threatened and Priority Ecological Community records (DPaW, 2013b and 2013c) • Threatened flora records (DPaW, 2013a) • NatureMap records (DPaW, 2007–) (also includes fauna records) • Vegetation extents (Government of Western Australia, 2013 and EPA, 2006a) Suitable habitat mapping and database records for most fauna species (and some flora species) is often lacking and not verified by the appropriate authority.
Scope (i.e. what life forms were sampled etc.)	Nil	Vascular flora and vertebrate fauna taxa were sampled during the survey. Non-vascular flora and invertebrate fauna taxa were not assessed as part of the survey.
Proportion of flora collected and identified (based on sampling, timing and intensity).	Minor	The flora recorded from the field survey is detailed in Section 5.9 and a full flora species list provided in Appendix D. A total of 131 taxa representing 37 families and 87 genera were recorded during the survey. Due to the absence of adequate flowering parts and/or fruiting bodies required for identification, 6 taxa could not be identified to genera level. In addition, 13 species were only tentatively identified to species and many herbs and grasses were too immature to be identifiable. The Level 2 survey was conducted at the end of November, 2013, which is at the end of the optimal spring survey season. As Such, there may have been a number of species (including orchids) that may have senesced.
Flora determination	Nil	Flora determination was undertaken by GHD ecologists in the field and in consultation with staff at the WA Herbarium (as necessary). The taxonomy and conservation status of the Western Australian flora is dynamic. This report was prepared with reliance on taxonomy and conservation current at the time issuing, but it should be noted this may change.

Limitation	Constraint	Impact on survey outcomes
Completeness and further work which might be needed (e.g. was the relevant area fully surveyed?)	Minor	The entire Study Areas were accessible during the field survey. It is considered that many of the taxa identifiable at the time of the survey would have been observed. It is anticipated that, due to the surveys being conducted in late spring, there may have been be a number of species (including orchids) that may have senesced. The Gibson et al., (1994) "*analysis of plant communities on the Swan Coastal Plain is the most recent regional floristic work on public lands,* [and considers] *the patterning of plant distribution on the Plain and relates to the total flora of the Plain*" (Government of Western Australia, 2000). Floristic Community Types (FCT) are based on the results of multivariant analysis conducted on 1122 quadrats. Comparison of vegetation identified at the Study Areas against FCTs identified by Gibson et al., (1994) can assist in determining the presence of a TEC or PEC. The vegetation types identified within the Study Areas have been aligned with various FCTs. Although, clarification with the Department of Parks and Wildlife (DPaW) is often recommended for certainty. In addition, FCTs cannot be definitively determined when the remaining vegetation has been too disturbed to sample adequately or not enough information about the vegetation can be obtained (Government of Western Australia, 2000).
Mapping reliability	Nil	The vegetation of the Study Areas was mapped at a scale of 1:2,000 using aerial photography captured in 2014 (Landgate: Landgate: Metro North Mosaic - 2013). As the majority of the Study Areas had not been burnt for over five years, fire is not considered to have an impact upon the vegetation type or condition identified during the survey.
Timing, weather, season	Minor	The vegetation survey was conducted in late spring, which is the optimal time for identifying many flowering species (e.g. shrubs, herbs, sedges and grasses). In addition, many annual species (e.g. orchids) would have emerged. Species that have a very low abundance in the area are more difficult to locate, due to the aforementioned factors. Flora composition changes over time, with flora species having specific growing periods, especially annuals and ephemerals (some plants lasting for a markedly brief time, some only a day or two). Therefore, the results of future botanical surveys in this location may differ from the results of this survey. Complete flora and fauna surveys can require multiple surveys, at different times of year, and over a period of a number of years, to enable observation of all species present. In the rainfall season (June–September 2013), the Gingin Aero Bureau of Meteorology weather station (station number 9178) (located 21.3 km from the Study Areas) recorded 494.4 mm of rainfall (BoM, 2013). This is 13 % higher than the long term average (438.2 mm) for the same period (BoM, 2013). No survey days experienced rain.

Limitation	Constraint	Impact on survey outcomes
Disturbances (fire, flood, accidental human intervention etc)	Nil	As the Study Areas are within the Perth metropolitan region, humans and domestic animals (especially dogs and cats) are a frequent occurrence. It is not considered that these disturbances impacted the survey.
Intensity (in retrospect, was the intensity adequate?)	Nil	The Study Areas were sufficiently covered by GHD ecologists for a Level 2 survey with a total of ten quadrats described within the Study Areas. The fauna assessment conducted was a reconnaissance (Level 1) survey only and thus only sampled those species that can be easily seen, heard or have distinctive signs, such as tracks, scats, diggings etc. Many cryptic and nocturnal species would not have been identified during a reconnaissance survey and seasonal variation within species often requires targeted surveys at a particular time of the year. The fauna assessment was aimed at identifying habitat types and terrestrial vertebrate fauna utilising the Study Areas. No sampling for invertebrates or aquatic species occurred. The information available on the identification, distribution and conservation status of invertebrates is generally less extensive than that of vertebrate species.
Resources	Nil	Adequate resources were employed during the survey. Four people days were spent conducting the flora and fauna surveys.
Access problems	Nil	The entire Study Areas was accessible.
Experience levels	Nil	The ecologists who executed the survey were practitioners suitably qualified in their respective fields.

4. Summary of previous surveys

Surveys of the flora and fauna of the Nowergup area have been conducted by a number of environmental consultancies. Five previous flora and fauna surveys which have been undertaken in the vicinity of the Study Areas (provided by Cockburn Cement) have been reviewed and summarised. The previous survey reports used in this report are listed in Table 6.

Table 6 Summary of previous flora & fauna survey reports used in this report

Consultancy	Date	Report name
Coffey Environments	2011	Flora and vegetation assessment M70/013 Hopkins Road, Nowergup. Prepared for Limestone Building Block Company.
Coffey Environments	2010a	Flora and vegetation assessment, M70/138 Hopkins Road, Nowergup. Prepared for Cockburn Cement
Coffey Environments	2010b	Flora and vegetation assessment, M70/339 Hopkins Road, Nowergup. Prepared for Limestone Building Block Company.
Western Wildlife	2008a	Limestone Building Block Company tenements M70/013 and M70/339, Hopkins Rd, Nowergup, Fauna assessment. Prepared for Limestone Building Block Company.
Western Wildlife	2008b	Cockburn Cement, Tenement M70/138, Nowergup, Fauna assessment. Prepared for Cockburn Cement.

Flora and vegetation assessment M70/013 Hopkins Road, Nowergup (Coffey Environments, 2011)

Coffey Environments (2011) conducted a flora and vegetation assessment of a 14 ha mining lease located approximately 300 m north of the Northern Study Area, and 2.1 km north of the Southern Study Area. The survey consisted of a desktop assessment, Level 2 flora and vegetation assessment (11 November 2010) to determine dominant vegetation types, vegetation condition and flora species present, and a discussion on potential impacts and recommendations.

Two vegetation types were identified within the site during the 2010 survey, comprising Open Woodland to Woodland of *Eucalyptus marginata* over Low Woodland of *Banksia attenuata* (EmBa) (approximately 60 % of the site), and Closed Tall Scrub of *Banksia sessilis* over Open Shrubland to Tall Shrubland of *Xanthorrhoea preissii* (BsXp) (approximately 30 % of the site). The condition of the site varied from *Very Good–Excellent* to *Excellent*, with a small area previously cleared (*Completely Degraded–Degraded*).

Vegetation type BsXp appears to align with Floristic Community Types (FCT) 24 (Northern Spearwood shrublands and woodland – DPaW Priority 3 PEC). Vegetation type EmBa aligns with FCT 28 (Spearwood *Banksia attenuata* or *Banksia attenuata–Eucalyptus woodlands* – no conservation significance).

Of the 118 flora species recorded during the survey, 100 were native and 18 were introduced species. No Threatened flora species were recorded. However, 700 plants of the DPaW Priority

4 species, *Jacksonia sericea*, were recorded in association within previously disturbed areas along tracks. In addition, three other species listed as Bush Forever significant flora species of the Spearwood Dunes (*Acacia alata* var. *tetrantha*, *Lechenaultia linearis*, and *Petrophile axillaris*) were recorded from the site.

Flora and vegetation assessment, M70/138 Hopkins Road, Nowergup (Coffey Environments, 2010a)

Coffey Environments (2010a) conducted a flora and vegetation assessment of an 8 ha mining lease located approximately 2 km south of the Northern Study Area, and 500 m east of the Southern Study Area. The survey consisted of a desktop assessment, Level 2 flora and vegetation assessment (two phases: 30 September–1 October 2009 and 24 November 2009) to determine dominant vegetation types, vegetation condition and flora species present, and a discussion on potential impacts and recommendations.

Eight vegetation types were identified within the site during the 2009 survey:

- Closed Tall Scrub of *Melaleuca systena* (CTSMs)
- Open Forest of *Corymbia calophylla* (OFCc)
- Open Heath of *Melaleuca systena* (OHMs)
- Open Woodland of *Corymbia calophylla* (OWCc)
- Tall Open Scrub of *Melaleuca huegelii* and *Melaleuca* sp. Wanneroo (G.J. Keighery 16705) (TOSMh)
- Tall Open Scrub of *Xanthorrhoea preissii*, *Banksia sessilis* and *Hakea trifurcata* (TOSXpBs)
- Tall Open Shrubland of *Xanthorrhoea preissii* and *Melaleuca huegelii* (TOSXpMh)
- Tall Shrubland of *Xanthorrhoea preissii* and *Banksia sessilis* (TSXpBs)

The vegetation of the site was in *Excellent* condition, with small areas of disturbance.

Vegetation types TOSMh and OHMs appear to align with FCT 24 (Northern Spearwood shrublands and woodland – DPaW Priority 3 PEC) and 26a (Limestone ridges: *Melaleuca huegelii – M. acerosa* [currently *M. systena*] – State Endangered TEC). Vegetation types CTSMs, TOSXpBs, TSXpBs and TOSXpMh appear to align with FCT 24 and FCT 27 (Species poor mallees and shrublands on limestone). The remaining vegetation types (OWCc and OFCc) appear to align with FCT 28 (Spearwood *Banksia attenuata* or *Banksia attenuata–Eucalyptus* woodlands – no conservation significance).

Of the 141 flora species recorded during the survey, 119 were native and 22 were introduced species. No Threatened flora species were recorded. However, two Priority species were recorded within the site. Over 40 plants of the DPaW Priority 1 species, *Melaleuca* sp. Wanneroo (G.J Keighery 16705), were recorded within vegetation types TOSMh and TOSXpMh. A total of 43 plants of the DPaW Priority 4 species, *Jacksonia sericea*, were recorded in association with previously disturbed areas along tracks. In addition, three other species listed as Bush Forever significant flora species of the Spearwood Dunes (*Acacia alata* var. *tetrantha*, *Eucalyptus foecunda*, and *Petrophile axillaris*) were recorded from the site.

One weed declared under the repealed *Agriculture and Related Resources Protection Act 1976* (*Moraea flaccida* – Cape Tulip) was recorded.

Flora and vegetation assessment, M70/339 Hopkins Road, Nowergup (Coffey Environments, 2010b)

Coffey Environments (2010b) conducted a flora and vegetation assessment of a 17 ha mining lease located approximately 2.3 km north of the Northern Study Area, and 3.6 k m north of the Southern Study Area. The survey consisted of a desktop assessment, Level 2 flora and vegetation assessment (two phases: 2 and 12 October 2009, and 24 November 2009) to determine dominant vegetation types, vegetation condition and flora species present, and a discussion on potential impacts and recommendations.

Six vegetation types were identified within the site during the 2009 survey:

- Low Woodland of *Eucalyptus marginata*, *Allocasuarina fraseriana* and *Banksia attenuata* (LWEm)
- Open Heath of *Melaleuca systena* and *Acacia rostellifera* (OHMs)
- Open Woodland of *Eucalyptus gomphocephala* (OWEg)
- Regrowth/rehabilitated vegetation (Reg)
- Tall Open Scrub of *Xanthorrhoea preissii*, *Acacia rostellifera* and *Banksia sessilis* (TOSXp)
- Tall Shrubland of *Melaleuca systena* (TSMs)
- Woodland of *Eucalyptus gomphocephala* (WEg)

The site was in *Excellent* to *Degraded–Completely Degraded* condition, with some vegetation in *Excellent* condition with minor weed invasion.

Vegetation types OHMs and TSMs appear to align with FCT 24 (Northern Spearwood shrublands and woodland – DPaW Priority 3 PEC) and 26a (Limestone ridges: *Melaleuca huegelii – M. acerosa* [currently *M. systena*] – State Endangered TEC). Vegetation types OWEg and TOSXp appear to align with FCT 24 and FCT 28 (Spearwood *Banksia attenuata* or *Banksia attenuata–Eucalytpus* woodlands – no conservation significance). The remaining vegetation types (LWEm and WEg) appear to align with FCT 28.

Of the 157 flora species recorded during the survey, 122 were native and 35 were introduced species. No Threatened flora species were recorded. However, two Priority species were recorded within the site. A total of 15 plants of the DPaW Priority 3 species, *Stylidium maritimum*, were recorded within vegetation type TSMs along the limestone ridge. Approximately 113 plants of the DPaW Priority 4 species, *Jacksonia sericea*, were recorded in association with previously disturbed areas along tracks. In addition, three other species listed as Bush Forever significant flora species of the Spearwood Dunes (*Conospermum triplinervium*, *Glischrocaryon aureum*, and *Petrophile axillaris*) were recorded from the site, with a further two possibly occurring (*Astroloma microcalyx* and *Conostylis aculeata* subsp. *cygnorum*). However, these two were not able to be identified to the appropriate level for certainty.

One weed declared under the repealed Agriculture and Related Resources Protection Act 1976 and listed as a Weed of National Significance (WoNS) (*Asparagus asparagoides* – Bridal Creeper) was recorded.

Limestone Building Block Company tenements M70/013 and M70/339, Hopkins Rd, Nowergup, Fauna assessment (Western Wildlife, 2008a)

Western Wildlife (2008a) conducted a fauna assessment of two mining tenements (M70/013: 14 ha site located approximately 300 m north of the Northern Study Area, and 2.1 km north of the Southern Study Area; M70/339: 17 ha site located approximately 2.3 km north of the Northern Study Area, and 3.6 k m north of the Southern Study Area). The survey consisted of a desktop assessment, Level 1 fauna assessment (15 September 2008) to determine fauna habitats available at the site, prepare a list of vertebrate fauna species (including fauna species of conservation significance), and make recommendations on fauna management for the sites.

M70/339 consisted of Limestone Closed Shrubland and Banksia/Eucalypt woodland. M70/013 consisted of Banksia/Eucalypt woodland only.

No frogs were observed during the site visit. No frogs of conservation significance were recorded or expected to occur on either site.

No reptiles were observed during the site visit. Seven reptiles of conservation significance (including one listed under the WC Act, one DPaW Priority species and five species considered to be of local significance) may occur on either site. However, as the sites are relatively small, they are likely to only support a small number of individuals of large species such as the Black-tailed Monitor or Yellow-faced Whipsnake.

A total of 23 bird species were observed during the site visit. A total of 34 birds of conservation significance (including five species protected under State and/or Federal legislation, and 29 species considered to be of local significance) potentially occur on the sites. The Threatened Carnaby's Black Cockatoo may breed in the local area and within two larger hollows present within M70/339. A total of 12 bird species considered to be of local significance were observed during the site visit.

A total of three mammal species were observed during the site visit. A total of six mammals of conservation significance (including three DPaW Priority species, and three species considered to be of local significance) potentially occur on the sites.

Two Threatened invertebrates were identified as potentially present within the sites (one of which – the Graceful Sunmoth – has been downgraded to DPaW Priority 4). A further three DPaW Priority species may occur within the sites.

Cockburn Cement, Tenement M70/138, Nowergup, Fauna assessment (Western Wildlife, 2008b)

Western Wildlife (2008b) conducted a fauna assessment of an 8 ha mining lease located approximately 2 km south of the Northern Study Area, and 500 m east of the Southern Study Area. The survey consisted of a desktop assessment, Level 1 fauna assessment (15 September 2008) to determine fauna habitats available at the site, prepare a list of vertebrate fauna species (including fauna species of conservation significance), and make recommendations on fauna management for the site.

The site consisted of Limestone Closed Shrubland and Banksia/Eucalypt woodland in generally good condition.

No frogs were observed during the site visit. No frogs of conservation significance were recorded or expected to occur on either site.

No reptiles were observed during the site visit. Seven reptiles of conservation significance (including one listed under the WC Act, one DPaW Priority species and five species considered to be of local significance) may occur on either site. However, as the sites are relatively small, they are likely to only support a small number of individuals of large species such as the Black-tailed Monitor or Yellow-faced Whipsnake.

A total of 13 bird species were observed during the site visit. A total of 34 birds of conservation significance (including five species protected under State and/or Federal legislation, and 29 species considered to be of local significance) potentially occur on the sites. The Threatened Carnaby's Black Cockatoo may breed in the local area although no suitable hollow-bearing trees were present within the site. A total of three species considered to be of local significance were observed during the site visit.

No mammal species were observed during the site visit. A total of six mammals of conservation significance (including three DPaW Priority species, and three species considered to be of local significance) potentially occur on the sites.

Two Threatened invertebrates were identified as potentially present within the sites (one of which – the Graceful Sunmoth – has been downgraded to DPaW Priority 4). A further three DPaW Priority species may occur within the sites.

4.1 Summary of results

It should be noted that differences in survey type, survey timing, extent and the size and location of each study area will have influenced the results. It is considered possible that flora species recorded during previous surveys will occur within the Study Areas. Due to the close proximity (between 300 m and 3.6 km), the vegetation types (especially potential TEC and PEC) identified within each previous study have been considered in the assessment of the Northern and Southern Study Areas. Due to the highly mobile nature of reptiles, birds and mammals, it is considered that the fauna species recorded in previous surveys are highly likely to occur within the Study Areas, even if the habitat types are different to those of the Study Areas.

5. Results

5.1 Bioregion

The Study Areas are located within the Swan Coastal Plain Interim Biogeographic Regionalisation of Australia (IBRA) Bioregion, Perth Sub-Region (SWA02). This sub-region is dominated by woodlands of *Banksia* and Tuart (*Eucalyptus gomphocephala*) on sandy soils, sheoak on outwash plains, and paperbark in swampy areas. The colluvial and aeolian sand areas represent three phases of Quaternary marine sand dune development (which provide relief), and include a complex series of seasonal fresh water wetlands, alluvial river flats, coastal limestone and several off-shore islands. Younger sandy areas and limestone are dominated by heath and/or Tuart woodlands, while *Banksia* and Jarrah (*E. marginata*)–*Banksia* woodlands are found on the older dune systems (Mitchell et al., 2002).

5.2 Climate

The Study Areas experience a Mediterranean climate, with mild wet winters and hot dry summers. The closest Bureau of Meteorology (BoM) weather station to the Study Areas is located 21.3 km from the Study Areas at Gingin Aero (station number 9178). A summary of the climatic data (BoM, 2013) for this weather station is below:

- Mean maximum temperature: 18.3 °C (July) to 33.3 °C (February)
- Mean minimum temperature: 6.1 °C (July) to 17.0 °C (February)
- Mean annual rainfall: 661.6 mm

5.3 Environmentally Sensitive Areas

The Northern Study Area is located within an Environmentally Sensitive Area (ESA), which relates to a Bush Forever site Hopkins Road Bushland, Nowergup (Site 290). (see Section 5.4). A small ESA is located within the north west section of the Southern Study Area which relates to the location of Threatened flora located adjacent to the Southern Study Area. The ESA is located within a highly disturbed area within the Southern Study Area. (Figure 2, Appendix A).

5.4 Reserves & conservation areas

The Northern Study Area is located within the DPaW-managed Gnangara-Moore River State Forest. No DPaW-managed reserves were located within the Southern Study Area. (Figure 2, Appendix A).

The Northern Study Area is located within Bush Forever site Hopkins Road Bushland, Nowergup (Site 290). Both Study Areas are within 1 km of Bush Forever site 136 (State Forest 65 – Pinjar Plantation South Bushland, Nowergup/Yanchep/Neerabup) (Figure 2, Appendix A). Details of these Sites are provided in Table 7.

Table 7 Bush Forever sites and details in the vicinity of the Study Areas

Site number	Site name	Size (ha)	Landscape features	Selection criteria met	Bush Forever recommendation	Linkages
290	Hopkins Road Bushland, Nowergup	406.9	Limestone ridge, vegetated uplands	Representation of ecological communities, Rarity	Site with Some Existing Protection; existing care, control and management of this Site is endorsed (proposed 'Gnangara Park').	Adjacent bushland to the south (to Site 293) and west.
136	State Forest 65 – Pinjar Plantation South Bushland, Nowergup/Yanchep/ Neerabup	61.5	Vegetated wetland, vegetated uplands	Representation of ecological communities, General criteria for the protection of wetland, streamline and estuarine fringing and coastal vegetation, Criteria not relevant to determination of regional significance, but which may be applied when evaluating areas with similar values.	Sites with Some Existing Protection; the existing care, control and management of these Sites is endorsed (proposed 'Gnangara Park').	Generally no adjacent bushland except for south of Site 135 (Site 293), north and south of Site 428 (Site 444, area outside Site), south of Site 444 (Site 428), south of Site 455 (Site 457 across road), north of Site 457 (Site 455).

5.5 Wetlands

5.5.1 Ramsar wetlands

There are no Ramsar wetlands located within 5 km of the Study Areas (DotE, 2013e). The nearest Ramsar wetland (Forrestdale and Thomsons Lakes) is located approximately 50 km south of the Study Areas.

5.5.2 Nationally important wetlands

There are no nationally important wetlands within 5 km of the Study Areas (DotE, 2013b). The nearest nationally important wetlands are located approximately 9 km south (Lake Joondalup) and 12 km north (Loch McNess System) of the Study Areas.

5.5.3 Lakes covered under the *Environmental Protection (Swan Coastal Plain Lakes) Policy 1992*

No EPP lakes are located within the Study Areas (Figure 2, Appendix A).

5.5.4 Geomorphic wetlands

There are no geomorphic wetlands located within the Study Areas. There is one Resource Enhancement Dampland, Camel Swamp (UFI 7938), located within approximately 1 km of both the Study Areas (Figure 2, Appendix A).

5.6 Broad vegetation types and extent

Broadscale vegetation mapping of the area (mapped by Beard, 1979 and digitised by Shepherd et al., 2002) identified the following vegetation association as present within the Study Areas:

- Low woodland; banksia (association 949)

The Heddle et al., (1980) mapping identified the following vegetation complex as present within the Study Areas (Government of Western Australia, 2000) (Figure 2, Appendix A):

- Spearwood dunes: *Cottesloe complex – central and south (complex 52):* Mosaic of woodland of *Eucalyptus gomphocephala* [tuart] and open forest of *E. gomphocephala* – *E. marginata* [jarrah] – *E. calophylla* [now *Corymbia calophylla*] [marri]; closed heath on the Limestone outcrops

Beard mapping has been adapted and digitised by Shepherd et al., (2002). The extent of Beard's (1979) vegetation associations have been determined by the state-wide vegetation remaining extent calculations maintained by DPaW (latest update 2012 – Government of Western Australia 2013)), The Local Biodiversity Program (2013) and Perth Biodiversity Project (2010) assess the extent of Heddle (1980) associations remaining. As indicated in Table 8 and Table 9, the remaining extents of Beard (1979) vegetation association 949 and Heddle et al., (1980) vegetation complex 52 are greater than the 30 percent threshold level of their pre-European extents at all levels.

Table 8 Extent of Beard (1979) vegetation associations within the Study Areas

Vegetation association	Scale	Pre-European extent (ha)	Current extent (ha)	Percent remaining	Percent current extent protected (IUCN I–IV) for conservation (proportion of pre-European extent)
Low woodland; banksia (association 949)	State	218,193.94	124,116.74	56.88	13.77
	Swan Coastal Plain IBRA bioregion	209,983.25	121,247.44	57.74	13.91
	Perth IBRA sub-region	184,475.82	105,107.74	56.98	14.88
	City of Wanneroo	37,138.47	17,641.75	47.50	8.56

(Beard, 1979; Government of Western Australia, 2012 and 2013; Shepherd et al., 2002)

Table 9 Extent of Heddle et al., (1980) vegetation complexes within the Study Areas

Vegetation complex description	Scale	Total pre-European extent (ha)	Present extent (ha)	Percent of pre-European extent remaining	Percent of pre-European extent with formal & informal protection
Cottesloe complex – central and south (complex 52)	Swan Coastal Plain[i]	44,899.92	15,815.73	35.22	18.32
	City of Wanneroo[ii]	13,310	6122.77	46.00	17.48

(Heddle et al., 1980)

[i] Local Biodiversity Program (2013)
[ii] Perth Biodiversity Project (2010)

5.7 Vegetation types & condition

5.7.1 Vegetation type

The Northern Study Area is predominantly vegetated with native vegetation consisting of two vegetation types: '*Melaleuca huegelii* Tall Open Scrub' and '*Banksia sessilis* Tall Shrubland'

The Southern Study Area has been cleared in the northern section of the Study Area, as part of previous limestone quarry works. The remaining native vegetation consists of one vegetation types, *Melaleuca systena* Open Heath (14.55 ha).

The vegetation types of both Study Areas are generally associated with the landform upon which they lie; heaths on shallow soils on hilltops and ridges.

The vegetation types of the Study Areas are mapped in Figure 3, Appendix A and described in more detail in Table 10

Table 10 Vegetation types within the Study Areas

Broad vegetation type	Vegetation type	Area of Study Areas (ha)	Location	Potential corresponding Gibson et al. (1994) vegetation complex based on field notes	Indicative photograph
Melaleuca huegelii Tall Open Scrub	Tall Open Scrub of *Melaleuca huegelii* over Open Heath of *Melaleuca systena* and *Xanthorrhoea preissii* over Low Shrubland of *Hibbertia hypericoides*, *Banksia sessilis* and *Hardenbergia comptoniana* over Herbland of *Desmocladus* spp., *Cassytha racemosa* and *Conostylis candicans* subsp. *calcicola*	1.85	Northern Study Area	FCT 26a: *Melaleuca acerosa* [now *M. systena]/M. huegelii* shrublands on limestone ridges (Endangered TEC)	
Banksia sessilis Tall Shrubland	Tall Shrubland of *Banksia sessilis* and *Xanthorrhoea preissii* over Open Heath of *Calothamnus quadrifidus*, *Melaleuca systena* and *Hakea trifurcata* over Open Low Heath of *Hibbertia hypericoides*, *Jacksonia calcicola* and *Hemiandra glabra* over Very Open Grassland of **Briza* spp. over Very Open Herbland of *Daucus glochidiatus* and *Conostylis candicans* subsp. *calcicola* over Open Sedgeland of *Mesomelaena pseudostygia*	6.95	Northern Study Area	FCT 24: Northern Spearwood Shrublands and Woodlands (Priority 3)	

Broad vegetation type	Vegetation type	Area of Study Areas (ha)	Location	Potential corresponding Gibson et al. (1994) vegetation complex based on field notes	Indicative photograph
Melaleuca systena Open Heath	Tall Open Shrubland of *Xanthorrhoea preissii* over Open Heath of *Melaleuca systena*, *Banksia sessilis* and *Calothamnus quadrifidus* over Open Low Heath of *Hibbertia hypericoides, Hardenbergia comptoniana* and *Grevillea preissii* over Very Open Grassland of **Briza* spp. and **Ehrharta calycina* over Open Herbland of **Lysimachia arvensis, Desmocladus* spp. and *Lomandra hermaphrodita* over Open Sedgeland of *Mesomelaena pseudostygia*	14.55	Southern Study Area	FCT 24: Northern Spearwood Shrublands and Woodlands (Priority 3)	
Highly Degraded	Areas where clearing or other activities have fundamentally altered the composition of native vegetation and are not in a condition of self-sustaining. These areas are completely or almost completely without native species. Some scattered native trees (*Eucalyptus* spp.) and shrub species may remain with an understorey dominated by introduced grasses (or crop species) and herbs	2.05	Occurs throughout both Study Areas		

5.7.2 Vegetation condition

The vegetation condition of the Northern Study Area ranged from *Pristine* (1) to *Completely Degraded* (6) (Figure 4, Appendix A). Areas adjacent to the limestone quarry were considered to be *Completely Degraded* (6) (0.28 ha). Vegetated areas in the southern section of the Northern Study Area consisted of native vegetation in predominantly *Excellent* (2) to *Very Good* condition (3) (6.57 ha). Scattered weeds and tracks were present throughout these areas. The vegetation in the northern section of the Northern Study Area was in *Pristine* (1) condition (1.39 ha).

The vegetation condition of the Southern Study Area ranged from *Pristine* (1) to *Completely Degraded* (6). The northern section of the Southern Study Area was in *Completely Degraded* (6) condition, as it has been cleared in the past for limestone quarry works (1.77 ha). Native vegetation adjacent to the limestone quarry (to the north) and paddocks (to the west), was mostly in *Very Good* (3) to *Degraded* (5) condition. Weeds, previous clearing and tracks were present throughout this section of the Southern Study Area. The remaining native vegetation within the Southern Study area was predominantly in *Pristine* (1) to *Excellent* (2) condition (10.88 ha).

5.8 Threatened & Priority Ecological Communities

Desktop investigations (DotE, 2013b; DPaW, 2013b; and DPaW 2013c) identified four TECs (of which two are listed under the EPBC Act) and two PECs that occur within 5 km of both Study Areas (Table 11). The remnant vegetation of the Study Areas may align with Gibson et al., (1994) vegetation complexes: FCT 26a: *Melaleuca acerosa* [now *M. systena]/M. huegelii* shrublands on limestone ridges (Endangered TEC) and FCT 24: Northern Spearwood Shrublands and Woodlands (Priority 3), as indicated in Table 10.

TECs and PECs located within 5 km of the Study Areas are mapped in Figure 2, Appendix A.

Table 11 Conservation significant communities occurring & possibly occurring within the Study Areas

Conservation significant community	Status		Description (DPaW, 2013b and 2013c)	Desktop
	State (DPaW listing)	Federal (EPBC Act listing)		
Melaleuca huegelii - Melaleuca acerosa (currently M. *systena*) shrublands on limestone ridges (Gibson et al. 1994 type 26a)	Endangered TEC		This community corresponds to Gibson et al. (1994) SCPFCT 26a.	Twenty two occurrences of this TEC lie within 5 km of both Study Areas (DPaW, 2013c)
Aquatic Root Mat Community Number 1 of Caves of the Swan Coastal Plain	Critically Endangered TEC	Endangered TEC	This community occurs in Yanchep caves, at the junction of the Bassendean sands and Tamala Limestone (Spearwood Dunes). The Aquatic Root Mat Community consists of tree roots that form thick mats in the caves. Roots belong to the Tuart trees (English et al. 2000)	Three occurrences of this TEC lie within 5 km of both Study Areas (DPaW, 2013c)
Banksia attenuata woodland over species rich dense shrublands	Endangered TEC		This community corresponds to Gibson et al. (1994) SCPFCT 20a.	One occurrence of this TEC lies within 5 km of both Study Areas (DPaW, 2013c)
Shrublands on dry clay flats	Endangered TEC	Critically Endangered TEC	The ecological community is comprised of seasonal wetlands found on clay substrates that rely solely on rainfall to fill and then dry to impervious pans in summer. The ecological community generally occurs as a shrubland (less commonly as a low, open woodland or herbland) over a ground layer of geophytes, herbs and sedges which are characteristic of the wetter parts of the sites (Commonwealth of Australia, 2012) This community corresponds to Gibson et al. (1994) SCPFCT 10a.	One occurrence of this TEC lies within 5 km of both Study Areas (DPaW, 2013c)

Conservation significant community	Status		Description (DPaW, 2013b and 2013c)	Desktop
	State (DPaW listing)	Federal (EPBC Act listing)		
Northern Spearwood Shrublands and Woodlands	Priority 3 PEC		Heaths with scattered *Eucalyptus gomphocephala* occurring on deeper soils north from Woodman Point. Most sites occur on the Cottesloe unit of the Spearwood system. The heathlands in this group typically include *Dryandra sessilis* [now *Banksia sessilis*], *Calothamnus quadrifidus* and *Schoenus grandiflorus* (DPaW, 2013). This community corresponds to Gibson et al. (1994) SCPFCT24.	Thirteen occurrences of this PEC lie within 5 km of both Study Areas (DPaW, 2013b).
Banksia ilicifolia woodlands	Priority 3 PEC		Low lying sites generally consisting of *Banksia ilicifolia – B. attenuata* woodlands, but *Melaleuca preissiana* woodlands and scrubs are also recorded. Occurs on Bassendean and Spearwood systems in the central Swan Coastal Plain north of Rockingham. Typically has very open understorey, and sites are likely to be seasonally waterlogged (DPaW, 2013). This community corresponds to Gibson et al. (1994) SCPFCT 22	Two occurrences of this PEC lie within 5 km of both Study Areas (DPaW, 2013b)

DPaW Department of Parks and Wildlife

EPBC Act *Environment Protection and Biodiversity Act 1999*

PEC Priority Ecological Community

SCPFCT Swan Coastal Plain Floristic Community Type

5.8.1 Statistical Analysis of Quadrat Data

A statistical analysis of all quadrat data from both Study Areas used to map vegetation types within the Study Areas was undertaken using PATN (PATN, 2004). The floristic data from quadrats 1 to 6 for the Northern Study Area and quadrats 1 to 4 for the Southern Study Area were compared to DPaW quadrat data of TECs and PECs recorded within 5 km of the Study Areas (where available). The TECs and PECs included in the analyses are FCT 24, 26a, 20a and 22. A dendogram of the results is included in Plate 1.

The results of the statistical analysis show three groupings of similar vegetation communities. The first group shows quadrats NEER-1, NEER11 (FCT 24), SVH1 and SHE-4 (FCT 26a) are similar in species composition. The second grouping of similar vegetation communities was GHD's quadrats from both Study Areas. The third grouping of similar vegetation communities were quadrats DEJONG01, ELE-23, (FCT 22), M53 and maida01 (FCT 20a).

The statistical analysis show GHD vegetation types *Melaleuca systena* Open Heath (14.55 ha), *Melaleuca huegelii* Tall Open Scrub (1.85 ha) and *Banksia sessilis* Tall Shrubland (6.95 ha) are similar in species composition. The statistical analysis show weak groupings of GHD quadrats with DPaW quadrats NEER-1, NEER11 (FCT 24 - Priority 3 PEC, Northern Spearwood Shrublands and Woodlands) and SVH1 and SHE-4 (FCT 26a - Endangered TEC, listed in Western Australia, *Melaleuca huegelii - Melaleuca acerosa* (currently *M. systena*) shrublands on limestone ridges).

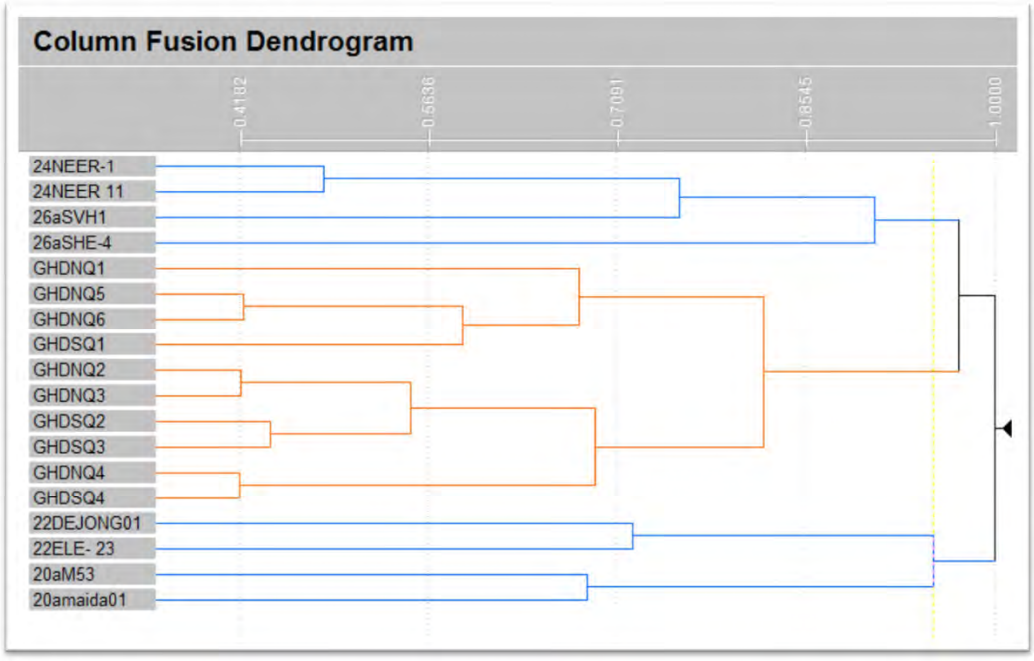


Plate 1 Dendogram comparing GHD quadrat data with DPaW, TEC and PEC quadrat data

5.9 Flora diversity

The desktop assessment (DPaW, 2007–) identified 291 plant taxa (including subspecies and varieties), representing 56 families and 170 genera, that have previously been recorded within 5 km of the Study Areas. This total is comprised of 247 native species and 44 introduced (exotic) species. Dominant families recorded within 5 km of the Study Areas include:

- Fabaceae: 35 species
- Myrtaceae: 24 species
- Proteaceae: 20 species

The GHD survey identified a total of 131 flora species from 37 families and 87 genera within the Study Areas. This number included 97 native species and 34 introduced/planted species. Dominant families recorded during the survey of the Study Areas were:

- Fabaceae: 15 taxa
- Poaceae: 15 taxa
- Proteaceae: 12 taxa

5.9.1 Conservation significant flora

Searches of the DPaW Threatened Flora (2013a) and the Western Australian Herbarium (WAHERB) databases, EPBC Act PMST (DotE, 2013b) and Western Australian Museum/DPaW NatureMap records (DPaW, 2007–) identified 23 vascular flora species of conservation significance previously recorded (or potentially recorded) within 5 km of the Study Areas (Figure 2, Appendix A) including :

- 11 EPBC Act- and WC Act-listed species
- One EPBC Act- and DPaW Priority 4-listed species
- 10 DPaW Priority-listed only species

No species listed under the EPBC Act or WC Act were recorded during the field survey. Three DPaW Priority species, *Melaleuca* sp. Wanneroo (G.J. Keighery 16705) (P1), *Stylidium maritimum* (P3) and *Leucopogon* sp. Yanchep (P3) were recorded during the field assessment within the Study Areas (Table 12).

A total of 16 plants from two populations of *Melaleuca* sp. Wanneroo (G.J. Keighery 16705) (P1) were recorded within the Northern Study Area (Plate 2). A population of 30 individuals of *Melaleuca* sp. Wanneroo (G.J. Keighery 16705) (P1) were recorded outside of the Northern Study Area. One individual of *Stylidium maritimum* (P3) was recorded within quadrat 1 in the Northern Study Area.

One individual of *Melaleuca* sp. Wanneroo (G.J. Keighery 16705) (P1) was recorded in the northern section of the Southern Study Area. Four plants of *Leucopogon* sp. Yanchep (P3) were also recorded within the southern most end of the Southern Study Area.

During the field assessment, one individual of *Sarcozona* ?*bicarinata* (P3) was recorded within the Southern Study Area. This plant was not able to be identified to species level and this specimen was put in to be verified by the Western Australian Herbarium. It was determined that it is probably *Sarcozona bicarinata*, but in the absence of flowers there is a level of uncertainty regarding this identification.

All Priority species collected during the field assessment were verified by the Western Australian Herbarium (Accession Number 5846, pers. comm. M. Hislop, 7th January, 2014).

Priority species recorded during the field assessment have been mapped at Figure 3, Appendix A.

Table 12 Priority flora species recorded during the field assessment

Family	Species	Status	Number of plants	Study Area	Easting	Northing
Aizoaceae	*Sarcozona ?bicarinata*	P3	1	Southern	382768	6497694
Ericaceae	*Leucopogon* sp. Yanchep	P3	1	Southern	382829	6497692
Ericaceae	*Leucopogon* sp. Yanchep	P3	1	Southern	382763	6497729
Ericaceae	*Leucopogon* sp. Yanchep	P3	1	Southern	382752	6497695
Ericaceae	*Leucopogon* sp. Yanchep	P3	1	Southern	382778	6497694
Myrtaceae	*Melaleuca* sp. Wanneroo (G.J. Keighery 16705)	P1	15	Northern	382253	6499878
Myrtaceae	*Melaleuca* sp. Wanneroo	P1	1	Northern	382189	6499911
Myrtaceae	*Melaleuca* sp. Wanneroo (G.J. Keighery 16705)	P1	30	Outside of Northern Study Area	382137	6499935
Myrtaceae	*Melaleuca* sp. Wanneroo (G.J. Keighery 16705)	P1	1	Southern	382669	6498109
Stylidiaceae	*Stylidium maritimum*	P3	1	Northern	382253	6499868

Plate 2 *Melaleuca* sp. Wanneroo (G.J. Keighery 16705) (P1) recorded within Study Areas

Plate 3 *Sarcozona ?bicarinata* recorded within Southern Study Area

Plate 4 *Leucopogon* sp. Yanchep (P3) recorded within Southern Study Area

Likelihood of occurrence assessment

A likelihood of occurrence assessment of conservation significant species (based on the range, habitat requirements and previous records of the species as well as taking into account the intensity of field survey and season) was conducted for all conservation significant species identified in the desktop assessment (Appendix D). The likelihood of occurrence assessment determined that one species listed under the EPBC Act and WC Act and five DPaW Priority species may occur within the Study Areas. Three DPaW Priority species were recorded during the field assessment (Table 13).

Table 13 Conservation significant flora species possibly occurring or likely to occur within the Study Areas

Taxa	Common name	Status		Likelihood of occurrence
		State (WC Act/DPaW listing)	Federal (EPBC Act listing)	
Acacia benthamii		Priority 2		Likely
Baeckea sp. Limestone (N. Gibson & M.N. Lyons 1425)		Priority 1		Likely
Drakaea micrantha	Dwarf Hammer-orchid	Threatened	Vulnerable	Possible
Hibbertia spicata subsp. *leptotheca*		Priority 3		Likely
Jacksonia sericea		Priority 4		Likely
Leucopogon sp. Yanchep (M. Hislop 1986)		Priority 3		Known
Melaleuca sp. Wanneroo (G.J. Keighery 16705)		Priority 1		Known
Pimelea calcicola		Priority 3		Likely
Stylidium maritimum		Priority 3		Known

Conservation codes are provided in Appendix B

5.9.2 Other significant flora

No other significant flora were recorded within the Study Areas during the field assessment.

5.9.3 Introduced flora

A total of 34 introduced (exotic) species were recorded within the Study Areas. One species, Bridal Creeper (**Asparagus asparagoides*), was recorded within the Southern Study Area and is listed as a Declared Pest under Section 22 of the Biosecurity and Agriculture Management (BAM) Act (2007) (Plate 5).This species is listed as a Declared Pest C3 Management for the Whole of the State under the BAM Act. Bridal creeper is also listed as a WoNS (Australian Weeds Committee, 2010). One individual of Bridal Creeper was recorded at 382669 E and 6498109 N and has been mapped at Figure 4, Appendix A.

Plate 5 Bridal Creeper recorded within the Southern Study Area

5.10 Dieback assessment

GHD undertook a preliminary assessment for *Phytophthora* spp. (Dieback) as part of the vegetation condition assessment. This was based on the presence/absence of typical indicator species, such as *Banksia* species and *Eucalyptus marginata*. Vegetation within the Southern Study Area was in predominantly Pristine to Excellent condition. No evidence of Dieback was sighted within the Southern Study Area during the field assessment.

A small number of dead *Banksia* species were sighted within the Northern Study Area during the field assessment. These Banksias were within vegetation with a condition rating of Excellent to Very Good. The *Banksia* deaths could be related to Dieback infestation. A formal Dieback assessment would need to be undertaken to determine whether Dieback is present within the Northern Study Area.

Plate 6 Dead *Banksia* sp. within Northern Study Area

5.11 Fauna

5.11.1 Fauna habitat

The Study Area contains two broad fauna habitat types based on the predominant vegetation structure in the area. This habitat type closely corresponds to the vegetation types outlined in Section 5.7.1:

- Mixed shrubland
- Highly modified roadside vegetation (cleared or highly degraded)

Mixed shrubland

The Habitat type within the Study Areas is predominantly a mixed shrubland

- There is 8.79 ha (97%) of the shrubland in the Northern Study Area There is 14.55 ha (89%) of the shrubland in the Southern Study Area

The mixed shrubland is a mosaic of *Melaleuca huegelii*, *Banksia sessilis* and *Melaleuca systena* Shrubland with dense understory of *Xanthorrhoea preissii, Hardenbergia comptoniana, Hakea trifurcata, Hibbertia hypericoides* and *Jacksonia calcicola* with ground cover of *Desmocladus* species and *Lomandra hermaphrodita* and *Mesomelaena pseudostygia*. There are scattered weeds through this habitat type including an unidentified *Briza* species, *Ehrharta calycina* and *Lysimachia arvensis.*

This habitat type includes all the shrubland vegetation types described in Section 5.7 and are mapped in Figure 5.

This habitat type provides extensive resources for fauna and contains multiple micro-habitat types such as deep leaf litter, logs and rocks scattered through the Study Area and excellent ground cover. The Habitat type also provides foraging resources for conservation significant species such as the Black Cockatoos, Quenda (*Isoodon obesulus*) and Western Brush Wallaby (*Marcopus irma*).

The Habitat is in generally excellent condition and has high degrees of connectivity to surrounding vegetation.

Highly modified roadside vegetation

There are small sections in the Study Area (3% in the Northern Study Area and 10% in the Southern Study Area) where the native vegetation has been completely cleared and the environment is highly modified. These sections offer little habitat value to fauna.

5.11.2 Fauna habitat connectivity

Habitat linkages are important to allow animals to move between areas of resource availability. They are important for ground and aerial fauna, providing cover, resources, and linking areas suitable for rest and reproduction. Fragmentation of habitat limits the resources available to species, particularly sedentary species, which means they may be more vulnerable to natural disasters or habitat changes over time. Fragmentation of habitat can also lead to edge effects, leading to degradation of the habitat. Where the distance between habitat fragments is small, species may still be able to move between these habitat areas, but may be more exposed to predation pressures in the cleared areas.

The Study Areas are within a broadly continuous tract of fauna habitat consisting of a mosaic of native shrublands, heath and woodlands.

To the east of the Study Areas there is high connectivity to surrounding habitat in several extensive patches of native vegetation including DPaW estate and the Northern Study Area is within a Bush Forever site as shown on Figure 2, Appendix A.

To the west of the Study Areas there is some habitat fragmentation and both Study Areas are adjacent to completely cleared land. The Western side of the Study Areas has a mosaic of other land uses, including roads, farm land, some urban development and mining.

The EPA states in the ”Environmental Protection Bulletin No. 20, Protection of naturally vegetated areas through planning and development” (2013) that both contiguous and non-contiguous patches of native vegetation act as habitat stepping stones which facilitate the maintenance of ecological processes and the movement of organisms within, and across, a landscape. The native vegetation located within the Study Areas acts as an important ecological linkage within the broader landscape, enabling the movement of organisms within the area.

5.11.3 Fauna diversity

A NatureMap search (DPaW, 2007–) identified 180 fauna species as previously recorded within 5 km of the Study Areas, of which 172 species are native and eight are introduced species (Appendix C). These results consisted of 100 birds, 15 mammals (of which six are introduced species), 37 reptiles, five amphibians and 23 invertebrate species.

During the field surveys, a total of 16 fauna species (13 birds and three mammals) were recorded within the Study Areas consisting of the following:

- *Melithreptus brevirostris* (Brown-headed Honeyeater)
- *Phylidonyris novaehollandiae* (New Holland Honeyeater)
- *Platycercus zonarius* (Twenty-eight Parrot)
- *Smicrornis brevirostris* (Weebill)
- *Aquila audax* (Wedge-tailed Eagle)
- *Artamus cinereus* (Black-faced Woodswallow)
- *Cacatua roseicapilla* (Galah)

- *Calyptorhynchus baudinii* (Baudin's Black Cockatoo) - vulnerable under the EPBC Act and Threatened (Schedule 1) under the WC Act
- *Corvus coronoides* (Australian Raven)
- *Malurus splendens* (Splendid Fairy-wren)
- *Phaps chalcoptera* (Common Bronzewing)
- *Rhipidura leucophrys* (Willie Wagtail)
- *Falco cenchroides* (Australian Kestrel)
- *Vulpes vulpes* (Fox) - introduced species
- *Oryctolagus cuniculus* (Rabbit) - introduced species
- *Macropus fuliginosus* (Western Grey Kangaroo).

In addition a Carpet Python (*Morelia spilota imbricata*) skin was also found in the Study Area and as such this specially protected species is also recorded as present.

5.11.4 Conservation significant fauna

Searches of the EPBC Act PMST (DotE, 2013b) and Western Australian Museum/DPaW NatureMap records (DPaW, 2007–) identified the presence or potential presence of the following:

- Six threatened (*Endangered* or *Vulnerable*) fauna listed under the EPBC Act
- Seven Migratory birds listed under the EPBC Act
- Five Threatened or other specially protected species listed under the WC Act
- Six Priority fauna species listed by the DPaW

The fauna likelihood of occurrence table (Appendix E) presents a list of the species reported in the EPBC Act PMST (DotE, 2013b) and Western Australian Museum/DPaW NatureMap records (DPaW, 2007–).

Calyptorhynchus baudinii (Baudin's Black Cockatoo)

During the field survey Baudin's Black Cockatoo (*Calyptorhynchus baudinii*) was recorded foraging in the Nothern Study Area. The Baudin's Black Cockatoo is listed vulnerable under the EPBC Act and Threatened (Schedule 1) under the WC Act. It is distributed across the south-west of Western Australia in uncleared or remnant areas of *Eucalyptus* woodland and shrubland of kwongan heath. The Northern Study Areas provide a total of 8.8 ha of suitable foraging habitat and the Southern Study Areas provide a total of 14.55 ha of suitable foraging habitat for the Baudin's Black Cockatoo (total of 23.35 ha in both Study Areas) (Figure 5). The entire shrubland habitat is considered to be foraging habitat. This habitat type has been mapped in Figure 5, Appendix A.

The Study Areas are not located within the known breeding range for the Baudin's Black Cockatoo (DSEWPaC, 2012). It nests in hollows in live or dead trees of *E. salmonophloia* (salmon gum), *E. wandoo* (wandoo), tuart, jarrah, *E. rudis* (flooded gum), *E. loxophleba* subsp. *loxophleba* (York gum), *E. accedens* (powderbark), *E. diversicolor* (karri) and marri. There were no suitable breeding trees recorded in the Study Areas. There are no known breeding sites in proximity to the Study Areas (Department of Planning, 2011).

There were no trees that provide potential roosting habitat recorded in the Study Areas. However there is a known roosting site for the Carnaby's Black Cockatoo (which have similar roosting habitat requirements) located approximately 5 km west of the Study Areas (Department of Planning, 2011).

5.11.5 Likelihood of occurrence assessment

In addition to Baudin's Black Cockatoo which was recorded during the field survey, a number of conservation significant fauna species were identified as potentially occurring within the Study Areas during the desktop investigation (Section 5.11.4). An assessment of the likelihood of these species occurring in the Study Areas was undertaken and the full assessment is presented in the likelihood of occurrence table (Appendix E). This assessment is based on species biology, habitat requirements, the quality and availability of suitable habitat and records of the species in the area.

The assessment concluded that:

- Baudin's Black Cockatoo (*Calyptorhynchus baudinii*) and the Carpet Python (*Morelia spilota imbricata*) are present within the Study Areas
- Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*), Rainbow Bee-eater (*Merops ornatus*), Southern Brown Bandicoot/Quenda (*Isoodon obesulus fusciventer*), Western Brush Wallaby (*Macropus irma*), Native Bee (*Hylaeus globuliferus*), Cricket (*Austrosaga spinifer*), and the Graceful Sun Moth (*Synemon gratiosa*) are likely to occur in the Study Areas
- Chuditch (*Dasyurus geoffroii*) and Fork-tailed Swift (*Apus pacificus*) may possibly occur wthin the Study Areas

White-bellied Sea-Eagle (*Haliaeetus leucogaster*) and Osprey (*Pandion haliaetus*) possibly occur in the Study Areas due to the proximity of the suitable habitat.

Malleefowl (*Leipoa ocellata*), Australian Painted Snipe (*Rostratula benghalensis australis*), Australian Fairy Tern (*Sternula nereis nereis*), Eastern Great Egret (*Ardea modesta*), Great Egret/ White Egret (*Ardea alba*), Cattle Egret (*Ardea ibis*), Woylie (*Bettongia penicillata ogilbyi*), Black-flanked Rock-wallaby (*Petrogale lateralis lateralis*) and Carter's Freshwater Mussel (*Westralunio carteri*) are unlikely to occur in the Study Areas primarily due to the absence or lack of suitable habitat in the Study Areas and/or the lack of recent records of the species in the area.

- The likelihood of these species occurring in the Study Areas was assessed and the assessment concluded that Baudin's Black Cockatoo and the Carpet Python are present within the Study Areas, seven species are likely to occur, four species may possibly occur and that nine species are unlikely to occur in the Study Areas.

6. Environmental approvals

6.1 Commonwealth approvals

Referral to DotE under the EPBC Act is triggered if a proposed action has/or potentially has a significant impact on any Matter of National Environmental Significance (MNES), including National Heritage values. An assessment against each of these issues is provided in Table 14.

The Study Areas are located within the modelled distribution for the Carnaby's Black Cockatoo and Forest Red-tailed Black Cockatoo and just outside the boundary for the Baudin's Black Cockatoo. During the flora and fauna survey several Baudin's Black Cockatoo were observed foraging in the Study Areas. The potential impacts on Black Cockatoo species is discussed in further detail in Section 6.1.1.

Table 14 Assessment of the Project against Matters of National Environmental Significance

Matters of National Environmental Significance (MNES)	Present	Impact
World Heritage Places	No	None
National Heritage Places	No	None
Ramsar Wetlands	No	None
Threatened Ecological Communities	No	None
Threatened Species	Yes	Potential impacts through the removal of 23.35 ha of quality foraging habitat for the Black Cockatoos.
Listed Migratory Species	May be present	Unlikely due to the wide ranging nature of species and likely low rate of occurrence. There is no important habitat for any of the migratory terrestrial or wetland species within the Study Areas. The proposed works are unlikely to disrupt the lifecycle of an ecologically significant proportion of a population of listed migratory species. The Project is unlikely to result in an invasive species that is harmful to a listed migratory species becoming established in an area of important habitat for listed migratory species. It is unlikely that listed migratory species would be significantly impacted by the proposed works.
Commonwealth Marine Areas	No	None
Nuclear Actions	No	None

6.1.1 Risk referral table for threatened Black Cockatoos

In October 2012, DotE (then DSEWPaC) released the referral guidelines for the assessment of projects for potential impacts on Black Cockatoos (DSEWPaC, 2012). These guidelines are for all Black Cockatoo species, and do not provide information relative to particular areas of the State, but provide information to decide whether a project may trigger referral.

Within these guidelines, DotE provides a risk table that gives guidance on what it views as risks/impacts to Black Cockatoos that will trigger referral. Risk is broken into three categories, high, uncertain and low, and primarily focuses on breeding, feeding and roosting areas as well as indirect impacts. If there is uncertainty in regards to risks on Black Cockatoos then DotE recommends referring the project or contacting the Department to ensure legal certainty.

The risk referral table is shown in Table 15 with an assessment of the Project against each of the potential risks. Based on the proposed clearing of 23.35 ha of quality Black Cockatoo foraging habitat referral is required. The threshold for referral is clearing of more than 1 ha of quality foraging habitat.

Table 15 Department of Sustainability, Environment, Water, Population & Communities risk referral table for Black Cockatoos

Risk type	Referral trigger
High risk of significant impacts: referral to DotE recommended	
Clearing of any known nesting tree.	Referral is not triggered. No currently known nesting trees.
Clearing of any part or degradation of breeding habitat in a woodland or forest within a species' known breeding range.	Referral is not triggered as potential breeding habitat was not identified within the Study Areas.
Clearing of more than 1 ha of quality foraging habitat.	Referral is likely to be triggered. There is more than 1 ha of quality foraging habitat present within the Study Areas (up to 23.35 ha).
Creating a gap or greater than 4 km between patches of Black Cockatoo habitat (breeding, foraging or roosting).	Referral is not triggered, the Study Area will not create a gap of more that 4km.
Clearing or degradation (including pruning of top canopy) of a known roosting site.	Referral is not triggered as no known roosting sites have been recorded in the Study Areas.
Uncertainty: referral recommended or contact the DotE	
Degradation (such as through altered hydrology or fire regimes) of more than 1 ha of foraging habitat. Significance will depend on the level and extent of degradation and the quality of the habitat.	Referral is likely to be triggered as the vegetation in the Study Areas is predominantly in Pristine to Very Good condition. Clearing of the vegetation will most likely degrade the quality of habitat. There is more than 1 ha of quality foraging habitat present within the Study Areas (up to 23.35 ha).
Clearing or disturbance in areas surrounding Black Cockatoo habitat that has the potential to degrade habitat through introduction of invasive species, edge effect, hydrological changes, increase human visitation or fire.	Referral is unlikely to be triggered. The Project is unlikely to impact on the current levels of habitat degradation through introduction of invasive species, edge effect, hydrological changes, increase human visitation or fire
Actions that do not directly affect the listed species but that have the potential for indirect impacts such as increasing competitors for nest hollows.	Referral is unlikely to be triggered. There is no clearing of nesting hollows and the foraging resources are reasonably well represented in the immediate area.

Risk type	Referral trigger
Actions with the potential to introduce known plant diseases such as Phytophthora spp.	Referral is unlikely to be triggered. Phytophthora is known to occur widely in the region and may already be present at the site. Management measures should be implemented to reduce the risk of introduction and spread of Phytophthora.
Low risk of significant impacts: referral may not be required but may refer to DotE for legal certainty	
Actions that do not affect Black Cockatoo habitat or individuals.	Not applicable
Actions whose impacts occur outside the modelled distribution of the three Black Cockatoos.	Not applicable

6.2 State approvals

6.2.1 Referral to the Environmental Protection Authority

Significant proposals (e.g. subdivision and development applications) must be referred to the EPA under Section 38 of the *Environmental Protection Act 1986* (EP Act).

In deciding whether a proposal will be subject to the formal environmental impact assessment process, the EPA takes into account the environmental significance of any potential impacts that may result from the implementation of the scheme or proposal.

The EPA considers that environmental significance is a function of:

- The extent and consequence of impacts on biophysical aspects
- The environmental values of the areas affected
- The extent of emissions and their potential to unreasonably interfere with the health, welfare, convenience, comfort or amenity of people
- The extent and rigour to which potential impacts have been investigated and described in the referral, and the confidence in the reliability of predicted impacts
- The extent to which the proposal implements the principles of sustainability
- The ability of decision-making authorities to place conditions on the proposals to ensure required environmental outcomes are achieved
- The likely level of public interest and the extent to which the proponent has consulted with interested and affect people and responded to issues raised

The results of this study suggest that the Project will have minimal adverse impacts to the surrounding environment, will only be associated with localised increases in emissions during construction, and is not likely to have a high level of public interest. The majority of the environmental impacts associated with the Project are linked to vegetation clearing and loss of fauna habitat. These potential impacts and proposed mitigation actions (and offsets, if required) for the Project can be effectively regulated through the Environmental Protection (Clearing of Native Vegetation) Regulations 2004. Therefore, it is considered the Project is unlikely to require referral to the EPA under Section 38 of the EP Act.

6.2.2 Vegetation clearing permit

Any clearing of native vegetation requires a permit from the Department of Environment Regulation (DER) or in this project as the areas to be cleared are entirely within an existing mining tenement, the Department of Mines and Petroleum (DMP) under Part V of the EP Act, except where exemptions apply under Schedule 6 of the Act or are prescribed in the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*, and not in an Environmentally Sensitive Area (ESA).

Clearing applications are assessed against ten principles outlined in Schedule 5 of the *Environmental Protection Amendment Act 2003*. These principles aim to ensure that all potential impacts resulting from removal of native vegetation can be assessed in an integrated way.

Assessment against the Ten Clearing Principles

An assessment against the Ten Clearing Principles is provided in Table 16.

The assessment against the Ten Clearing Principles determined that the Project is likely to be at variance with Clearing Principle (a) (related to clearing of vegetation of high biological diversity associated with Priority flora and TECs/PECs) and (h) (related to clearing of vegetation within DPaW-managed conservation reserve and an ESA).

The Project may be at variance with Clearing Principles (b) (related to clearing of foraging habitat for the Baudin's Black Cockatoo) and (d) (related to the potential clearing of a TEC).

Table 16 Assessment against the Ten Clearing Principles

Principle Number	Principle	Assessment	Outcome
(a)	Native vegetation should not be cleared if it comprises a high level of biological diversity.	Desktop assessments identified 291 native flora species recorded within 5 km of the Study Areas (DPaW, 2007–). The field survey identified 97 native species within the Study Areas. Broadscale vegetation mapping of the area undertaken by Beard (1979) identified the following vegetation association within the Study Areas: • Low woodland; banksia (association 949) The Heddle et al. (1980) mapping identified the following vegetation complex on Aeolian Deposits of the Swan Coastal Plain within the Study Areas (Government of Western Australia, 2000): • Spearwood dunes: Cottesloe complex – central and south (complex 52): Mosaic of woodland of *Eucalyptus gomphocephala* and open forest of *E. gomphocephala – E. marginata – E. calophylla* [now *Corymbia calophylla*]; closed heath on the Limestone outcrops The Study Areas contain both native vegetation and cleared areas on limestone. The native vegetation (8.8 ha within Northern Study Area and 14.55 ha in Southern Study Area) within the Study Areas consists of three vegetation types: • *Melaleuca huegelii* Tall Open Scrub • *Banksia sessilis* Tall Shrubland • Melaleuca systena Open Heath A likelihood of occurrence assessment identified the following 6 flora species of conservation significance potentially occurring within the Study Areas: • *Acacia benthamii* (State Priority 2) • *Baeckea* sp. Limestone (N. Gibson & M.N. Lyons 1425) (State Priority 1) • *Drakaea micrantha* (State Threatened, Federal Vulnerable) • *Hibbertia spicata* subsp. *leptotheca* (State Priority 3) • *Jacksonia sericea* (State Priority 4) • *Pimelea calcicola* (State Priority 3)	Likely to be at variance.

Principle Number	Principle	Assessment	Outcome
		No species listed under the EPBC Act or WC Act were recorded during the survey. Two DPaW Priority species, *Melaleuca* sp. Wanneroo (G.J. Keighery 16705) (P1) (16 plants) and *Stylidium maritimum* (P3) (one plant) were recorded within the Northern Study Area. Two DPaW Priority species, *Melaleuca* sp. Wanneroo (G.J. Keighery 16705) (P1) (one plant) and *Leucopogon* sp. Yanchep (P3) (four plants) were recorded within the Southern Study Area. The field assessment identified GHDs vegetation types *Banksia sessilis* Tall Shrubland (6.95 ha) and *Melaleuca systena* Open Heath (14.55 ha) (found within vegetated areas of the Study Areas) as potentially corresponding to Gibson et al. (1994) vegetation complex Priority 3 PEC, Northern Spearwood Shrublands and Woodlands. The field assessment also identified GHDs vegetation type *Melaleuca huegelii* Tall Open Scrub (1.85 ha) as potentially corresponding to Gibson et al. (1994) Endangered TEC, *Melaleuca huegelii - Melaleuca acerosa* (currently *M. systena*) shrublands on limestone ridges, which is listed in Western Australia (FCT 26a). The remaining extents of both vegetation associations and complexes identified within the Study Areas (Beard, 1979 and Heddle et al,. 1980) are greater than the 30 percent threshold level of their pre-European extents at all levels. The vegetation of the Northern Study Area observed during the survey is considered to be in predominantly Excellent to Very Good condition (6.57 ha). The vegetation of the Southern Study Area observed during the survey is considered to be in predominantly Pristine to Excellent condition (10.88 ha). The vegetation in surrounding areas (and nearby DPaW-managed reserves and Bush Forever sites) were observed be in similar condition to that of the Study Areas. The Northern Study Area is located within the DPaW-managed Gnangara-Moore River State Forest and Bush Forever site 290 (Hopkins Road Bushland). No reserves, conservation areas or other DPaW-managed estates are located within the Southern Study Area (Government of Western Australia, 2012). Bush Forever site 136 (State Forest 65 – Pinjar Plantation South Bushland, Nowergup/Yanchep/Neerabup) is located within 1 km of both Study Areas	

Principle Number	Principle	Assessment	Outcome
		(Government of Western Australia, 2012). No Ramsar wetlands, nationally important wetlands, EPP Lakes or geomorphic wetlands are located within the Study Areas (DotE, 2012c) (Government of Western Australia, 2012). During the field surveys, a total of 16 fauna species (13 birds and three mammals) were recorded within the Study Areas consisting of the following. The conservation significant Baudin's Black Cockatoo (*Calyptorhynchus baudinii)* was recorded foraging in the Study Areas during the field assessment. This species is listed as Threatened under the WC Act and Vulnerable under the EPBC Act. The fauna habitat type within the Study Areas is predominantly a mixed shrubland. There is 8.79 ha (97%) of the shrubland in the Northern Study Area and 14.55 ha (89%) of the shrubland in the Southern Study Area. The clearing of 23.35 ha of the Study Areas may result in the clearing of native vegetation that has similar biodiversity attributes than that of the surrounding undisturbed vegetation.	
(b)	Native vegetation should not be cleared if it comprises the whole or part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous Western Australia.	During the survey, the conservation significant Baudin's Black Cockatoo (*Calyptorhynchus baudinii)* was recorded foraging in the Study Areas. This species is listed as Threatened under the WC Act and Vulnerable under the EPBC Act. The project will clear 23.35 ha of foraging habitat for the Baudin's Black Cockatoo. Furthermore, Carnaby's Black Cockatoo, Rainbow Bee-eater, Southern Brown Bandicoot/Quenda, Western Brush Wallaby, Hylaeus globuliferus (Native Bee) Austrosaga spinifer (Cricket) and the Graceful Sun Moth are likely to occur in the Study Areas. The Study Areas are within a well-connected large area of habitat and this project could impact on the functionality the broader connectivity. This habitat is generally in excellent condition and is likely to provide a range of resources to a broad suite of fauna species. However there is some fragmentation already existing on the western edge of the Study Area. The native vegetation located within the Study Areas acts as an important ecological linkage within the broader landscape, enabling the movement of organisms within the area.	May be at variance.

Principle Number	Principle	Assessment	Outcome
(c)	Native vegetation should not be cleared if it includes, or is necessary for the continued existence of, rare flora.	A desktop likelihood of occurrence assessment of conservation significant species identified the following two Threatened species as potentially occurring within the Study Areas: • *Drakaea micrantha* • *Eucalyptus argutifolia* The field survey was conducted outside the flowering time for *Drakaea micrantha;* however, limited habitat for this species was recorded within the Study Areas. This species occurs in cleared fire breaks or open sandy patches and infertile grey sands and the Study Areas were densely vegetated with native vegetation over limestone. *Eucalyptus argutifolia* is a tree and, if present, would have been identified during the field assessment. No Threatened flora species were observed during the field survey within the Study Areas and none are considered likely to occur	Unlikely to be at variance.
(d)	Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of, a threatened ecological community [TEC].	Desktop searches (DotE, 2013b; DPaW, 2013b; and DPaW, 2013c) identified four TECs within 5 km of the Study Areas: • *Melaleuca huegelii – M. acerosa* shrublands on limestone ridges • Aquatic Root Mat Community Number 1 of Caves of the Swan Coastal Plain • *Banksia attenuata* woodland over species rich dense shrublands • Shrublands on dry clay flats Based on the field assessment, GHD vegetation type, *Melaleuca huegelii* Tall Open Scrub (1.85 ha), shows affinities to the Endangered TEC, listed in Western Australia, *Melaleuca huegelii - Melaleuca acerosa* (currently *M. systena*) shrublands on limestone ridges.	May be at variance
(e)	Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared.	The present extent of the vegetation associations and complexes (Beard, 1979 and Heddle et al., 1980) identified within the Study Areas are greater than the 30 percent threshold level of the pre-European extent. However, small amounts (less than 20 percent) of each vegetation association/complex are reserved (Government of Western Australia and 2013 and EPA, 2006a).	Unlikely to be at variance.

Principle Number	Principle	Assessment	Outcome
		The remnant vegetation of the Study Areas (23.54 ha) comprises a very minor proportion (0.59 %) of vegetation remaining within 10 km of the Study Areas (3991.67 ha) (Government of Western Australia, 2012). The large patches of native vegetation surrounding the Study Areas are considered to support a similar number and diversity of species as the vegetation within the Study Areas. The vegetation associated with both the Study Areas is located within a landscape that has been extensively cleared in the past. Clearing of the Study Areas may lead to further fragmentation of adjacent vegetation.	
(f)	Native vegetation should not be cleared if it is growing in or in association with a watercourse or wetland.	The desktop assessment and field survey did not identify any watercourses or wetlands within the Study Areas. No vegetation growing in association with a watercourse or wetland was recorded during the field assessment.	Not at variance.
(g)	Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.	The field survey identified the soils of the Study Areas as consisting of brown sand over limestone in lower-lying areas and limestone outcropping in higher areas. Areas of sandy soils within the Study Areas have the potential to increase the risk of wind erosion, which may lead to increased soil erosion. There is a 0-2% high to extreme risk of salinity occurring within the Study Areas (Government of Western Australia, 2014). The clearing of the vegetation within the Study Areas is relatively small in relation to the large areas of remnant native vegetation in the surrounding landscape. As such, it is considered that minimal land degradation would occur if the Study Areas were to be cleared.	Unlikely to be at variance, however further assessment required – the scope of this assessment does not include Acid Sulphate Soils.
(h)	Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area.	The Northern Study Area is located within an ESA, which may relate Bush Forever site Hopkins Road Bushland, Nowergup (Site 290). A small ESA is located within the north west section of the Southern Study Area. This ESA would be related to the location of Threatened flora located adjacent to the Southern Study Area. Desktop assessments identified one DPaW-managed conservation reserve (Gnangara-Moore River State Forest) and Bush Forever site 290 (Hopkins Road Bushland, Nowergup) within the Northern Study Area (Government of Western Australia, 2012).	Likely to be at variance.

Principle Number	Principle	Assessment	Outcome
		In addition, Bush Forever site 136 (State Forest 65 – Pinjar Plantation South Bushland, Nowergup/Yanchep/Neerabup) is located within 1 km of both Study Areas. The proposed works will include the clearing of 8.8 ha of vegetation within Bush Forever site 290 and the Gnangara-Moore River State Forest within the Northern Study Area. The amount of vegetation to be cleared (23.35 ha) within the Study Areas provides a considerable regional connection to other conservation areas, and it provides a substantial buffer from adverse impacts, such as clearing, for the adjacent vegetation. To the east of the Study Areas there is good connectivity to surrounding habitat in several extensive patches of native vegetation including DPaW estate. Clearing 23.35 ha of native vegetation within the Study Areas will reduce habitat connectivity to conservation areas to the east of the Study Areas. Areas to the west of the Study Areas have predominantly been cleared and now consist of paddock. As was discussed in principle (e), the present extent of vegetation associations and complexes (Beard, 1979 and Heddle et al., 1980) are above the 30 percent threshold level for remnant vegetation. However, neither vegetation association nor complex is well-reserved at any level.	
(i)	Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water.	As indicated in principle (g), the risk of dryland salinity is 0-2% high to extreme risk, within the Study Areas (Government of Western Australia, 2014). No watercourses or wetlands are located within either of the Study Areas. No Public Drinking Water Source Areas were located within either of the Study Areas (Figure 2, Appendix A). As the Study Areas are already surrounded by a highly altered landscape on the Swan Coastal Plain, it is not considered likely that clearing of 23.35 ha of native vegetation will cause deterioration in quality of surface or underground water.	Unlikely to be at variance, however further assessment required – the scope of this assessment does not include Acid Sulphate Soils.
(j)	Native vegetation should not be cleared if the clearing of the vegetation is likely to cause, or exacerbate, the intensity of flooding.	Both Study Areas are immediately adjacent to existing cleared areas (limestone quarries). This indicates that the Study Areas exist within land which is capable of withstanding the intended use and is not considered likely to cause, or exacerbate, the intensity of flooding The vegetation to be cleared within the Study Areas is relatively small in	Unlikely to be at variance.

Principle Number	Principle	Assessment	Outcome
		area in relation to the size of the catchment area. The likelihood of waterlogging is considered minimal, as the Study Areas are located on limestone ridges. It is considered unlikely that clearing 23.35 ha of vegetation associated with the Study Areas would cause, or exacerbate the incidence or intensity of flooding.	

7. Conclusion & recommendations

7.1 Conclusions

7.1.1 Flora & vegetation

The Northern Study Area is located within an Environmentally Sensitive Area (ESA), which may relate to a Bush Forever site. A small ESA is located within the north west section of the Southern Study Area. This ESA would be related to the location of Threatened flora located adjacent to the Southern Study Area.

Both vegetation associations and complexes identified within the Study Areas (Beard, 1979 and Heddle et al. 1980) are considered to be of least concern as they are well-represented at local, regional and State levels with more than 30 percent of their pre-European extents remaining.

The field assessment identified GHD vegetation type *Melaleuca huegelii* Tall Open Scrub (1.85 ha) as potentially corresponding to Gibson et al. (1994) vegetation complex Endangered TEC, *Melaleuca huegelii - Melaleuca acerosa* (currently *M. systena*) shrublands on limestone ridges, which is listed in Western Australia (FCT 26a). The field assessment also identified GHDs vegetation types *Banksia sessilis* Tall Shrubland (6.95 ha) and *Melaleuca systena* Open Heath (14.55 ha) as potentially corresponding to Gibson et al. (1994) vegetation complex Priority 3 PEC, Northern Spearwood Shrublands and Woodlands (FCT 24).

The PATN statistical anaylsis showed a weak association of GHD quadrats with DPaW quadrat data for the Priority 3 PEC, Northern Spearwood Shrublands and Woodlands, and the Endangered TEC, *Melaleuca huegelii - Melaleuca acerosa* (currently *M. systena*) shrublands on limestone ridges, which is listed in Western Australia (not listed as a TEC under the EPBC Act). This could be due to limited DPaW quadrat data available at the time of the analysis and the DPaW quadrat locations in relation to the Study Areas.

No species listed under the EPBC Act or WC Act were recorded during the survey.

During the survey, 16 plants from two populations of *Melaleuca* sp. Wanneroo (G.J. Keighery 16705) (P1) were recorded within the Northern Study Area. One individual of *Stylidium maritimum* (P3) was recorded within quadrat 1 in the Northern Study Area. One individual of *Melaleuca* sp. Wanneroo (G.J. Keighery 16705) (P1) and four plants of *Leucopogon* sp. Yanchep (P3) were recorded within the Southern Study Area during the survey.

During the field assessment, one individual of *Sarcozona ?bicarinata* (P3) was recorded within the Southern Study Area. This plant was not able to be identified to species level and this specimen was put in to be verified by the Western Australian Herbarium. It was determined that it is probably *Sarcozona bicarinata*, but in the absence of flowers there is a level of uncertainty regarding this identification.

The likelihood of occurrence assessment determined that one species listed under the EPBC Act and WC Act (*Drakaea micrantha*) and five DPaW Priority species (*Acacia benthamii*, *Baeckea* sp. Limestone (N. Gibson & M.N. Lyons 1425), *Hibbertia spicata* subsp. *leptotheca*, *Jacksonia sericea*, *Pimelea calcicola*) may occur within the Study Areas.

One species, Bridal Creeper (**Asparagus asparagoides*), which was recorded within the Southern Study Area is listed as a Declared Pest under Section 22 of the BAM Act and is also listed as a WoNS.

A small number of dead *Banksia* species were sighted within the Northern Study Area during the field assessment. The *Banksia* deaths could be related to Dieback infestation. No evidence of Dieback was sighted within the Southern Study Area during the field assessment.

Clearing of the Study Areas is likely to be at variance with Clearing Principle (a) of the ten clearing principles due to the clearing of:

- DPaW Priority species, *Melaleuca* sp. Wanneroo (G.J. Keighery 16705) (P1), *Stylidium maritimum* (P3) and *Leucopogon* sp. Yanchep (P3)
- Vegetation that may represent occurrences of the Priority 3 PEC, Northern Spearwood Shrublands and Woodlands or the Endangered TEC, listed in Western Australia, *Melaleuca huegelii - Melaleuca acerosa* (currently *M. systena*) shrublands on limestone ridges

Clearing of the Study Areas is likely to be at variance with Clearing Principle (h) of the ten clearing principles, due to the clearing of vegetation that will impact on the environmental values of the ESA located within the Northern Study Area, which is associated with Bush Forever site Hopkins Road Bushland, Nowergup (Site 290) and the clearing of the ESA in the Southern Study Area which is associated with location of Threatened flora located adjacent to the Southern Study Area.

The Project may be at variance with Principles:

- (d) due to the potential clearing of the Endangered TEC, which is listed in Western Australia, *Melaleuca huegelii - Melaleuca acerosa* (currently *M. systena*) shrublands on limestone ridges
- (h) due to the clearing within an ESA, DPaW-managed conservation reserve and Bush Forever Site
- (e) due to clearing that may potentially lead to further fragmentation of adjacent vegetation

7.1.2 Fauna

Most of the Study Area (97% of the Northern and 89% of the southern Study Areas) contains a mixed shrubland habitat type that represents good micro-habitat diversity and would provide a broad range of resources to a wide suite of fauna species.

The Study Areas are part of a larger area of connected habitat that extends to the east, north and south of the Study Areas. There is some existing habitat fragmentation to the west of the Study Areas.

During the survey Baudin's Black Cockatoo was recorded foraging in the Study Area. The project would remove 23.35 ha of foraging habitat for this species and the other two species of Black Cockatoo (Redtail Black Cockatoo and Carnaby's Black Cockatoo) that are likely to occur in the Study Areas.

A Carpet Python skin was also found in the Study Areas and as such this specially protected species is also recorded as present.

Further to the know occurrence of the Baudin's Black Cockatoo and Carpet Python a likelihood of occurrence of conservation significant fauna assessment determined that seven species are likely to occur, four species possibly occur and nine species are considered unlikely to occur within the Study Areas.

The clearing of 23.35 ha of Black Cockatoo foraging habitat within the Study Areas will trigger referral to the DotE under the EPBC Act. No current evidence of breeding or roosting habitat or activity by any of the Black Cockatoo species was observed within the Study Areas.

Clearing of the Study Areas is considered to be at variance with the Clearing Principle (b) of DPaW ten clearing principles due to the clearing of Black Cockatoo foraging habitat and potential impacts on the connectivity of the broader habitat in the local area.

7.2 Recommendations

7.2.1 Flora

A clearing permit from the Department of Mines and Petroleum (DMP) will be required as the clearing will occur on mining tenements M 7000138 and M 7000141.The clearing of vegetation within the Study Areas is at variance with Principle (a) and (h) from the 10 Clearing Principles. The clearing of vegetation will impact on the environmental values of the ESAs located within the Study Areas.

Consultation with DPaW as to whether GHD vegetation types are the Endangered TEC, *Melaleuca huegelii - Melaleuca acerosa* (currently *M. systena*) shrublands on limestone ridges (FCT 26a) or the Priority 3 PEC, Northern Spearwood Shrublands and Woodlands (FCT 24) is advised because the field assessment results show similarity between GHD vegetation types and FCT 26a and FCT 24, while the PATN analysis showed only a weak association.

Clearing should be avoided, if possible within GHD vegetation type *Melaleuca huegelii* Tall Open Scrub, as this vegetation type potentially corresponds to Gibson et al. (1994) vegetation complex Endangered TEC, *Melaleuca huegelii - Melaleuca acerosa* (currently *M. systena*) shrublands on limestone ridges, which is listed in Western Australia (FCT 26a).

The clearing will also impact on DPaW Priority species and it is recommended that clearing of the Study Areas is reduced, to minimse the impacts to Priority flora located throughout the Study Areas and the potential Priority 3 PEC, Northern Spearwood Shrublands and Woodlands or the Endangered TEC, listed in Western Australia, *Melaleuca huegelii - Melaleuca acerosa* (currently *M. systena*) shrublands on limestone ridges.

A formal Dieback assessment would need to be undertaken to determine whether Dieback is present within the Northern and Southern Study Areas. Based on the outcomes of the assessment, management measures should be implemented to reduce the risk of introduction and spread of Dieback.

Potential impacts associated with the Project are likely to be largely restricted to the clearing phase, and should be mitigated through design as much as possible. It is recommended that Cockburn Cement develops an Environmental Management Plan (EMP) to manage the potential impacts from clearing.

7.2.2 Fauna

The clearing of the Study Areas will trigger referral to the DotE due to the clearing of more than 1 ha of quality Black Cockatoo foraging habitat identified within the Study Areas which is within the known breeding range of the Carnaby's Black Cockatoo. A total of 23.35 ha of Black Cockatoo foraging habitat is located within Study Areas. It is recommended the project be discussed with DotE before a final decision to refer is made.

An EMP to address the potential impacts expected to be experienced during the clearing of native vegetation for the proposed mine should include a general fauna clearance program by qualified fauna relocation personnel.

References

Australian Government 2012, *Weeds in Australia*, retrieved April 2013, from http://www.environment.gov.au/biodiversity/invasive/weeds/index.html.

Australian Weeds Committee 2010, *Weeds of National Significance: Update 2010*, Launceston, Commonwealth of Australia.

Beard, JS 1979, *Vegetation Survey of Western Australia: Perth Map and Explanatory Memoir 1:250,000 series*, Perth, Vegmap Publications.

Bureau of Meteorology 2013, *Climate Data Online*, retrieved December 12, 2013, from http://www.bom.gov.au/climate/data/?ref=ftr.

Christidis, L & Boles, WE 2008, *Systematics and Taxonomy of Australian Birds*, Melbourne, CSIRO Publishing.

Coffey Environments 2010a, *Flora and vegetation assessment, M70/138 Hopkins Road, Nowergup.* Prepared for Cockburn Cement

Coffey Environments 2010b, *Flora and vegetation assessment, M70/339 Hopkins Road, Nowergup.* Prepared for Limestone Building Block Company.

Coffey Environments 2011, *Flora and vegetation assessment M70/013 Hopkins Road, Nowergup.* Prepared for Limestone Building Block Company.

Department of Parks and Wildlife (DPaW) 2007–, *NatureMap: Mapping Western Australia's Biodiversity*, retrieved August 6, 2013, from http://NatureMap.dec.wa.gov.au/.

Department of Parks and Wildlife (DPaW) 2013a, *Department of Environment and Conservation Threatened Flora (Rare Flora Notice 2012(2)*), updated 17 September, 2013.

Department of Parks and Wildlife (DPaW) 2013b, *Priority ecological communities for Western Australia*, 20 September 2013.

Department of Parks and Wildlife (DPaW) 2013c, *Threatened ecological communities endorsed by the Minister for the Environment*, May 2013.

Department of Planning Western Australia 2011, *Metropolitan Region Scheme (MRS) North West – Potential habitat for the Carnaby's Black Cockatoo which may require further assessment*, Perth, Department of Planning WA on behalf of Western Australian Planning Commission.

Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) 2012, Environmental Protection and Biodiversity Conservation Act 1999 *referral guidelines for three threatened Black Cockatoo species*, Canberra, DSEWPaC.

Department of the Environment (DotE) 2013a, *Directory of Important Wetlands in Australia*, retrieved October 31, 2013, from http://www.environment.gov.au/topics/water/water-our-environment/wetlands/australian-wetlands-database/directory-important.

Department of the Environment (DotE) 2013b, *Protected Matters Search Tool Results*, retrieved August 6, 2013, from http://www.environment.gov.au/epbc/pmst/index.html.

Department of the Environment (DotE) 2013c, *The Ramsar Convention on Wetlands*, retrieved June 4, 2013, from http://www.environment.gov.au/water/topics/wetlands/ramsar-convention/index.html.

Department of the Environment (DotE) 2013d, *Threatened species & ecological communities*, retrieved July, 2013, from http://www.environment.gov.au/biodiversity/threatened/index.html.

Department of Environment (DotE) 2014, *Species and Profile Database,* retrieved January 2014 from http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=7669

English, V & Blyth, J 1997, *Identifying and Conserving Threatened Ecological Communities in the South West Botanical Province*, Perth, Department of Conservation and Land Management.

Environmental Protection Authority (EPA) 2000, *Environmental Protection of Native Vegetation in Western Australia. Clearing of native vegetation, with particular reference to the agricultural area. Position Statement No. 2*, Perth, Environmental Protection Authority.

Environmental Protection Authority (EPA) 2002, *Terrestrial Biological Surveys as an Element of Biodiversity Protection: Position Statement No. 3*, Perth, EPA.

Environmental Protection Authority (EPA) 2004a, *Guidance Statement No. 51: Terrestrial Flora and Vegetation Surveys for Impact Assessment in Western Australia*, Perth, EPA.

Environmental Protection Authority (EPA) 2004b, *Guidance Statement No. 56: Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia*, Perth, Environmental Protection Authority.

Environmental Protection Authority (EPA) 2006a, *Guidance for the Assessment of Environmental Factors (in accordance with the* Environmental Protection Act 1986*): Level of Assessment for Proposals Affecting Natural Areas Within the System 6 Region and Swan Coastal Plain Portion of the System 1 Region (No. 10)*, Perth, Environmental Protection Authority.

Environmental Protection Authority (EPA) 2013, *Environmental Protection Bulletin No. 20. Protection of naturally vegetated areas through planning and development.* Environmental Protection Authority.

Gibson, N, Keighery, BJ, Keighery, GJ, Burbidge, AH & Lyons, MN 1994, *A Floristic Survey of the Southern Swan Coastal Plain*, unpublished report prepared for the Australian Heritage Commission prepared by the Department of Conservation and Land Management and The Conservation Council of Western Australia (Inc.).

Government of Western Australia 2000, *Bush Forever – Keeping the Bush in the City. Volumes 1 (Policies, Principals and Processes) & 2 (Directory of Bush Forever sites)*, Perth, Government of Western Australia.

Government of Western Australia 2013, *2012 Statewide Vegetation Statistics incorporating the CAR Reserve Analysis (Full Report): current as of October 2012*, retrieved September 6, 2013, from https://www2.landgate.wa.gov.au/web/guest/downloader.

Heddle, EM, Loneragan, OW, & Havel, JJ 1980, '*Vegetation Complexes of the Darling System, Western Australia*', In Atlas of Natural Resources, Darling System, Western Australia, Perth, Department of Conservation and Environment.

Keighery, B 1994, *Bushland Plant Survey: a Guide to Plant Community Survey for the Community*, Nedlands, Wildflower Society of WA (Inc.).

Local Biodiversity Program 2013, 2013 *Native vegetation by vegetation complex dataset for the South West of Western Australia*, retrieved November 11, 2013, from http://pbp.walga.asn.au/Publications.aspx.

Mitchell, D, Williams, K & Desmond, A 2002, '*Swan Coastal Plain 2 (SWA2 — Swan Coastal Plain subregion)*', In A Biodiversity Audit of Western Australia's 53 Biogeographical Subregions in 2002, Perth, Department of Conservation and Land Management.

PATN 2004. Computer software. Blatant Fabrications Pty Ltd.

Perth Biodiversity Project 2010, *2010 Native vegetation extent by vegetation complexes for each Local Government in Perth and Peel*, retrieved November 11, 2013, from http://pbp.walga.asn.au/Publications.aspx.

Shepherd, DP, Beeston, GR, & Hopkins, AJM 2002, *Native Vegetation in Western Australia – Extent, Type and Status, Resource Management Technical Report 249*, Perth, Department of Agriculture.

Western Australian (WA) Herbarium 1998–, *FloraBase—the Western Australian Flora*, retrieved July, 2013, from http://florabase.dpaw.wa.gov.au/.

Western Wildlife 2008a, *Limestone Building Block Company tenements M70/013 and M70/339, Hopkins Rd, Nowergup, Fauna assessment*, unpublished report prepared for Limestone Building Block Company.

Western Wildlife 2008b, *Cockburn Cement, Tenement M70/138, Nowergup, Fauna assessment*, unpublished report prepared for Cockburn Cement.

Appendices

Appendix A – Figures

LEGEND

- Northern study area
- Southern study area

1: 50,000 (at A3)

0 0.25 0.5 1 1.5 2 2.5

Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 50

N

GHD

Cockburn Cement Ltd

powered by SLIP ENABLER

Cockburn Cement Ltd
Nowergup Flora and Fauna Survey

Locality

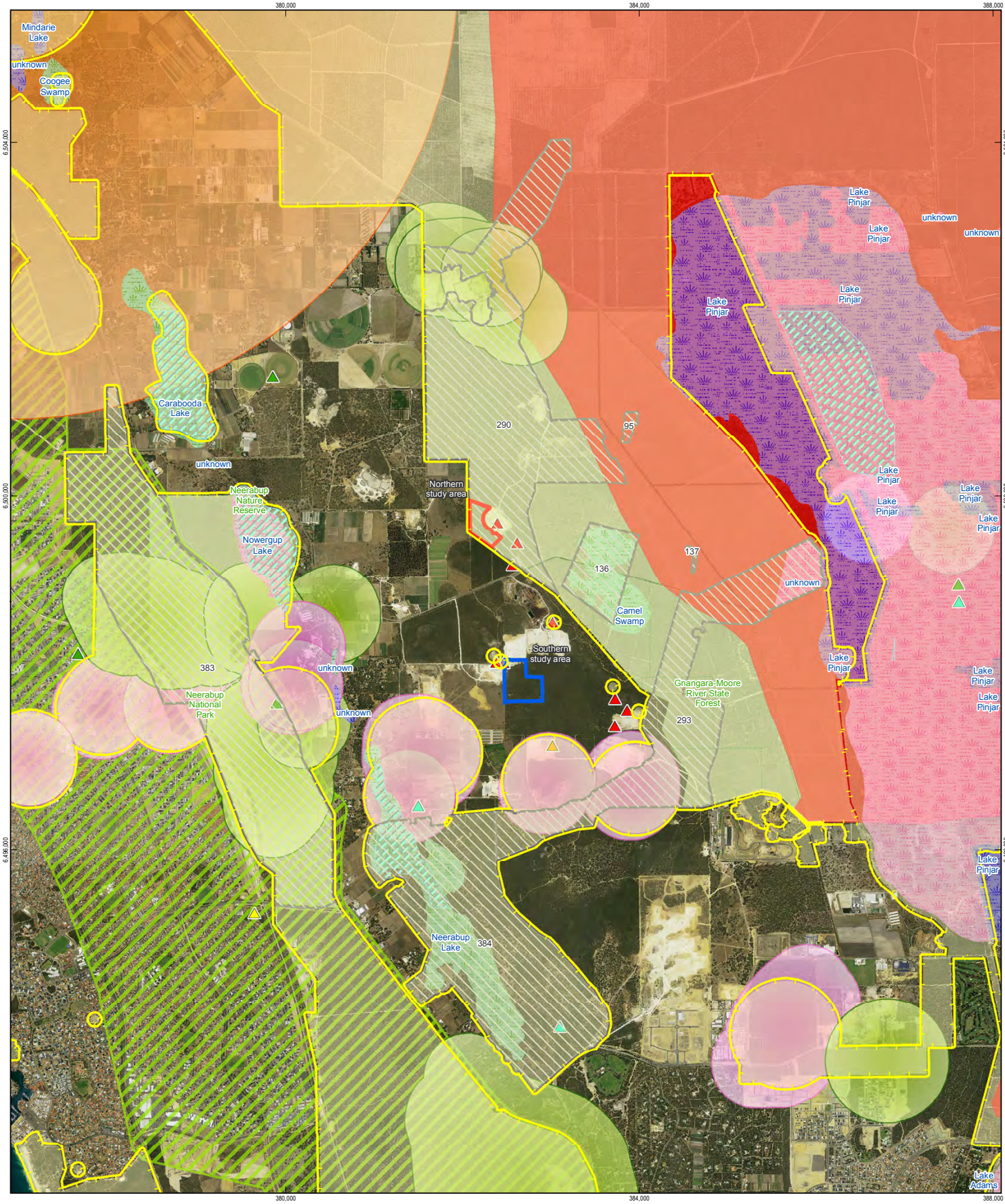
Job Number	61-30230
Revision	0
Date	30 Jan 2014

Figure 1

G:\61\30230\GIS\Maps\PDF\temp\6130230_G001_Rev0.mxd

239 Adelaide Terrace Perth WA 6004 Australia T 61 8 6222 8222 F 61 8 6222 8555 E permail@ghd.com.au W www.ghd.com.au

Data source: Landgate : Traveller Atlas - 2004; GHD : Study area - 20131211; GA: 250k Topo Serie 3 - 2006. Created by : vdinh



LEGEND

Threatened (Declared Rare) & Priority Flora

- T; (T) Threatened Rare Flora - Extant Taxa
- Priority 1 - Poorly Known Taxa
- Priority 3 - Poorly Known Taxa
- Priority 4 - Rare Taxa
- Environmentally Sensitive Area

Threatened Ecological Communities

- Critically Endangered
- Endangered
- Priority 3

Geomorphic Wetlands

- Conservation
- Resource Enhancement
- Multiple Use
- EPP lake

Public Drinking Water Source Area

- Protection Area-P1
- Protection Area-P3

- DPaW Estate
- Bush forever site
- Northern study area
- Southern study area

1: 40,000 (at A3)

0 0.2 0.4 0.8 1.2 1.6 2

Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 50

N

GHD

Cockburn Cement Ltd

powered by SLIP ENABLER

Cockburn Cement Ltd
Nowergup Flora and Fauna Survey

Job Number	61-30230
Revision	0
Date	30 Jan 2014

Environmental context

Figure 2

G:\61\30230\GIS\Maps\MXD\6130230_G002_Rev0.mxd

239 Adelaide Terrace Perth WA 6004 Australia T 61 8 6222 8222 F 61 8 6222 8555 E permail@ghd.com.au W www.ghd.com.au

Data source: Landgate - Traveller Atlas - 2004; DPaW: Threatened and priority species - 20131209, Geomorphic wetlands - 20131211, Threatened ecological communities - 20131209; DoW: Public drinking water source area - 20131211, DEC Estate - 20131211; GHD - Study area - 20131211; GA: 250k Topo Serie 3 - 2006; DPI: Bushforever site - 20131211. DPaW: Environmentally sensitive area - 20140130. Created by : vdinh

LEGEND

Prioirty Flora	Vegetation type	
P1	*Banksia sessilis* Tall Shrubland	Northern study area
P3	*Melaleuca huegelii* Tall Open Scrub	Southern study area
Quadrat	*Melaleuca systena* Open Heath	
	Highly Degraded	

1: 2,000 (at A3)

0 10 20 40 60 80 100

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 50

N

GHD

Cockburn Cement Ltd

powered by SLIP ENABLER

Cockburn Cement Ltd
Nowergup Flora and Fauna Survey

Vegetation types, survey sites and Priority flora locations

Job Number	61-30230
Revision	0
Date	30 Jan 2014

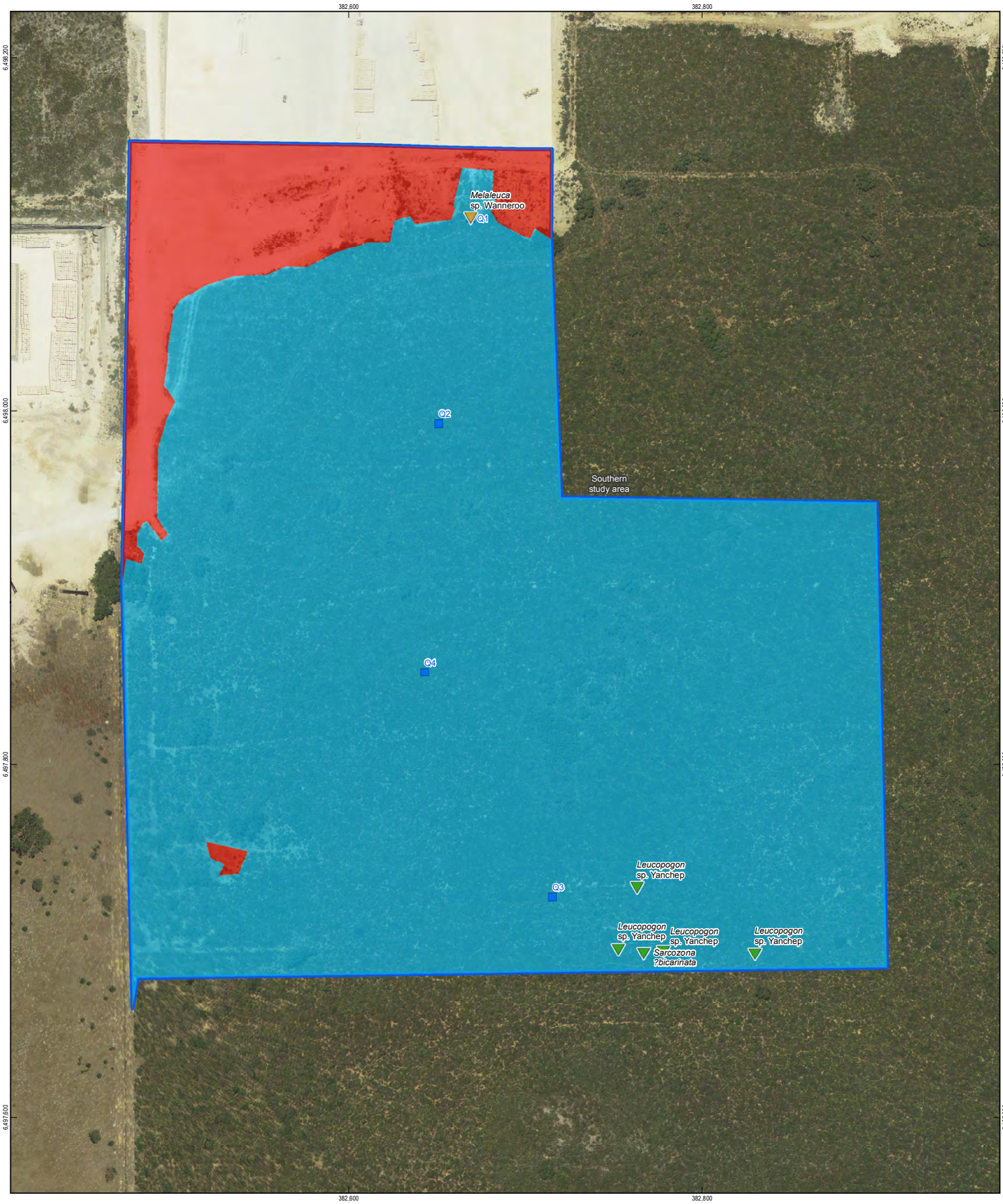
Map sheet 1 of 2

Figure 3

G:\61\30230\GIS\Maps\MXD\6130230_G003_Rev0.mxd

239 Adelaide Terrace Perth WA 6004 Australia T 61 8 6222 8222 F 61 8 6222 8555 E permail@ghd.com.au W www.ghd.com.au

Data source: Landgate - Metro North Mosaic - 2013; GHD - Study area - 20131211, Vegetation type - 20131211, Priority flora - 20140123. Created by : vdinh



LEGEND

Prioirty Flora

- P1
- P3
- Quadrat

Vegetation type

- *Banksia sessilis* Tall Shrubland
- *Melaleuca huegelii* Tall Open Scrub
- *Melaleuca systena* Open Heath
- Highly Degraded

- Northern study area
- Southern study area

1: 2,000 (at A3)

0 10 20 40 60 80 100

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 50

N

GHD

Cockburn Cement Ltd

powered by SLIP ENABLER

Cockburn Cement Ltd
Nowergup Flora and Fauna Survey

Vegetation types, survey sites and Priority flora locations

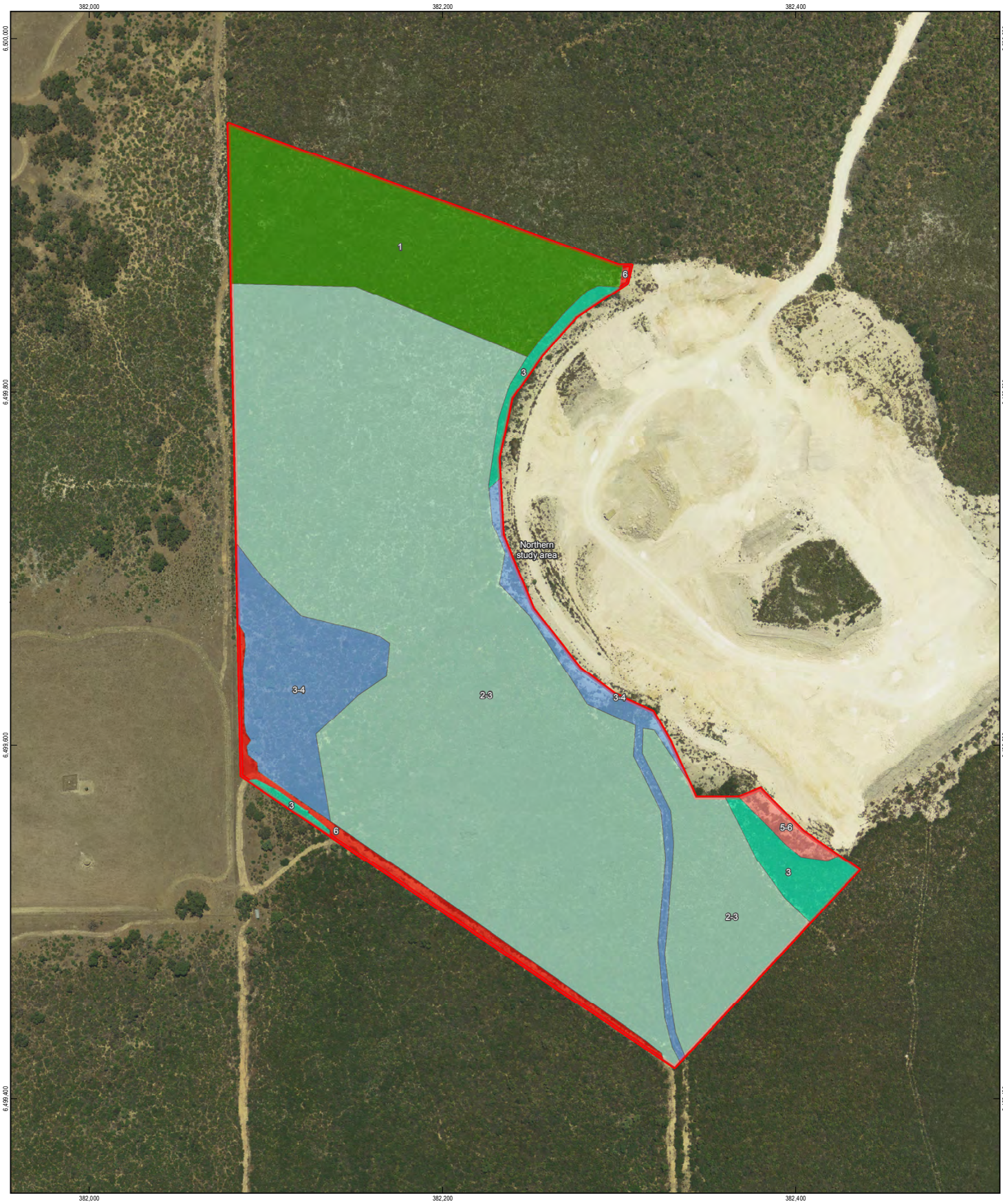
Job Number	61-30230
Revision	0
Date	30 Jan 2014

Map sheet 2 of 2

Figure 3

G:\61\30230\GIS\Maps\MXD\6130230_G003_Rev0.mxd

239 Adelaide Terrace Perth WA 6004 Australia T 61 8 6222 8222 F 61 8 6222 8555 E permail@ghd.com.au W www.ghd.com.au



LEGEND

Bridal Creeper

Vegetation condition

- 1. Pristine
- 1-2
- 2. Excellent
- 2-3
- 3. Very Good
- 3-4
- 4. Good
- 4-5
- 5. Degraded
- 5-6
- 6. Completely Degraded

- Northern study area
- Southern study area

1: 2,000 (at A3)

0 10 20 40 60 80 100

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 50

N

GHD

Cockburn Cement Ltd

powered by SLIP ENABLER

Cockburn Cement Ltd
Nowergup Flora and Fauna Survey

Vegetation condition & weeds

Job Number	61-30230
Revision	0
Date	30 Jan 2014

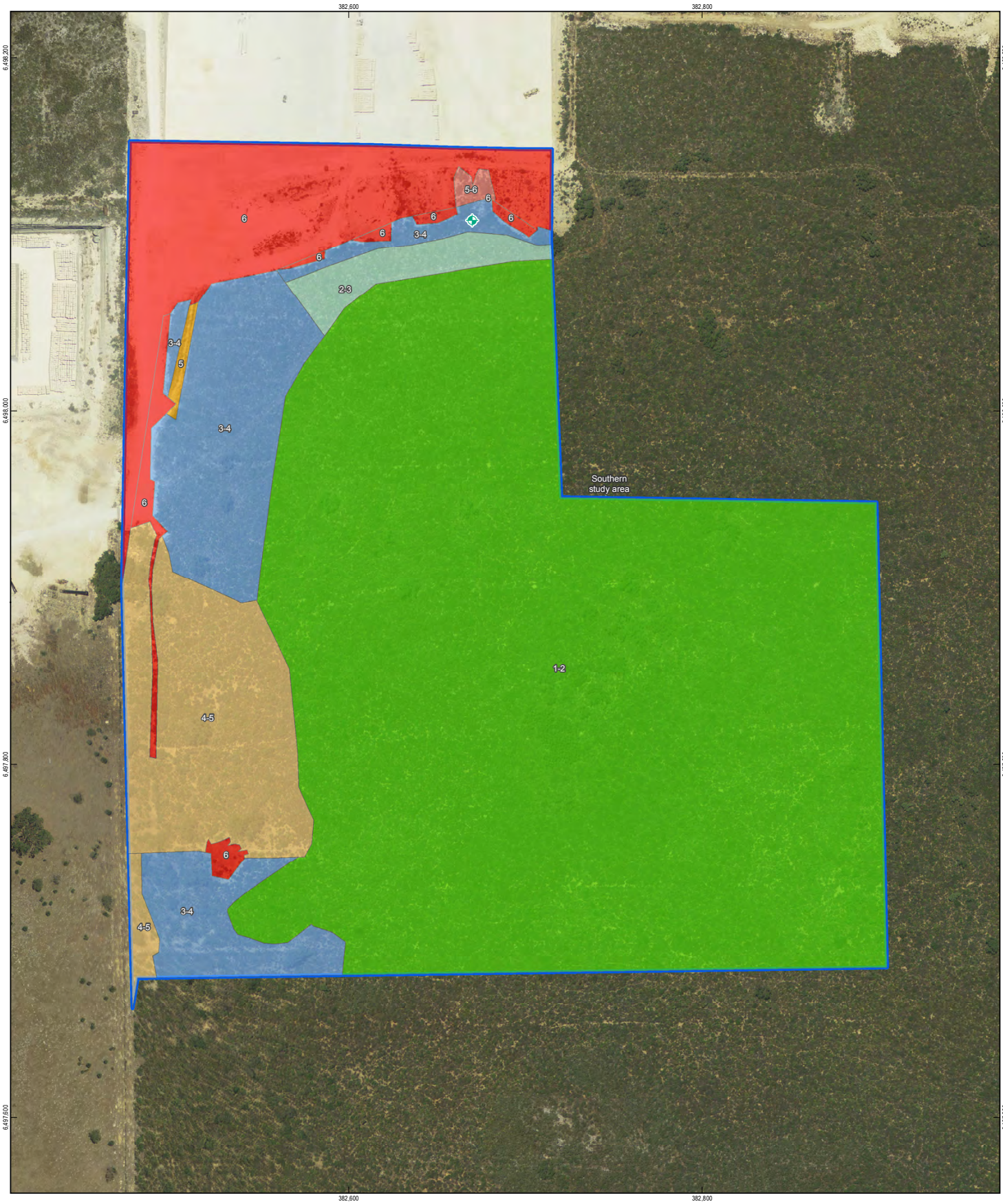
Map sheet 1 of 2

Figure 4

G:\61\30230\GIS\Maps\MXD\6130230_G004_Rev0.mxd

239 Adelaide Terrace Perth WA 6004 Australia T 61 8 6222 8222 F 61 8 6222 8555 E permail@ghd.com.au W www.ghd.com.au

Data source: Landgate - Metro North Mosaic - 2013; GHD - Study area - 20131211, Vegetation condition - 20131211, Bridal Creeper - 20140123. Created by : vdinh



LEGEND

Bridal Creeper

Vegetation condition

- 1. Pristine
- 1-2
- 2. Excellent
- 2-3
- 3. Very Good
- 3-4
- 4. Good
- 4-5
- 5. Degraded
- 5-6
- 6. Completely Degraded

Northern study area

Southern study area

1: 2,000 (at A3)

0 10 20 40 60 80 100

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 50

N

GHD

Cockburn Cement Ltd

powered by SLIP ENABLER

Cockburn Cement Ltd
Nowergup Flora and Fauna Survey

Job Number 61-30230
Revision 0
Date 30 Jan 2014

Map sheet 2 of 2

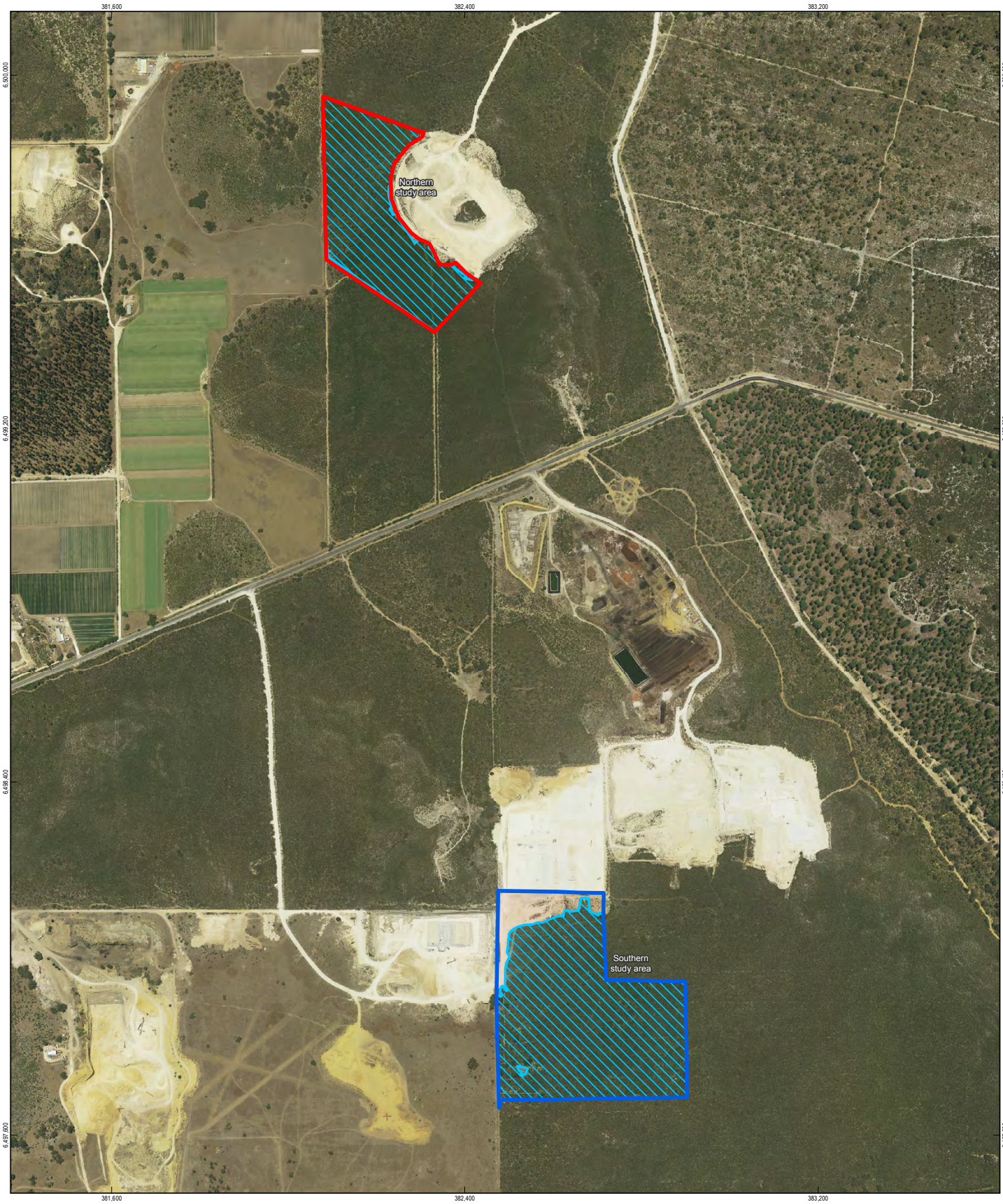
Vegetation condition & weeds

Figure 4

G:\61\30230\GIS\Maps\MXD\6130230_G004_Rev0.mxd

239 Adelaide Terrace Perth WA 6004 Australia T 61 8 6222 8222 F 61 8 6222 8555 E permail@ghd.com.au W www.ghd.com.au

Data source: Landgate - Metro North Mosaic - 2013; GHD - Study area - 20131211, Vegetation condition - 20131211, Bridal Creeper - 20140123. Created by : vdinh



LEGEND

- Mixed shrubland
- Northern study area
- Southern study area

1: 8,000 (at A3)

0 40 80 160 240 320 400

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 50

N

GHD

Cockburn Cement Ltd

powered by SLIP ENABLER

Cockburn Cement Ltd
Nowergup Flora and Fauna Survey

Job Number	61-30230
Revision	0
Date	30 Jan 2014

Fauna habitat types

Figure 5

G:\61\30230\GIS\Maps\MXD\6130230_G005_Rev0.mxd

239 Adelaide Terrace Perth WA 6004 Australia T 61 8 6222 8222 F 61 8 6222 8555 E permail@ghd.com.au W www.ghd.com.au

Appendix B – Conservation codes & background information

Conservation categories & definitions for *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) listed flora & fauna species

Conservation category	Definition
Extinct	Taxa not definitely located in the wild during the past 50 years
Extinct in the Wild	Taxa known to survive only in captivity
Critically Endangered	Taxa facing an extremely high risk of extinction in the wild in the immediate future
Endangered	Taxa facing a very high risk of extinction in the wild in the near future
Vulnerable	Taxa facing a high risk of extinction in the wild in the medium-term
Near Threatened	Taxa that risk becoming Vulnerable in the wild
Conservation Dependent	Taxa whose survival depends upon ongoing conservation measures. Without these measures, a conservation dependent taxon would be classified as Vulnerable or more severely threatened.
Data Deficient (Insufficiently Known)	Taxa suspected of being Rare, Vulnerable or Endangered, but whose true status cannot be determined without more information.
Least Concern	Taxa that are not considered Threatened

Migratory Species listed under the EPBC Act

The EPBC Act protects lands and migratory species that are listed under International Agreements. The list of migratory species established under section 209 of the EPBC Act comprises:

- Migratory species which are native to Australia and are included in the appendices to the Bonn Convention (Convention on the Conservation of Migratory Species of Wild Animals Appendices I and II);
- Migatory species included in annexes established under the Japan-Australia Migratory Bird Agreement (JAMBA) and the China-Australia Migratory Bird Agreement (CAMBA); and
- Native, migratory species identified in a list established under, or an instrument made under, an international agreement approved by the Minister, such as the republic of Korea-Australia Migratory Bird Agreement (ROKAMBA).

Conservation codes and descriptions for Western Australian flora & fauna

Code	Conservation category	Description
Wildlife Conservation Act 1950		
T	Schedule 1 under the WC Act	Threatened Fauna (Fauna that is rare or is likely to become extinct Threatened Flora (Declared Rare Flora – Extant) Taxa that 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. **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.
X	Schedule 2 under the WC Act	Presumed Extinct Fauna 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.
IA	Schedule 3 under the WC Act	Birds protected under an international agreement. Birds that are subject to an agreement between governments of Australia and Japan relating to the protection of migratory birds and birds in danger of extinction.
S	Schedule 4 under the WC Act	Other specially protected fauna. Fauna that is in need of special protection, otherwise than for the reasons mentioned in the above schedules.
DPaW Priority Listed		
1	Priority One: Poorly-known taxa	Taxa 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. Taxa 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.
2	Priority Two: Poorly-known taxa	Taxa 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. Taxa 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.

Code	Conservation category	Description
3	Priority Three: Poorly-known taxa	Taxa 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. Taxa 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.
4	Priority Four: Rare, Near Threatened and other taxa in need of monitoring	(a) Rare. Taxa 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 taxa are usually represented on conservation lands. (b) Near Threatened. Taxa 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) Taxa that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.
5	Priority 5: Conservation Dependent taxa	Taxa that are not threatened but are subject to a specific conservation program, the cessation of which would result in the taxon becoming threatened within five years.

Department of Agriculture and Food (Western Australia) Categories for Declared Pests under the *Biosecurity and Agriculture Management Act 2007*.

Control class code	Description
C1 (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.
C2 (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.
C3 (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.

Conservation codes & definitions for Threatened Ecological Communities (TEC) endorsed by the Western Australian Minister for the Environment & listed under the EPBC Act

Western Australia conservation categories		Federal Government Conservation Categories (EPBC Act)	
Presumed Totally Destroyed (PD)	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.	Critically Endangered (CR)	If, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future
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 or rehabilitated	Endangered (EN)	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
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.	Vulnerable (VU)	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
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.		

Conservation categories & definitions for Priority Ecological Communities (PEC) as listed by the DPaW

Category	Description
Priority 1	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 2	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 3	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 4	Ecological communities that are adequately known, rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list. These communities require regular monitoring. (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.

Category	Description
Priority 5	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.

Appendix C – Desktop searches

Environment Protection and Biodiversity Conservation Act 1999 Protected Matters Search Tool results

NatureMap flora search results

NatureMap fauna search results

Australian Government
Department of the Environment

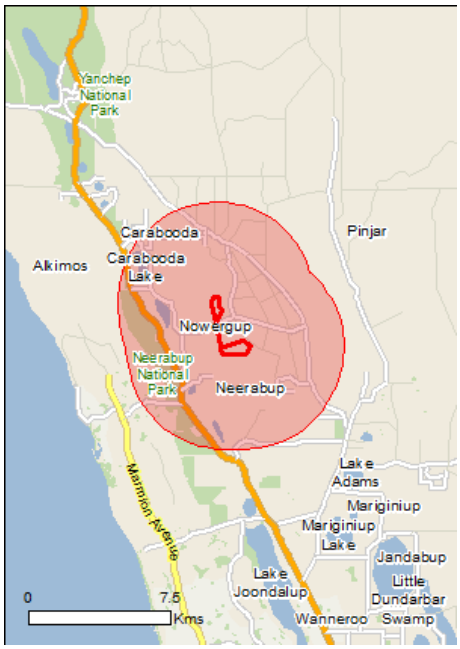
EPBC Act Protected Matters Report

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

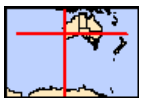
Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 31/10/13 16:00:23



Coordinates
Buffer: 5.0Km



Summary

Matters of National Environmental Significance

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

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

Other Matters Protected by the EPBC Act

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

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place and the heritage values of a place on the Register of the National Estate.

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

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

Commonwealth Land:	1
Commonwealth Heritage Places:	None
Listed Marine Species:	7
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Commonwealth Reserves Marine	None

Extra Information

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

Place on the RNE:	4
State and Territory Reserves:	2
Regional Forest Agreements:	None
Invasive Species:	36
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Listed Threatened Species		[Resource Information]
Name	Status	Type of Presence
Birds		
Calyptorhynchus baudinii		
Baudin's Black-Cockatoo, Long-billed Black-Cockatoo [769]	Vulnerable	Species or species habitat likely to occur within area
Calyptorhynchus latirostris		
Carnaby's Black-Cockatoo, Short-billed Black-Cockatoo [59523]	Endangered	Breeding likely to occur within area
Leipoa ocellata		
Malleefowl [934]	Vulnerable	Species or species habitat may occur within area
Rostratula australis		
Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area
Sternula nereis nereis		
Australian Fairy Tern [82950]	Vulnerable	Species or species habitat may occur within area
Mammals		
Dasyurus geoffroii		
Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat likely to occur within area
Plants		
Andersonia gracilis		
Slender Andersonia [14470]	Endangered	Species or species habitat may occur within area
Anigozanthos viridis subsp. terraspectans		
Dwarf Green Kangaroo Paw [3435]	Vulnerable	Species or species habitat likely to occur within area
Caladenia huegelii		
King Spider-orchid, Grand Spider-orchid, Rusty Spider-orchid [7309]	Endangered	Species or species habitat likely to occur within area

Name	Status	Type of Presence
Centrolepis caespitosa [6393]	Endangered	Species or species habitat may occur within area
Darwinia foetida Muchea Bell [83190]	Critically Endangered	Species or species habitat likely to occur within area
Diuris micrantha Dwarf Bee-orchid [55082]	Vulnerable	Species or species habitat likely to occur within area
Diuris purdiei Purdie's Donkey-orchid [12950]	Endangered	Species or species habitat may occur within area
Drakaea elastica Glossy-leafed Hammer-orchid, Praying Virgin [16753]	Endangered	Species or species habitat likely to occur within area
Drakaea micrantha Dwarf Hammer-orchid [56755]	Vulnerable	Species or species habitat may occur within area
Epiblema grandiflorum var. cyaneum Baby Blue Orchid, Blue Babe-in-the-cradle Orchid, Blue Babe-in-a-cradle [67182]	Endangered	Species or species habitat may occur within area
Eucalyptus argutifolia Yanchep Mallee, Wabling Hill Mallee [24263]	Vulnerable	Species or species habitat likely to occur within area
Lepidosperma rostratum Beaked Lepidosperma [14152]	Endangered	Species or species habitat likely to occur within area

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Migratory Wetlands Species		
Ardea alba Great Egret, White Egret [59541]		Species or species habitat known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat likely to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land -

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba		
Great Egret, White Egret [59541]		Species or species habitat known to occur within area
Ardea ibis		
Cattle Egret [59542]		Species or species habitat likely to occur within area
Haliaeetus leucogaster		
White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Merops ornatus		
Rainbow Bee-eater [670]		Species or species habitat may occur within area
Pandion haliaetus		
Osprey [952]		Species or species habitat likely to occur within area
Rostratula benghalensis (sensu lato)		
Painted Snipe [889]	Endangered*	Species or species habitat may occur within area

Extra Information

Places on the RNE [Resource Information]

Note that not all Indigenous sites may be listed.

Name	State	Status
Natural		
Wanneroo Wetlands Eastern Chain	WA	Indicative Place
Neerabup National Park	WA	Registered
Nowergup Lake Fauna Reserve	WA	Registered
Indigenous		
Orchestra Shell Cave	WA	Registered

State and Territory Reserves [Resource Information]

Name	State
Neerabup	WA
Neerabup	WA

Invasive Species

[Resource Information]

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

Name	Status	Type of Presence
Birds		
Acridotheres tristis Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Carduelis carduelis European Goldfinch [403]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Passer montanus Eurasian Tree Sparrow [406]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Streptopelia senegalensis Laughing Turtle-dove, Laughing Dove [781]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Funambulus pennantii Northern Palm Squirrel, Five-striped Palm Squirrel [129]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus norvegicus Brown Rat, Norway Rat [83]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Asparagus aethiopicus Asparagus Fern, Ground Asparagus, Basket Fern, Sprengi's Fern, Bushy Asparagus, Emerald Asparagus [62425]		Species or species habitat likely to occur within area
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Brachiaria mutica Para Grass [5879]		Species or species habitat may occur within area
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species habitat may occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat may occur within area
Chrysanthemoides monilifera subsp. monilifera Boneseed [16905]		Species or species habitat likely to occur within area
Genista linifolia Flax-leaved Broom, Mediterranean Broom, Flax Broom [2800]		Species or species habitat likely to occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat likely to occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Olea europaea Olive, Common Olive [9160]		Species or species habitat may occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Salvinia molesta Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area
Tamarix aphylla Athel Pine, Athel Tree, Tamarisk, Athel Tamarisk, Athel Tamarix, Desert Tamarisk, Flowering		Species or species habitat likely to occur

Name	Status	Type of Presence
Cypress, Salt Cedar [16018]		within area
Reptiles		
Hemidactylus frenatus		
Asian House Gecko [1708]		Species or species habitat likely to occur within area
Ramphotyphlops braminus		
Flowerpot Blind Snake, Brahminy Blind Snake, Cacing Besi [1258]		Species or species habitat likely to occur within area

Coordinates

-31.647817 115.759091,-31.645114 115.769477,-31.647087 115.773082,-31.650667 115.771451,-31.65074 115.75995,-31.647671 115.759006,-31.630499 115.754886,-31.627502 115.755229,-31.627064 115.758147,-31.63123 115.758576,-31.632618 115.759606,-31.637441 115.756516

Caveat

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

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

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

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

For species where the distributions are well known, maps are digitised from sources such as recovery plans and detailed habitat studies. Where appropriate, core breeding, foraging and roosting areas are indicated under 'type of presence'. For species whose distributions are less well known, point locations are collated from government wildlife authorities, museums, and non-government organisations; bioclimatic distribution models are generated and these validated by experts. In some cases, the distribution maps are based solely on expert knowledge.

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

- migratory and
- marine

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

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

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

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

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

Acknowledgements

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

-Department of Environment, Climate Change and Water, New South Wales
-Department of Sustainability and Environment, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment and Natural Resources, South Australia
-Parks and Wildlife Service NT, NT Dept of Natural Resources, Environment and the Arts
-Environmental and Resource Management, Queensland
-Department of Environment and Conservation, Western Australia
-Department of the Environment, Climate Change, Energy and Water
-Birds Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-SA Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Atherton and Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
-State Forests of NSW
-Geoscience Australia
-CSIRO
-Other groups and individuals

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

Please feel free to provide feedback via the Contact Us page.

Department of Sustainability, Environment, Water, Population and Communities
GPO Box 787
Canberra ACT 2601 Australia
+61 2 6274 1111

NatureMap
Mapping Western Australia's biodiversity

NatureMap Flora Species Report 5 km buffer

Created By Melissa Longman on 31/10/2013

Kingdom Plantae
Current Names Only Yes
Core Datasets Only Yes
Method 'By Line'
Group By Family

Family	Species	Records
Amaranthaceae	5	7
Apiaceae	5	20
Araceae	1	2
Araliaceae	2	12
Asparagaceae	15	41
Asteraceae	16	50
Brassicaceae	4	6
Campanulaceae	2	4
Caryophyllaceae	4	8
Casuarinaceae	2	7
Celastraceae	3	4
Centrolepidaceae	2	8
Chenopodiaceae	2	3
Convolvulaceae	1	1
Crassulaceae	1	3
Cyperaceae	18	42
Dasypogonaceae	1	2
Dilleniaceae	5	15
Droseraceae	4	20
Elaeocarpaceae	1	2
Ericaceae	10	25
Fabaceae	35	79
Geraniaceae	3	5
Goodeniaceae	6	8
Gyrostemonaceae	1	1
Haemodoraceae	8	23
Haloragaceae	3	6
Hemerocallidaceae	6	19
Hydatellaceae	1	1
Iridaceae	3	18
Lamiaceae	1	3
Lauraceae	2	4
Loranthaceae	1	1
Malvaceae	1	2
Menyanthaceae	1	1
Myrtaceae	24	59
Orchidaceae	15	42
Oxalidaceae	1	1
Phyllanthaceae	2	13
Phytolaccaceae	1	1
Poaceae	16	49
Polygalaceae	3	3
Portulacaceae	2	2
Proteaceae	20	38
Restionaceae	4	5
Rhamnaceae	3	6
Rubiaceae	2	2
Rutaceae	2	5
Santalaceae	2	2
Sapindaceae	1	1
Solanaceae	1	1
Stylidiaceae	8	14
Thymelaeaceae	5	7
Violaceae	1	4
Xanthorrhoeaceae	1	9
Zamiaceae	1	3
TOTAL	**291**	**720**

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
Amaranthaceae					
1.	2668	*Amaranthus powellii (Powell's Amaranth)*	Y		
2.	2671	*Amaranthus viridis (Green Amaranth)*	Y		
3.	11260	*Ptilotus drummondii var. drummondii (Pussytail)*			
4.	2742	*Ptilotus manglesii (Pom Poms, Mulamula)*			
5.	2751	*Ptilotus polystachyus (Prince of Wales Feather)*			
Apiaceae					
6.	6205	*Actinotus leucocephalus (Flannel Flower)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
7.	6218	*Daucus glochidiatus (Australian Carrot)*			
8.	15446	*Eryngium pinnatifidum subsp. pinnatifidum*			
9.	6222	*Homalosciadium homalocarpum*			
10.	6289	*Xanthosia huegelii*			
Araceae					
11.	28342	*Landoltia punctata (Thin Duckweed)*			
Araliaceae					
12.	6232	*Hydrocotyle hispidula*			
13.	6280	*Trachymene pilosa (Native Parsnip)*			
Asparagaceae					
14.	1208	*Acanthocarpus preissii*			
15.	1280	*Chamaescilla corymbosa (Blue Squill)*			
16.	1287	*Dichopogon capillipes*			
17.	1223	*Lomandra caespitosa (Tufted Mat Rush)*			
18.	1228	*Lomandra hermaphrodita*			
19.	1231	*Lomandra maritima*			
20.	14542	*Lomandra micrantha subsp. micrantha*			
21.	1234	*Lomandra nigricans*			
22.	1239	*Lomandra preissii*			
23.	1246	*Lomandra suaveolens*			
24.	1312	*Sowerbaea laxiflora (Purple Tassels)*			
25.	1338	*Thysanotus manglesianus (Fringed Lily)*			
26.	1339	*Thysanotus multiflorus (Many-flowered Fringe Lily)*			
27.	1343	*Thysanotus patersonii*			
28.	1351	*Thysanotus sparteus*			
Asteraceae					
29.	7909	*Carduus pycnocephalus (Slender Thistle)*	Y		
30.	7937	*Cirsium vulgare (Spear Thistle)*	Y		
31.	8005	*Gnephosis uniflora*			
32.	8086	*Hypochaeris glabra (Smooth Catsear)*	Y		
33.	8106	*Millotia tenuifolia (Soft Millotia)*			
34.	8175	*Podolepis gracilis (Slender Podolepis)*			
35.	8177	*Podolepis lessonii*			
36.	8195	*Quinetia urvillei*			
37.	13312	*Rhodanthe pyrethrum*			
38.	8225	*Siloxerus humifusus (Procumbent Siloxerus)*			
39.	8230	*Sonchus asper (Rough Sowthistle)*	Y		
40.	9367	*Sonchus hydrophilus (Native Sowthistle)*			
41.	8231	*Sonchus oleraceus (Common Sowthistle)*	Y		
42.	8254	*Urospermum picroides (False Hawkbit)*	Y		
43.	8255	*Ursinia anthemoides (Ursinia)*	Y		
44.	8282	*Waitzia suaveolens (Fragrant Waitzia)*			
Brassicaceae					
45.	11187	*Brassica barrelieri subsp. oxyrrhina (Smooth-stem Turnip)*	Y		
46.	3000	*Brassica tournefortii (Mediterranean Turnip)*	Y		
47.	3016	*Heliophila pusilla*	Y		
48.	3080	*Stenopetalum robustum*			
Campanulaceae					
49.	7408	*Lobelia tenuior (Slender Lobelia)*			
50.	7389	*Wahlenbergia preissii*			
Caryophyllaceae					
51.	2889	*Cerastium glomeratum (Mouse Ear Chickweed)*	Y		
52.	16693	*Minuartia mediterranea*	Y		
53.	2910	*Silene nocturna (Mediterranean Catchfly)*	Y		
54.	2918	*Stellaria media (Chickweed)*	Y		
Casuarinaceae					
55.	1728	*Allocasuarina fraseriana (Sheoak, Kondil)*			
56.	1732	*Allocasuarina humilis (Dwarf Sheoak)*			
Celastraceae					
57.	4733	*Stackhousia monogyna*			
58.	4737	*Tripterococcus brunonis (Winged Stackhousia)*			
59.	16998	*Tripterococcus paniculatus*		P4	
Centrolepidaceae					
60.	1125	*Centrolepis drummondiana*			
61.	1132	*Centrolepis mutica*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
Chenopodiaceae					
62.	2483	*Chenopodium album (Fat Hen)*	Y		
63.	11341	*Rhagodia baccata subsp. baccata*			
Convolvulaceae					
64.	11021	*Cuscuta planiflora*	Y		
Crassulaceae					
65.	3137	*Crassula colorata (Dense Stonecrop)*			
Cyperaceae					
66.	740	*Baumea arthrophylla*			
67.	757	*Carex preissii*			
68.	910	*Isolepis cernua (Nodding Club-rush)*			
69.	925	*Lepidosperma angustatum*			
70.	944	*Lepidosperma scabrum*			
71.	945	*Lepidosperma squamatum*			
72.	946	*Lepidosperma striatum*			
73.	955	*Mesomelaena pseudostygia*			
74.	973	*Schoenus asperocarpus (Poison Sedge)*			
75.	982	*Schoenus clandestinus*			
76.	984	*Schoenus curvifolius*			
77.	985	*Schoenus discifer*			
78.	992	*Schoenus grandiflorus (Large Flowered Bogrush)*			
79.	997	*Schoenus lanatus (Woolly Bog-rush)*			
80.	1006	*Schoenus odontocarpus*			
81.	1018	*Schoenus subfascicularis*			
82.	1023	*Schoenus tenellus*			
83.	1036	*Tetraria octandra*			
Dasypogonaceae					
84.	1213	*Calectasia cyanea (Blue Tinsel Lily)*		T	
Dilleniaceae					
85.	5112	*Hibbertia aurea*			
86.	5134	*Hibbertia huegelii*			
87.	5135	*Hibbertia hypericoides (Yellow Buttercups)*			
88.	5162	*Hibbertia racemosa (Stalked Guinea Flower)*			
89.	11461	*Hibbertia spicata subsp. leptotheca*		P3	
Droseraceae					
90.	3095	*Drosera erythrorhiza (Red Ink Sundew)*			
91.	3106	*Drosera macrantha (Bridal Rainbow)*			
92.	13216	*Drosera menziesii subsp. penicillaris*			
93.	3118	*Drosera pallida (Pale Rainbow)*			
Elaeocarpaceae					
94.	4524	*Platytheca galioides*			
Ericaceae					
95.	6311	*Andersonia heterophylla*			
96.	6314	*Andersonia lehmanniana*			
97.	6323	*Astroloma ciliatum (Candle Cranberry)*			
98.	6331	*Astroloma microcalyx (Native Cranberry)*			
99.	6334	*Astroloma pallidum (Kick Bush)*			
100.	6348	*Conostephium pendulum (Pearl Flower)*			
101.	6427	*Leucopogon parviflorus (Coast Beard-heath)*			
102.	6434	*Leucopogon polymorphus*			
103.	6456	*Lysinema ciliatum (Curry Flower)*			
104.	34736	*Lysinema pentapetalum*			
Fabaceae					
105.	15470	*Acacia barbinervis subsp. borealis*			
106.	3237	*Acacia benthamii*		P2	
107.	3282	*Acacia cyclops (Coastal Wattle)*			
108.	3409	*Acacia lasiocarpa (Panjang)*			
109.	11611	*Acacia lasiocarpa var. lasiocarpa*			
110.	3502	*Acacia pulchella (Prickly Moses)*			
111.	15482	*Acacia pulchella var. goadbyi*			
112.	3525	*Acacia rostellifera (Summer-scented Wattle)*			
113.	3527	*Acacia saligna (Orange Wattle, Kudjong)*			
114.	30032	*Acacia saligna subsp. saligna*			
115.	3584	*Acacia truncata*			
116.	3602	*Acacia willdenowiana (Grass Wattle)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
117.	3710	*Bossiaea eriocarpa (Common Brown Pea)*			
118.	3793	*Daviesia angulata*			
119.	3805	*Daviesia decurrens (Prickly Bitter-pea)*			
120.	3807	*Daviesia divaricata (Marno)*			
121.	3824	*Daviesia nudiflora*			
122.	3845	*Daviesia triflora*			
123.	20483	*Gastrolobium linearifolium*			
124.	3957	*Gompholobium tomentosum (Hairy Yellow Pea)*			
125.	3961	*Hardenbergia comptoniana (Native Wisteria)*			
126.	3966	*Hovea pungens (Devil's Pins, Puyenak)*			
127.	12859	*Hovea trisperma var. trisperma*			
128.	3992	*Isotropis cuneifolia (Granny Bonnets)*			
129.	14783	*Jacksonia calcicola*			
130.	4027	*Jacksonia sericea (Waldjumi)*		P4	
131.	4029	*Jacksonia sternbergiana (Stinkwood, Kapur)*			
132.	4044	*Kennedia prostrata (Scarlet Runner)*			
133.	4207	*Sphaerolobium medium*			
134.	4256	*Templetonia retusa (Cockies Tongues)*			
135.	4292	*Trifolium campestre (Hop Clover)*	Y		
136.	4295	*Trifolium dubium (Suckling Clover)*	Y		
137.	4297	*Trifolium glomeratum (Cluster Clover)*	Y		
138.	4322	*Vicia sativa (Common Vetch)*	Y		
139.	4325	*Viminaria juncea (Swishbush, Koweda)*			
Geraniaceae					
140.	4339	*Geranium molle (Dove's Foot Cranesbill)*	Y		
141.	4343	*Pelargonium capitatum (Rose Pelargonium)*	Y		
142.	4346	*Pelargonium littorale*			
Goodeniaceae					
143.	19286	*Goodenia pulchella subsp. Coastal Plain A (M. Hislop 634)*			
144.	7574	*Lechenaultia floribunda (Free-flowering Leschenaultia)*			
145.	7580	*Lechenaultia linarioides (Yellow Leschenaultia)*			
146.	7603	*Scaevola canescens (Grey Scaevola)*			
147.	13182	*Scaevola repens var. repens*			
148.	13152	*Scaevola thesioides subsp. thesioides*			
Gyrostemonaceae					
149.	2784	*Gyrostemon ramulosus (Corkybark)*			
Haemodoraceae					
150.	1409	*Anigozanthos humilis (Catspaw)*			
151.	1418	*Conostylis aculeata (Prickly Conostylis)*			
152.	11826	*Conostylis aculeata subsp. aculeata*			
153.	1427	*Conostylis candicans (Grey Cottonhead)*			
154.	1443	*Conostylis pauciflora (Dawesville Conostylis)*			
155.	1454	*Conostylis setigera (Bristly Cottonhead)*			
156.	1468	*Haemodorum laxum*			
157.	1478	*Phlebocarya ciliata*			
Haloragaceae					
158.	6143	*Glischrocaryon aureum (Common Popflower)*			
159.	6161	*Gonocarpus pithyoides*			
160.	6192	*Myriophyllum drummondii*			
Hemerocallidaceae					
161.	1276	*Caesia micrantha (Pale Grass Lily)*			
162.	1285	*Corynotheca micrantha (Sand Lily)*			
163.	1259	*Dianella revoluta (Blueberry Lily)*			
164.	1293	*Hensmania turbinata*			
165.	1260	*Stypandra glauca (Blind Grass)*			
166.	1361	*Tricoryne elatior (Yellow Autumn Lily)*			
Hydatellaceae					
167.	1141	*Trithuria submersa*			
Iridaceae					
168.	1520	*Gladiolus caryophyllaceus (Wild Gladiolus)*	Y		
169.	1537	*Orthrosanthus laxus (Morning Iris)*			
170.	1556	*Romulea rosea (Guildford Grass)*	Y		
Lamiaceae					
171.	16934	*Hemiandra glabra subsp. glabra*			
Lauraceae					

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
172.	2952	*Cassytha glabella (Tangled Dodder Laurel)*			
173.	2957	*Cassytha racemosa (Dodder Laurel)*			
Loranthaceae					
174.	2401	*Nuytsia floribunda (Christmas Tree, Mudja)*			
Malvaceae					
175.	5105	*Thomasia triphylla*			
Menyanthaceae					
176.	36177	*Ornduffia albiflora*			
Myrtaceae					
177.	20283	*Astartea scoparia*			
178.	5382	*Beaufortia elegans*			
179.	5415	*Calothamnus lateralis*			
180.	5426	*Calothamnus quadrifidus (One-sided Bottlebrush, Kwowdjard)*			
181.	5429	*Calothamnus sanguineus (Silky-leaved Blood flower, Pindak)*			
182.	5458	*Calytrix flavescens (Summer Starflower)*			
183.	17104	*Corymbia calophylla (Marri)*			
184.	13091	*Eucalyptus argutifolia (Wabling Hill Mallee)*		T	
185.	13536	*Eucalyptus decipiens subsp. decipiens*			
186.	5649	*Eucalyptus foecunda (Narrow-leaved Red Mallee)*			
187.	5659	*Eucalyptus gomphocephala (Tuart, Duart)*			
188.	5708	*Eucalyptus marginata (Jarrah, Djara)*			
189.	20808	*Eucalyptus petiolaris*	Y		
190.	13541	*Eucalyptus petrensis*			
191.	13511	*Eucalyptus rudis subsp. rudis*			
192.	5847	*Leptospermum erubescens (Roadside Teatree)*			
193.	5920	*Melaleuca huegelii (Chenille Honeymyrtle)*			
194.	5952	*Melaleuca preissiana (Moonah)*			
195.	33022	*Melaleuca sp. Wanneroo (G.J. Keighery 16705)*		P1	Y
196.	18598	*Melaleuca systena*			
197.	5978	*Melaleuca teretifolia (Banbar)*			
198.	5986	*Melaleuca urceolaris*			
199.	6012	*Regelia ciliata*			
200.	15432	*Verticordia densiflora var. densiflora*			
Orchidaceae					
201.	11038	*Caladenia bicalliata*			
202.	1592	*Caladenia flava (Cowslip Orchid)*			
203.	1595	*Caladenia hirta (Sugar Candy Orchid)*			
204.	1599	*Caladenia latifolia (Pink Fairy Orchid)*			
205.	10916	*Cyrtostylis huegelii*			
206.	19649	*Disa bracteata*	Y		
207.	1635	*Diuris longifolia (Common Donkey Orchid)*			
208.	1643	*Elythranthera brunonis (Purple Enamel Orchid)*			
209.	1645	*Epiblema grandiflorum (Babe-in-a-cradle)*			
210.	1646	*Eriochilus dilatatus (White Bunny Orchid)*			
211.	1653	*Leporella fimbriata (Hare Orchid)*			
212.	15419	*Microtis media subsp. media*			
213.	17267	*Pterostylis brevisepala*			
214.	12217	*Pterostylis sanguinea*			
215.	1698	*Pterostylis vittata (Banded Greenhood)*			
Oxalidaceae					
216.	4356	*Oxalis pes-caprae (Soursob)*	Y		
Phyllanthaceae					
217.	4675	*Phyllanthus calycinus (False Boronia)*			
218.	4691	*Poranthera microphylla (Small Poranthera)*			
Phytolaccaceae					
219.	2793	*Phytolacca octandra (Red Ink Plant)*	Y		
Poaceae					
220.	184	*Aira caryophyllea (Silvery Hairgrass)*	Y		
221.	17240	*Austrostipa flavescens*			
222.	231	*Avellinia michelii*	Y		
223.	233	*Avena barbata (Bearded Oat)*	Y		
224.	244	*Briza maxima (Blowfly Grass)*	Y		
225.	245	*Briza minor (Shivery Grass)*	Y		
226.	249	*Bromus diandrus (Great Brome)*	Y		
227.	347	*Ehrharta calycina (Perennial Veldt Grass)*	Y		
228.	349	*Ehrharta longiflora (Annual Veldt Grass)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
			Y		
229.	376	*Eragrostis curvula (African Lovegrass)*	Y		
230.	445	*Holcus setiger (Annual Fog)*	Y		
231.	467	*Lagurus ovatus (Hare's Tail Grass)*	Y		
232.	485	*Microlaena stipoides (Weeping Grass)*			
233.	573	*Poa drummondiana (Knotted Poa)*			
234.	578	*Poa porphyroclados*			
235.	724	*Vulpia myuros (Rat's Tail Fescue)*	Y		
Polygalaceae					
236.	4550	*Comesperma calymega (Blue-spike Milkwort)*			
237.	4552	*Comesperma confertum*			
238.	4554	*Comesperma flavum*			
Portulacaceae					
239.	2848	*Calandrinia corrigioloides (Strap Purslane)*			
240.	2856	*Calandrinia liniflora (Parakeelya)*			
Proteaceae					
241.	1800	*Banksia attenuata (Slender Banksia, Piara)*			
242.	11386	*Banksia leptophylla var. melletica*			
243.	1834	*Banksia menziesii (Firewood Banksia)*			
244.	32077	*Banksia sessilis var. cygnorum*			
245.	1876	*Conospermum incurvum (Plume Smokebush)*			
246.	1885	*Conospermum triplinervium (Tree Smokebush)*			
247.	15839	*Grevillea preissii subsp. preissii*			
248.	2119	*Grevillea vestita*			
249.	12824	*Grevillea vestita subsp. vestita*			
250.	2146	*Hakea costata (Ribbed Hakea)*			
251.	2175	*Hakea lissocarpha (Honey Bush)*			
252.	2203	*Hakea ruscifolia (Candle Hakea)*			
253.	2214	*Hakea trifurcata (Two-leaf Hakea)*			
254.	2258	*Persoonia comata*			
255.	2273	*Persoonia saccata (Snottygobble)*			
256.	20368	*Petrophile axillaris*			
257.	2299	*Petrophile linearis (Pixie Mops)*			
258.	2301	*Petrophile macrostachya*			
259.	2309	*Petrophile serruriae*			
260.	2316	*Stirlingia latifolia (Blueboy)*			
Restionaceae					
261.	17663	*Desmocladus asper*			
262.	1070	*Hypolaena exsulca*			
263.	1090	*Lepyrodia muirii*			
264.	17694	*Meeboldina scariosa*			
Rhamnaceae					
265.	4802	*Cryptandra mutila*			
266.	4810	*Cryptandra scoparia*			
267.	4828	*Spyridium globulosum (Basket Bush)*			
Rubiaceae					
268.	7323	*Galium murale (Small Goosegrass)*	Y		
269.	18255	*Opercularia vaginata (Dog Weed)*			
Rutaceae					
270.	17665	*Boronia purdieana subsp. purdieana*			
271.	4453	*Diplolaena angustifolia (Yanchep Rose)*			
Santalaceae					
272.	2344	*Leptomeria empetriformis*			
273.	2352	*Leptomeria preissiana*			
Sapindaceae					
274.	4746	*Diplopeltis huegelii*			
Solanaceae					
275.	6988	*Solanum americanum (Glossy Nightshade)*	Y		
Stylidiaceae					
276.	7677	*Levenhookia stipitata (Common Stylewort)*			
277.	7693	*Stylidium brunonianum (Pink Fountain Triggerplant)*			
278.	7696	*Stylidium calcaratum (Book Triggerplant)*			
279.	7717	*Stylidium divaricatum (Daddy-long-legs)*			
280.	7745	*Stylidium junceum (Reed Triggerplant)*			
281.	7756	*Stylidium longitubum (Jumping Jacks)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
				P3	
282.	13127	*Stylidium maritimum*		P3	
283.	7774	*Stylidium piliferum (Common Butterfly Triggerplant)*			
Thymelaeaceae					
284.	5232	*Pimelea argentea (Silvery Leaved Pimelea)*			
285.	5237	*Pimelea calcicola*		P3	
286.	5243	*Pimelea ferruginea*			
287.	18117	*Pimelea rosea subsp. rosea*			
288.	5268	*Pimelea sulphurea (Yellow Banjine)*			
Violaceae					
289.	5216	*Hybanthus calycinus (Wild Violet)*			
Xanthorrhoeaceae					
290.	1256	*Xanthorrhoea preissii (Grass tree, Palga)*			
Zamiaceae					
291.	85	*Macrozamia riedlei (Zamia, Djiridji)*			

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

[1] For NatureMap's purposes, species flagged as endemic are those whose records are wholely contained within the search area. Note that only those records complying with the search criterion are included in the calculation. For example, if you limit records to those from a specific datasource, only records from that datasource are used to determine if a species is restricted to the query area.

NatureMap
Mapping Western Australia's biodiversity

NatureMap Fauna Species Report 5 km buffer

Created By Melissa Longman on 31/10/2013

Kingdom Animalia
Current Names Only Yes
Core Datasets Only Yes
Method 'By Line'
Group By Family

Family	Species	Records
Acanthizidae	6	50
Accipitridae	6	27
Agamidae	2	4
Anatidae	9	45
Araneidae	4	4
Ardeidae	3	4
Artamidae	2	6
Atemnidae	1	1
Barychelidae	1	1
Boidae	2	2
Bovidae	2	2
Campephagidae	1	19
Caprimulgidae	1	1
Carangidae	1	1
Castniidae	1	3
Charadriidae	1	2
Cheluidae	1	2
Colletidae	1	4
Columbidae	5	26
Corvidae	3	27
Cracticidae	6	38
Cuculidae	2	3
Dasyuridae	1	1
Dicaeidae	1	2
Dicruridae	3	32
Diplodactylidae	3	4
Elapidae	10	25
Falconidae	2	12
Felidae	1	2
Gekkonidae	1	5
Halcyonidae	2	14
Hirundinidae	1	15
Hyriidae	1	1
Ixodidae	1	1
Julidae	1	4
Leporidae	1	2
Limnodynastidae	2	23
Macropodidae	3	5
Maluridae	4	16
Meliphagidae	7	89
Meropidae	1	5
Micropholcommatidae	2	3
Muridae	3	33
Myobatrachidae	3	10
Neosittidae	1	2
Pachycephalidae	6	18
Paradoxosomatidae	1	3
Pararchaeidae	1	1
Pardalotidae	2	12
Peramelidae	1	25
Peripatopsidae	1	1
Petroicidae	2	2
Podicipedidae	3	9
Potoroidae	2	2
Procellariidae	1	2
Psittacidae	12	48
Pygopodidae	5	9
Rallidae	3	14
Recurvirostridae	1	5
Scincidae	12	73
Scolopendridae	4	62
Strigidae	1	1
Sylviidae	1	1
Tarsipedidae	1	5
Tettigoniidae	1	2
Threskiornithidae	3	11
Typhlopidae	1	2
Urodacidae	1	12
Varanidae	1	1
Zosteropidae	1	15
TOTAL	**184**	**914**

Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
Acanthizidae					
1.	24260	*Acanthiza apicalis (Broad-tailed Thornbill, Inland Thornbill)*			
2.	24261	*Acanthiza chrysorrhoa (Yellow-rumped Thornbill)*			
3.	24262	*Acanthiza inornata (Western Thornbill)*			
4.	25530	*Gerygone fusca (Western Gerygone)*			
5.	25534	*Sericornis frontalis (White-browed Scrubwren)*			
6.	30948	*Smicrornis brevirostris (Weebill)*			
Accipitridae					
7.	25535	*Accipiter cirrocephalus (Collared Sparrowhawk)*			
8.	25536	*Accipiter fasciatus (Brown Goshawk)*			
9.	24282	*Accipiter fasciatus subsp. fasciatus (Brown Goshawk)*			
10.	24285	*Aquila audax (Wedge-tailed Eagle)*			
11.	24288	*Circus approximans (Swamp Harrier)*			
12.	24295	*Haliastur sphenurus (Whistling Kite)*			
Agamidae					
13.	30899	*Ctenophorus adelaidensis (Southern Heath Dragon, Western Heath Dragon)*			
14.	24907	*Pogona minor subsp. minor (Dwarf Bearded Dragon)*			
Anatidae					
15.	24312	*Anas gracilis (Grey Teal)*			
16.	24315	*Anas rhynchotis (Australasian Shoveler)*			
17.	24316	*Anas superciliosa (Pacific Black Duck)*			
18.	24318	*Aythya australis (Hardhead)*			
19.	24319	*Biziura lobata (Musk Duck)*			
20.	24321	*Chenonetta jubata (Australian Wood Duck, Wood Duck)*			
21.	24322	*Cygnus atratus (Black Swan)*			
22.	24328	*Oxyura australis (Blue-billed Duck)*			
23.	24331	*Tadorna tadornoides (Australian Shelduck, Mountain Duck)*			
Araneidae					
24.	-13382	*Araneus cyphoxis*			
25.	-12899	*Araneus senicaudatus*			
26.	-11836	*Austracantha minax*			
27.	-13400	*Paraplectanoides crassipes*			
Ardeidae					
28.	41324	*Ardea modesta (Eastern Great Egret)*		IA	
29.	24341	*Ardea pacifica (White-necked Heron)*			
30.	25564	*Nycticorax caledonicus (Rufous Night Heron)*			
Artamidae					
31.	25566	*Artamus cinereus (Black-faced Woodswallow)*			
32.	24353	*Artamus cyanopterus (Dusky Woodswallow)*			
Atemnidae					
33.	-12804	*Oratemnus curtus*			
Barychelidae					
34.	-13273	*Idiommata blackwalli*			
Boidae					
35.	25241	*Antaresia stimsoni subsp. stimsoni (Stimson's Python)*			
36.	25240	*Morelia spilota subsp. imbricata (Carpet Python)*		S	
Bovidae					
37.	24251	*Bos taurus (European Cattle)*	Y		
38.	34016	*Ovis aries (Sheep)*			
Campephagidae					
39.	25568	*Coracina novaehollandiae (Black-faced Cuckoo-shrike)*			
Caprimulgidae					
40.	24368	*Eurostopodus argus (Spotted Nightjar)*			
Carangidae					
41.	-15884	*Seriola lalandi*			
Castniidae					
42.	33992	*Synemon gratiosa (Graceful Sunmoth)*		P4	
Charadriidae					
43.	24377	*Charadrius ruficapillus (Red-capped Plover)*			
Cheluidae					
44.	25337	*Chelodina oblonga (Oblong Turtle)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
Colletidae					
45.	33977	*Hylaeus globuliferus (bee)*		P3	
Columbidae					
46.	24399	*Columba livia (Domestic Pigeon)*	Y		
47.	24407	*Ocyphaps lophotes (Crested Pigeon)*			
48.	24409	*Phaps chalcoptera (Common Bronzewing)*			
49.	25589	*Streptopelia chinensis (Spotted Turtle-Dove)*	Y		
50.	25590	*Streptopelia senegalensis (Laughing Turtle-Dove)*	Y		
Corvidae					
51.	24416	*Corvus bennetti (Little Crow)*			
52.	25592	*Corvus coronoides (Australian Raven)*			
53.	24417	*Corvus coronoides subsp. perplexus (Australian Raven)*			
Cracticidae					
54.	24420	*Cracticus nigrogularis (Pied Butcherbird)*			
55.	25595	*Cracticus tibicen (Australian Magpie)*			
56.	24422	*Cracticus tibicen subsp. dorsalis (White-backed Magpie)*			
57.	25596	*Cracticus torquatus (Grey Butcherbird)*			
58.	24424	*Cracticus torquatus subsp. torquatus (Grey Butcherbird)*			
59.	25597	*Strepera versicolor (Grey Currawong)*			
Cuculidae					
60.	25598	*Cacomantis flabelliformis (Fan-tailed Cuckoo)*			
61.	42307	*Cacomantis pallidus (Pallid Cuckoo)*			
Dasyuridae					
62.	24092	*Dasyurus geoffroii (Chuditch, Western Quoll)*		T	
Dicaeidae					
63.	25607	*Dicaeum hirundinaceum (Mistletoebird)*			
Dicruridae					
64.	24443	*Grallina cyanoleuca (Magpie-lark)*			
65.	25613	*Rhipidura fuliginosa (Grey Fantail)*			
66.	25614	*Rhipidura leucophrys (Willie Wagtail)*			
Diplodactylidae					
67.	24918	*Crenadactylus ocellatus subsp. ocellatus (Clawless Gecko)*			
68.	24939	*Diplodactylus polyophthalmus*			
69.	24943	*Strophurus spinigerus subsp. inornatus*			
Elapidae					
70.	42380	*Brachyurophis fasciolatus subsp. fasciolatus*			
71.	42381	*Brachyurophis semifasciatus*			
72.	25296	*Demansia psammophis subsp. reticulata (Yellow-faced Whipsnake)*			
73.	25251	*Echiopsis curta (Bardick)*			
74.	25248	*Neelaps bimaculatus (Black-naped Snake)*			
75.	25252	*Notechis scutatus (Tiger Snake)*			
76.	25253	*Parasuta gouldii*			
77.	25511	*Pseudonaja affinis (Dugite)*			
78.	25259	*Pseudonaja affinis subsp. affinis (Dugite)*			
79.	25266	*Simoselaps bertholdi (Jan's Banded Snake)*			
Falconidae					
80.	25622	*Falco cenchroides (Australian Kestrel)*			
81.	25623	*Falco longipennis (Australian Hobby)*			
Felidae					
82.	24041	*Felis catus (Cat)*	Y		
Gekkonidae					
83.	24980	*Christinus marmoratus (Marbled Gecko)*			
Halcyonidae					
84.	30901	*Dacelo novaeguineae (Laughing Kookaburra)*	Y		
85.	25549	*Todiramphus sanctus (Sacred Kingfisher)*			
Hirundinidae					
86.	24491	*Hirundo neoxena (Welcome Swallow)*			
Hyriidae					
87.	34113	*Westralunio carteri (Carter's Freshwater Mussel)*		P4	
Ixodidae					
88.	-12532	*Amblyomma triguttatum*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
Julidae					
89.	-12391	*Ommatoiulus moreletii*			
Leporidae					
90.	24085	*Oryctolagus cuniculus (Rabbit)*	Y		
Limnodynastidae					
91.	25410	*Heleioporus eyrei (Moaning Frog)*			
92.	25415	*Limnodynastes dorsalis (Western Banjo Frog)*			
Macropodidae					
93.	24132	*Macropus fuliginosus (Western Grey Kangaroo)*			
94.	24133	*Macropus irma (Western Brush Wallaby)*		P4	
95.	24142	*Petrogale lateralis subsp. lateralis (Black-flanked Rock-wallaby, Black-footed Rock-wallaby)*		T	
Maluridae					
96.	25651	*Malurus lamberti (Variegated Fairy-wren)*			
97.	25652	*Malurus leucopterus (White-winged Fairy-wren)*			
98.	25654	*Malurus splendens (Splendid Fairy-wren)*			
99.	24552	*Malurus splendens subsp. splendens (Splendid Fairy-wren)*			
Meliphagidae					
100.	24560	*Acanthorhynchus superciliosus (Western Spinebill)*			
101.	24561	*Anthochaera carunculata (Red Wattlebird)*			
102.	24562	*Anthochaera lunulata (Western Little Wattlebird)*			
103.	25661	*Lichmera indistincta (Brown Honeyeater)*			
104.	24583	*Manorina flavigula (Yellow-throated Miner)*			
105.	25663	*Melithreptus brevirostris (Brown-headed Honeyeater)*			
106.	24596	*Phylidonyris novaehollandiae (New Holland Honeyeater)*			
Meropidae					
107.	24598	*Merops ornatus (Rainbow Bee-eater)*		IA	
Micropholcommatidae					
108.	-12205	*Raveniella cirrata*			
109.	-11693	*Raveniella peckorum*			
Muridae					
110.	24223	*Mus musculus (House Mouse)*	Y		
111.	24243	*Rattus fuscipes (Western Bush Rat)*			
112.	24245	*Rattus rattus (Black Rat)*	Y		
Myobatrachidae					
113.	25400	*Crinia insignifera (Squelching Froglet)*			
114.	25420	*Myobatrachus gouldii (Turtle Frog)*			
115.	25433	*Pseudophryne guentheri (Crawling Toadlet)*			
Neosittidae					
116.	25673	*Daphoenositta chrysoptera (Varied Sittella)*			
Pachycephalidae					
117.	25675	*Colluricincla harmonica (Grey Shrike-thrush)*			
118.	24613	*Colluricincla harmonica subsp. rufiventris (Grey Shrike-thrush)*			
119.	25679	*Pachycephala pectoralis (Golden Whistler)*			
120.	24623	*Pachycephala pectoralis subsp. fuliginosa (Golden Whistler)*			
121.	25680	*Pachycephala rufiventris (Rufous Whistler)*			
122.	24624	*Pachycephala rufiventris subsp. rufiventris (Rufous Whistler)*			
Paradoxosomatidae					
123.	-11712	*Antichiropus whistleri*			
Pararchaeidae					
124.	-11716	*Westrarchaea spinosa*			
Pardalotidae					
125.	25681	*Pardalotus punctatus (Spotted Pardalote)*			
126.	25682	*Pardalotus striatus (Striated Pardalote)*			
Peramelidae					
127.	24153	*Isoodon obesulus subsp. fusciventer (Quenda, Southern Brown Bandicoot)*		P5	
Peripatopsidae					
128.	-12547	*Occiperipatoides gilesii*			
Petroicidae					
129.	24659	*Petroica goodenovii (Red-capped Robin)*			
130.	25695	*Petroica multicolor (Scarlet Robin)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
Podicipedidae					
131.	25704	*Podiceps cristatus (Great Crested Grebe)*			
132.	24681	*Poliocephalus poliocephalus (Hoary-headed Grebe)*			
133.	25705	*Tachybaptus novaehollandiae (Australasian Grebe, Black-throated Grebe)*			
Potoroidae					
134.	24161	*Bettongia lesueur subsp. graii (Boodie, Burrowing Bettong)*			
135.	24162	*Bettongia penicillata subsp. ogilbyi (Woylie, Brush-tailed Bettong)*		T	
Procellariidae					
136.	24689	*Halobaena caerulea (Blue Petrel)*			
Psittacidae					
137.	25714	*Cacatua pastinator (Western Long-billed Corella)*			
138.	25715	*Cacatua roseicapilla (Galah)*			
139.	25716	*Cacatua sanguinea (Little Corella)*			
140.	24727	*Cacatua sanguinea subsp. westralensis (Little Corella)*			
141.	25717	*Calyptorhynchus banksii (Red-tailed Black-Cockatoo)*			
142.	24734	*Calyptorhynchus latirostris (Carnaby's Cockatoo (short-billed black-cockatoo), Carnaby's Cockatoo)*		T	
143.	24735	*Glossopsitta porphyrocephala (Purple-crowned Lorikeet)*			
144.	24738	*Neophema elegans (Elegant Parrot)*			
145.	25720	*Platycercus icterotis (Western Rosella)*			
146.	24750	*Platycercus zonarius subsp. semitorquatus (Twenty-eight Parrot)*			
147.	25722	*Polytelis anthopeplus (Regent Parrot)*			
148.	25723	*Trichoglossus haematodus (Rainbow Lorikeet)*			
Pygopodidae					
149.	24991	*Aprasia repens*			
150.	25766	*Delma fraseri (Fraser's Legless Lizard)*			
151.	24999	*Delma grayii*			
152.	25005	*Lialis burtonis*			
153.	25008	*Pygopus lepidopodus (Common Scaly Foot)*			
Rallidae					
154.	25727	*Fulica atra (Eurasian Coot)*			
155.	25729	*Gallinula tenebrosa (Dusky Moorhen)*			
156.	25731	*Porphyrio porphyrio (Purple Swamphen)*			
Recurvirostridae					
157.	25734	*Himantopus himantopus (Black-winged Stilt)*			
Scincidae					
158.	42368	*Acritoscincus trilineatus*			
159.	30893	*Cryptoblepharus buchananii*			
160.	25027	*Ctenotus australis*			
161.	25039	*Ctenotus fallens*			
162.	25087	*Cyclodomorphus celatus*			
163.	25100	*Egernia napoleonis*			
164.	25119	*Hemiergis quadrilineata*			
165.	25133	*Lerista elegans*			
166.	25165	*Lerista praepedita*			
167.	25184	*Menetia greyii*			
168.	25192	*Morethia obscura*			
169.	25207	*Tiliqua rugosa subsp. rugosa*			
Scolopendridae					
170.	-1758	*Cormocephalus aurantiipes*			
171.	-11860	*Cormocephalus novaehollandiae*			
172.	-13272	*Cormocephalus rubriceps*			
173.	-1711	*Cormocephalus turneri*			
Strigidae					
174.	25748	*Ninox novaeseelandiae (Boobook Owl)*			
Sylviidae					
175.	25755	*Acrocephalus australis (Australian Reed Warbler)*			
Tarsipedidae					
176.	24167	*Tarsipes rostratus (Honey Possum, Noolbenger)*			
Tettigoniidae					
177.	33973	*Austrosaga spinifer (cricket)*		P3	
Threskiornithidae					
178.	24841	*Platalea flavipes (Yellow-billed Spoonbill)*			
179.	24844	*Threskiornis molucca (Australian White Ibis)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
180.	24845	*Threskiornis spinicollis (Straw-necked Ibis)*			
Typhlopidae					
181.	25271	*Ramphotyphlops australis*			
Urodacidae					
182.	-12778	*Urodacus novaehollandiae*			
Varanidae					
183.	25526	*Varanus tristis (Racehorse Monitor)*			
Zosteropidae					
184.	25765	*Zosterops lateralis (Grey-breasted White-eye, Silvereye)*			

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

[1] For NatureMap's purposes, species flagged as endemic are those whose records are wholely contained within the search area. Note that only those records complying with the search criterion are included in the calculation. For example, if you limit records to those from a specific datasource, only records from that datasource are used to determine if a species is restricted to the query area.

Appendix D – Flora results

Quadrat data & photographs

Flora species list recorded within the Study Areas during the survey

Likelihood of occurrence assessment of conservation significant flora identified in the desktop assessment as potentially occurring within the Study Areas

Quadrat data & photographs

Site	Q01	Project	Nowergup
Type:	Quadrat	Size:	10 × 10 m
Date:	25/11/2013	Described by:	GO & DM
Co-ordinates:	MGA 50	382253 mE	6499868 mN
Location:	Northern site		
Soil colour & type:	Limestone outcropping		
Vegetation type:			
Vegetation condition:	Pristine (1) – Excellent (2)		
Fire age & intensity:	Old (5-20 years)		
Disturbances:	Weeds, quarry nearby		
Bare ground (%):	10-30	Logs (%):	10-30
Twigs (%):	10-30	Leaves (%):	10-30
Rocks (%):	30-70 limestone		

Species list

Family	Species	Status	Cover (%)	Height (m)
Asteraceae	sp.		<2	0.3
Asteraceae	sp.		<2	0.15
Asparagaceae	*Thysanotus arenarius*		<2	0.7
Asteraceae	*Hypochaeris* sp.	*	<2	0.15
Campanulaceae	*Lobelia tenuior*		<2	0.2
Cyperaceae	*Schoenus* sp.		30-70	0.4
Dilleniaceae	*Hibbertia hypericoides*		30-70	0.6
Ericaceae	*Leucopogon parviflorus*		<2	0.5
Fabaceae	*Acacia alata* var. *tetrantha*		<2	0.4
Fabaceae	*Acacia pulchella*		<2	0.5
Fabaceae	*Acacia truncata*		<2	0.8
Fabaceae	*Hardenbergia comptoniana*		10-30	CREEPER
Gentianaceae	*Centaurium erythraea*	*	<2	0.15

Family	Species	Status	Cover (%)	Height (m)
Geraniaceae	*Pelargonium capitatum*	*	<2	0.1
Haemodoraceae	*Conostylis candicans* subsp. *calcicola*		2-10	0.2
Hemerocallidaceae	*Tricoryne tenella*		<2	0.5
Hemerocallidaceae	*Tricoryne tenella*		<2	0.4
Lauraceae	*Cassytha racemosa*		2-10	CREEPER
Malvaceae	*Thomasia triphylla*		<2	0.3
Myrtaceae	*Melaleuca systena*		30-70	1
Myrtaceae	*Melaleuca huegelii*		30-70	2.1
Poaceae	*Aira caryophyllea*	*	10-30	0.15
Poaceae	*Rytidosperma occidentale*		<2	0.8
Polygalaceae	*Comesperma confertum*		<2	0.8
Proteaceae	*Banksia nivea* subsp. *nivea*		2-10	0.4
Proteaceae	*Banksia sessilis*		2-10	0.8
Proteaceae	*Grevillea preissii*		2-10	0.3
Restionaceae	*Desmocladus flexuosus*		30-70	0.2
Rhamnaceae	*Trymalium ledifolium* var. *ledifolium*		<2	0.6
Rubiaceae	*Opercularia vaginata*		<2	0.4
Stylidiaceae	*Stylidium maritimum*	P3	<2	0.8
Xanthorrhoeaceae	*Xanthorrhoea preissii*		10-30	1.6

Site	Q02	Project	Nowergup
Type:	Quadrat	Size:	10 × 10 m
Date:	25/11/2013	Described by:	GO & DM
Co-ordinates:	MGA 50	382113 mE	6499694 mN
Location:	Northern site		
Soil colour & type:	Brown sand		
Vegetation type:			
Vegetation condition:	Very Good (3)		
Fire age & intensity:	Old (5-20 years)		
Disturbances:	Weeds, cleared paddock adjacent		
Bare ground (%):	10-30	Logs (%):	0
Twigs (%):	10-30	Leaves (%):	10-30
Rocks (%):	0		

Species list

Family	Species	Status	Cover (%)	Height (m)
Iridaceae	*Watsonia meriana*	*	<2	1.2
Apiaceae	*Trachyandra divaricata*	*	<2	0.2
Proteaceae	*Hakea trifurcata*		<2	3
Asteraceae	*Ursinia anthemoides*	*	2-10	0.2
Casuarinaceae	*Allocasuarina humilis*		2-10	1.5
Cyperaceae	*Cyperaceae sp.*		2-10	0.3
Cyperaceae	*Mesomelaena pseudostygia*		10-30	0.6
Dilleniaceae	*Hibbertia hypericoides*		30-70	0.6
Fabaceae	*Acacia pulchella*		<2	1.3
Lamiaceae	*Hemiandra glabra*		<2	1
Myrtaceae	*Calothamnus quadrifidus*		10-30	1.5
Myrtaceae	*Melaleuca systena*		30-70	1.2
Poaceae	*Brachypodium distachyon*	*	30-70	0.2
Primulaceae	*Lysimachia arvensis*	*	10	0.2
Proteaceae	*Hakea trifurcata*		<2	0.2
Xanthorrhoeaceae	*Xanthorrhoea preissii*		<2	2.5

Site	Q03	Project	Nowergup
Type:	Quadrat	Size:	10 × 10 m
Date:	25/11/2013	Described by:	GO & DM
Co-ordinates:	MGA 50	382207 mE	6499640 mN
Location:	Northern site		
Soil colour & type:	Brown sand		
Vegetation type:			
Vegetation condition:	Very Good (3)		
Fire age & intensity:	Old (5-20 years)		
Disturbances:	Weeds, potential dieback (dead Banksia)		
Bare ground (%):	<2	Logs (%):	0
Twigs (%):	10-30	Leaves (%):	2-10
Rocks (%):	<2 limestone outcropping		

Species list

Family	Species	Status	Cover (%)	Height (m)
Proteaceae	*Hakea trifurcata*		<2	1.5
Primulaceae	*Lysimachia arvensis*	*	30-70	0.3
Cyperaceae	*Mesomelaena pseudostygia*		2-10	0.5
Dilleniaceae	*Hibbertia hypericoides*		30-70	1
Fabaceae	*Acacia pulchella*		<2	1.0
Fabaceae	*Jacksonia calcicola*		10-30	0.8
Lamiaceae	*Hemiandra glabra*		10-30	1.1
Myrtaceae	*Calothamnus quadrifidus*		30-70	1.1
Myrtaceae	*Melaleuca systena*		10-30	1.1
Poaceae	*Briza maxima*	*	<2	0.2
Poaceae	*Lolium rigidum*	*	2-10	0.6
Polygalaceae	*?Comesperma sp.*		30-70	0.2
Proteaceae	*Banksia attenuata*		2-10	3.5
Proteaceae	*Banksia sessilis*		30-70	2.5
Proteaceae	*Hakea trifurcata*		<2	0.2

Family	Species	Status	Cover (%)	Height (m)
Xanthorrhoeaceae	*Xanthorrhoea preissii*		<2	0.9
Apiaceae	*Daucus glochidiatus*		<2	0.3

Site	Q04	Project	Nowergup
Type:	Quadrat	Size:	10 × 10 m
Date:	25/11/2013	Described by:	GO & DM
Co-ordinates:	MGA 50	382325 mE	6499529 mN
Location:	Northern site		
Soil colour & type:			
Vegetation type:			
Vegetation condition:	Excellent (2)		
Fire age & intensity:	Old (5-20 years)		
Disturbances:			
Bare ground (%):	30-70	Logs (%):	0
Twigs (%):	10-30	Leaves (%):	30-70
Rocks (%):	30-70 limestone outcropping		

Species list

Family	Species	Status	Cover (%)	Height (m)
Proteaceae	*Hakea trifurcata*		30-70	1.7
Haemodoraceae	*Conostylis candicans* subsp. *calcicola*		2-10	0.5
Poaceae	*Aristida* sp.		<2	0.6
Primulaceae	*Lysimachia arvensis*	*	<2	0.2
Asparagaceae	sp.		<2	0.5
Iridaceae	*Watsonia meriana*	*	<2	1.0
Goodeniaceae	*Lechenaultia linarioides*		2-10	0.8
Goodeniaceae	*Scaevola thesioides*		OPP	OPP
Asparagaceae	*Lomandra hermaphrodita*		<2	0.4
Asteraceae	*Asteraceae sp.*		<2	0.2
Apiaceae	*Daucus glochidiatus*		<2	0.5
Colchicaceae	*Burchardia congesta*		<2	0.7
Cyperaceae	*Lepidosperma pubisquameum*		<2	0.3
Cyperaceae	*Mesomelaena pseudostygia*		30-70	0.6

Family	Species	Status	Cover (%)	Height (m)
Dilleniaceae	*Hibbertia hypericoides*		10-30	0.5
Dilleniaceae	*Hibbertia racemosa*		OPP	OPP
Ericaceae	*Leucopogon polymorphus*		<2	0.7
Fabaceae	*Acacia pulchella*		<2	0.9
Fabaceae	*Bossiaea eriocarpa*		<2	0.5
Fabaceae	*Jacksonia calcicola*		2-10	0.5
Geraniaceae	*Pelargonium capitatum*	*	<2	0.2
Myrtaceae	*Calothamnus quadrifidus*		30-70	1.0
Myrtaceae	*Calothamnus sanguineus*		OPP	OPP
Myrtaceae	*Melaleuca systena*		2-10	0.2
Myrtaceae	*Melaleuca systena*		10-30	0.6
Myrtaceae	*Melaleuca systena*		OPP	OPP
Poaceae	*Briza maxima*	*	<2	0.6
Poaceae	*Briza minor*	*	<2	0.2
Poaceae	*Catapodium rigidum*	*	OPP	OPP
Proteaceae	*Banksia dallanneyi*		<2	0.15
Proteaceae	*Banksia sessilis*		10-30	1.1
Proteaceae	*Hakea costata*		OPP	OPP
Proteaceae	*Petrophile macrostachya*		<2	0.1
Restionaceae	*Desmocladus asper*		10-30	0.2
Violaceae	*Hybanthus calycinus*		<2	0.1
Xanthorrhoeaceae	*Xanthorrhoea preissii*		2-10	1.0

Site	Q05	Project	Nowergup
Type:	Quadrat	Size:	10 × 10 m
Date:	25/11/2013	Described by:	GO & DM
Co-ordinates:	MGA 50	382324 mE	6499586 mN
Location:	Northern site		
Soil colour & type:	Brown sand		
Vegetation type:			
Vegetation condition:	Excellent (2)		
Fire age & intensity:	Old (5-20 years)		
Disturbances:			
Bare ground (%):		Logs (%):	
Twigs (%):		Leaves (%):	
Rocks (%):	30-70 limestone outcropping		

Species list

Family	Species	Status	Cover (%)	Height (m)
Proteaceae	*Hakea trifurcata*		30-70	1.9
Lauraceae	*Cassytha racemosa*		<2	CREEPER
Dilleniaceae	*Hibbertia hypericoides*		30-70	0.4
Fabaceae	*Jacksonia calcicola*		<2	0.8
Lamiaceae	*Hemiandra glabra*		<2	1.4
Malvaceae	*Thomasia triphylla*		10-30	1.2
Apiaceae	*Daucus glochidiatus*		<2	0.15
Haemodoraceae	*Conostylis candicans* subsp. *calcicola*		<2	0.3
Restionaceae	*Desmocladus flexuosus*		2-10	0.2
Cyperaceae	*Mesomelaena pseudostygia*		10-30	0.6
Fabaceae	*Acacia lasiocarpa* var. *lasiocarpa*		2-10	0.4
Geraniaceae	*Pelargonium capitatum*	*	<2	0.3
Haemodoraceae	*?Phlebocarya ciliata*		2-10	0.3
Myrtaceae	*Calothamnus quadrifidus*		10-30	1.1

Family	Species	Status	Cover (%)	Height (m)
Myrtaceae	*Melaleuca huegelii*		10-30	1.8
Myrtaceae	*Melaleuca systena*		30-70	1.2
Proteaceae	*Banksia sessilis*		30-70	2.1
Solanaceae	*Solanum nigrum*	*	<2	0.3
Xanthorrhoeaceae	*Xanthorrhoea preissii*		10-30	2

Site	Q06	Project	Nowergup
Type:	Quadrat	Size:	10 × 10 m
Date:	25/11/2013	Described by:	GO & DM
Co-ordinates:	MGA 50	382113 mE	6499868 mN
Location:	Northern site		
Soil colour & type:			
Vegetation type:			
Vegetation condition:	Pristine (1)		
Fire age & intensity:	Old (5-20 years)		
Disturbances:			
Bare ground (%):	2-10	Logs (%):	0
Twigs (%):	2-10	Leaves (%):	2-10
Rocks (%):	>70 limestone ridge		

Species list

Family	Species	Status	Cover (%)	Height (m)
Poaceae	*Aristida* sp.		2-10	1
Proteaceae	*Hakea trifurcata*		2-10	0.9
Ericaceae	*Leucopogon parviflorus*		<2	0.4
Fabaceae	*Acacia lasiocarpa var. lasiocarpa*		<2	0.6
Restionaceae	*Desmocladus flexuosus*		30-70	0.4
Dilleniaceae	*Hibbertia hypericoides*		2-10	0.5
Lauraceae	*Cassytha racemosa*		70-100	CREEPER
Haemodoraceae	*Conostylis candicans* subsp. *calcicola*		2-10	0.2
Asparagaceae	*Lomandra ?maritima*		10-30	0.3
Asteraceae	*Carduus pycnocephalus*	*	30-70	0.4
Campanulaceae	*Lobelia tenuior*		10-30	0.2
Fabaceae	*Hardenbergia comptoniana*		2-10	CREEPER
Myrtaceae	*Calothamnus quadrifidus*		2-10	0.8
Myrtaceae	*Melaleuca huegelii*		30-70	2

Family	Species	Status	Cover (%)	Height (m)
Myrtaceae	*Melaleuca systena*		30-70	1
Polygalaceae	*Comesperma confertum*		<2	0.5
Proteaceae	*Banksia sessilis*		<2	0.6
Restionaceae	*Desmocladus fasciculatus*		10-30	0.2
Xanthorrhoeaceae	*Xanthorrhoea preissii*		30-70	1.1

Site	Q01	Project	Nowergup
Type:	Quadrat	Size:	10 × 10 m
Date:	25/11/2013	Described by:	GO & DM
Co-ordinates:	MGA 50	382669 mE	6498109 mN
Location:	Southern site		
Soil colour & type:	Dark brown sandy loam		
Vegetation type:			
Vegetation condition:	Good (4)		
Fire age & intensity:	Old (5-20 years)		
Disturbances:	Weeds, neighbouring quarry		
Bare ground (%):	30-70	Logs (%):	0
Twigs (%):	30-70	Leaves (%):	30-70
Rocks (%):	Limestone outcropping		

Species list

Family	Species	Status	Cover (%)	Height (m)
Myrtaceae	*Melaleuca systena*		30-70	1.1
Primulaceae	*Lysimachia arvensis*	*	<2	0.2
Haemodoraceae	*Conostylis candicans* subsp. *calcicola*		<2	0.3
Apiaceae	*Daucus glochidiatus*		<2	0.15
Proteaceae	*Hakea trifurcata*		>70	2.1
Primulaceae	*Lysimachia arvensis*	*	30-70	0.2
Restionaceae	*Desmocladus flexuosus*		<2	0.3
Asparagaceae	*Asparagus asparagoides*	* DP, WoNS	<2	CREEPER
Asparagaceae	*Lomandra ?maritima*		2-10	0.3
Asteraceae	*Centaurea melitensis*	*	2-10	0.2
Cyperaceae	*Lepidosperma sp.*		<2	0.4
Dilleniaceae	*Hibbertia hypericoides*		30-70	0.5
Euphorbiaceae	*Euphorbia terracina*	*	2-10	0.15

Family	Species	Status	Cover (%)	Height (m)
Fabaceae	*Hardenbergia comptoniana*		2-10	CREEPER
Myrtaceae	*Melaleuca huegelii*		2-10	2
Myrtaceae	*Melaleuca* sp. Wanneroo (G.J. Keighery 16705)	P1	<2	2.1
Poaceae	*Briza maxima*	*	2-10	0.3
Poaceae	*Cynodon dactylon*	*	2-10	0.2
Poaceae	*Ehrharta calycina*	*	2-10	1
Proteaceae	*Banksia sessilis*		30-70	1.2
Proteaceae	*Grevillea preissii*		<2	0.4
Restionaceae	*Desmocladus flexuosus*		10-30	0.15

Site	Q02	Project	Nowergup
Type:	Quadrat	Size:	10 × 10 m
Date:	25/11/2013	Described by:	GO & DM
Co-ordinates:	MGA 50	382651 mE	6497993 mN
Location:	Southern site		
Soil colour & type:	Brown sand		
Vegetation type:			
Vegetation condition:	Excellent (2)		
Fire age & intensity:			
Disturbances:			
Bare ground (%):	2-10	Logs (%):	0
Twigs (%):	30-70	Leaves (%):	10-30
Rocks (%):	<2 limestone outcropping		

Species list

Family	Species	Status	Cover (%)	Height (m)
Myrtaceae	*Melaleuca systena*		30-70	1.1
Primulaceae	*Lysimachia arvensis*	*	02-10	0.2
Apiaceae	*Daucus glochidiatus*		2-10	0.2
Primulaceae	*Lysimachia arvensis*	*	10-30	0.15
Proteaceae	*Hakea trifurcata*		<2	0.5
Haemodoraceae	*Conostylis teretifolia* subsp. *planescens*		<2	0.2
Iridaceae	*Watsonia meriana*	*	<2	1
Asparagaceae	*Acanthocarpus preissii*		2-10	0.4
Asparagaceae	*Lomandra hermaphrodita*		2-10	0.4
Asteraceae	*Asteraceae* sp.		<2	0.5
Asteraceae	*Sonchus oleraceus*	*	<2	0.2
Asteraceae	*Ursinia anthemoides*	*	2-10	0.15
Caryophyllaceae	*Silene nocturna*	*	<2	0.3
Cyperaceae	*Mesomelaena pseudostygia*		10-30	0.5

Family	Species	Status	Cover (%)	Height (m)
Dilleniaceae	*Hibbertia hypericoides*		30-70	0.6
Fabaceae	*?Pultenaea* sp.		<2	0.8
Fabaceae	*?Pultenaea* sp.		<2	0.3
Myrtaceae	*Calothamnus quadrifidus*		10-3	1.8
Myrtaceae	*Melaleuca systena*		30-70	0.2
Poaceae	*Avena sp.*	*	<2	1
Poaceae	*Briza minor*	*	<2	0.15
Poaceae	*Ehrharta calycina*	*	<2	0.4
Poaceae	*Lolium rigidum*	*	<2	0.3
Poaceae	*Poaceae sp.*		<2	0.2
Proteaceae	*Banksia nivea* subsp. *nivea*		2-10	0.3
Proteaceae	*Grevillea preissii*		<2	0.7
Xanthorrhoeaceae	*Xanthorrhoea preissii*		10-30	2.2

Site	Q03	Project	Nowergup
Type:	Quadrat	Size:	10 × 10 m
Date:	25/11/2013	Described by:	GO & DM
Co-ordinates:	MGA 50	382715 mE	6497724 mN
Location:	Southern site		
Soil colour & type:	Light brown sand		
Vegetation type:			
Vegetation condition:	Excellent (2)		
Fire age & intensity:	Old (5-20 years)		
Disturbances:	Weeds		
Bare ground (%):	10-30	Logs (%):	0
Twigs (%):	2-10	Leaves (%):	10-30
Rocks (%):	Limestone outcropping near top of ridge		

Species list

Family	Species	Status	Cover (%)	Height (m)
Myrtaceae	*Melaleuca systena*		10-30	1.2
Dilleniaceae	*Hibbertia hypericoides*		30-70	1.1
Primulaceae	*Lysimachia arvensis*	*	10-30	0.2
Iridaceae	*Watsonia meriana*	*	<2	1
Lauraceae	*Cassytha flava*		<2	CREEPER
Fabaceae	*Trifolium arvense*	*	<2	0.06
Asparagaceae	*Lomandra hermaphrodita*		2-10	0.3
Asteraceae	*Ursinia anthemoides*	*	<2	0.2
Caryophyllaceae	*Silene gallica*	*	<2	0.15
Cyperaceae	*Mesomelaena pseudostygia*		10-30	0.4
Fabaceae	*?Pultenaea sp.*		<2	0.3
Fabaceae	*Acacia pulchella*		<2	1.1
Fabaceae	*Bossiaea eriocarpa*		<2	0.8
Haemodoraceae	*Conostylis teretifolia subsp. planescens*		<2	0.15
Myrtaceae	*Calothamnus quadrifidus*		2-10	1.8
Myrtaceae	*Melaleuca systena*		10-30	0.2

Family	Species	Status	Cover (%)	Height (m)
Orobanchaceae	*Orobanche minor*	*	OPP	OPP
Poaceae	*Poaceae sp.*		10-30	0.15
Proteaceae	*Banksia dallanneyi*		<2	0.15
Proteaceae	*Banksia grandis*		OPP	OPP
Proteaceae	*Banksia sessilis*		<2	1.1
Xanthorrhoeaceae	*Xanthorrhoea preissii*		2-10	2.1
Xanthorrhoeaceae	*Xanthorrhoea preissii*		2-10	2

Site	Q04	Project	Nowergup
Type:	Quadrat	Size:	10 × 10 m
Date:	25/11/2013	Described by:	GO & DM
Co-ordinates:	MGA 50	382643 mE	6497852 mN
Location:	Southern site		
Soil colour & type:	Light brown sand		
Vegetation type:			
Vegetation condition:	Excellent (2)		
Fire age & intensity:	Old (5-20 years)		
Disturbances:	Weeds, rabbits, fox den in quadrat		
Bare ground (%):	10-30	Logs (%):	0
Twigs (%):	10-30	Leaves (%):	2-10
Rocks (%):	30-70 limestone outcropping		

Species list

Family	Species	Status	Cover (%)	Height (m)
Myrtaceae	*Melaleuca systena*		<2	0.6
Dilleniaceae	*Hibbertia hypericoides*		30-70	0.8
Primulaceae	*Lysimachia arvensis*	*	10-30	0.2
Restionaceae	*Desmocladus flexuosus*		2-10	0.3
Apiaceae	*Daucus glochidiatus*		<2	0.15
Asparagaceae	*Acanthocarpus preissii*		<2	0.8
Asparagaceae	*Lomandra hermaphrodita*		2-10	0.4
Asteraceae	*Asteraceae* sp.		<2	0.1
Colchicaceae	*Burchardia congesta*		<2	0.3
Cyperaceae	*Lepidosperma pubisquameum*		<2	0.4
Cyperaceae	*Mesomelaena pseudostygia*		<2	0.6
Dilleniaceae	*Hibbertia hypericoides*		30-70	0.4
Ericaceae	*Leucopogon parviflorus*		<2	0.8
Fabaceae	*Hardenbergia comptoniana*		2-10	CREEPER
Haemodoraceae	*Conostylis aculeata*		2-10	0.25

Family	Species	Status	Cover (%)	Height (m)
Lauraceae	*Cassytha flava*		<2	CREEPER
Myrtaceae	*Calothamnus quadrifidus*		30-70	1
Myrtaceae	*Melaleuca huegelii*		30-70	2.1
Poaceae	*Briza maxima*	*	<2	0.3
Poaceae	*Briza minor*	*	<2	0.08
Proteaceae	*Banksia dallanneyi*		<2	0.2
Proteaceae	*Banksia sessilis*		2-10	1.5
Proteaceae	*Grevillea preissii*		2-10	0.4
Restionaceae	*Desmocladus asper*		<2	0.2
Restionaceae	*Desmocladus asper*		30-70	0.2
Xanthorrhoeaceae	*Xanthorrhoea preissii*		10-30	1.8

Opportunistics

Family	Species	Status
Asparagaceae	*Acanthocarpus preissii*	
Asteraceae	*Conyza bonariensis*	*
Asteraceae	*Hypochaeris sp.*	*
Asteraceae	*Podotheca gnaphalioides*	
Asteraceae	*Waitzia suaveolens subsp. suaveolens*	
Casuarinaceae	*Allocasuarina humilis*	
Cyperaceae	*Mesomelaena preissii*	
Dilleniaceae	*Hibbertia hypericoides*	
Fabaceae	*Gompholobium tomentosum*	
Fabaceae	*Kennedia prostrata*	
Gentianaceae	*Centaurium erythraea*	*
Goodeniaceae	*Lechenaultia linarioides*	
Myrtaceae	*Calothamnus ?sanguineus*	
Myrtaceae	*Melaleuca huegelii*	
Myrtaceae	*Melaleuca systena*	
Phyllanthaceae	*Phyllanthus scaber*	
Poaceae	*Aira caryophyllea*	*
Poaceae	*Poa drummondiana*	
Poaceae	*Rostraria cristata*	*
Proteaceae	*Hakea trifurcata*	
Proteaceae	*Petrophile axillaris*	
Stylidiaceae	*Stylidium brunonianum*	

Flora species recorded within the Northern and Southern Study Areas

Family	Taxon	Status
Aizoaceae	*Sarcozona ?bicarinata*	
Amaranthceae	*Ptilotus manglesii*	
Apiaceae	*Daucus glochidiatus*	
Apiaceae	*Trachyandra divaricata*	*
Asparagaceae	*Acanthocarpus preissii*	
Asparagaceae	*Asparagus asparagoides*	* DP, WoNS
Asparagaceae	*Lomandra ?maritima*	
Asparagaceae	*Lomandra ?suaveolens*	
Asparagaceae	*Lomandra caespitosa*	
Asparagaceae	*Lomandra hermaphrodita*	
Asparagaceae	sp.	*
Asparagaceae	*Thysanotus arenarius*	
Asparagaceae	*Thysanotus sparteus*	
Asteraceae	sp.	
Asteraceae	*Carduus pycnocephalus*	*
Asteraceae	*Centaurea melitensis*	*
Asteraceae	*Conyza bonariensis*	*
Asteraceae	*Hypochaeris* sp.	*
Asteraceae	*Olearia axillaris*	
Asteraceae	*Podotheca gnaphalioides*	
Asteraceae	*Sonchus oleraceus*	*
Asteraceae	*Urospermum picroides*	*
Asteraceae	*Ursinia anthemoides*	*
Asteraceae	*Waitzia suaveolens* subsp. *suaveolens*	
Brassicaceae	*Brassica tournefortii*	*
Brassicaceae	*Heliophila pusilla*	*
Campanulaceae	*Lobelia rhytidosperma*	
Campanulaceae	*Lobelia tenuior*	
Caryophyllaceae	*Petrorhagia dubia*	*
Caryophyllaceae	*Silene gallica*	*
Caryophyllaceae	*Silene nocturna*	*
Casuarinaceae	*Allocasuarina humilis*	
Colchicaceae	*Burchardia congesta*	
Cyperaceae	sp.	
Cyperaceae	*Lepidosperma pubisquameum*	
Cyperaceae	*Lepidosperma* sp.	
Cyperaceae	*Lepidosperma squamatum*	
Cyperaceae	*Mesomelaena preissii*	
Cyperaceae	*Mesomelaena pseudostygia*	
Cyperaceae	*Schoenus* sp.	
Cyperaceae	*Tetraria octandra*	

Family	Taxon	Status
Dilleniaceae	*Hibbertia hypericoides*	
Dilleniaceae	*Hibbertia racemosa*	
Ericaceae	*Leucopogon parviflorus*	
Ericaceae	*Leucopogon polymorphus*	
Ericaceae	*Leucopogon* sp. Yanchep	P3
Euphorbiaceae	*Euphorbia terracina*	*
Fabaceae	?*Pultenaea* sp.	
Fabaceae	*Acacia ?lasiocarpa*	
Fabaceae	*Acacia alata* var. *tetrantha*	
Fabaceae	*Acacia lasiocarpa* var. *lasiocarpa*	
Fabaceae	*Acacia pulchella*	
Fabaceae	*Acacia truncata*	
Fabaceae	*Bossiaea eriocarpa*	
Fabaceae	*Gompholobium tomentosum*	
Fabaceae	*Hardenbergia comptoniana*	
Fabaceae	*Hovea trisperma*	
Fabaceae	*Jacksonia calcicola*	
Fabaceae	*Kennedia prostrata*	
Fabaceae	*Sphaerolobium medium*	
Fabaceae	*Templetonia retusa*	
Fabaceae	*Trifolium arvense*	*
Gentianaceae	*Centaurium erythraea*	*
Geraniaceae	*Pelargonium capitatum*	*
Goodeniaceae	*Lechenaultia linarioides*	
Goodeniaceae	*Scaevola thesioides*	
Haemodoraceae	*?Phlebocarya ciliata*	
Haemodoraceae	*Conostylis aculeata*	
Haemodoraceae	*Conostylis candicans* subsp. *calcicola*	
Haemodoraceae	*Conostylis teretifolia* subsp. *planescens*	
Haemodoraceae	*Haemodorum laxum*	
Hemerocallidaceae	*Tricoryne tenella*	
Iridaceae	*Watsonia meriana*	*
Lamiaceae	*Hemiandra glabra*	
Lauraceae	*Cassytha flava*	
Lauraceae	*Cassytha racemosa*	
Malvaceae	*Thomasia triphylla*	
Myrtaceae	*Calothamnus ?sanguineus*	
Myrtaceae	*Calothamnus quadrifidus*	
Myrtaceae	*Calothamnus sanguineus*	
Myrtaceae	*Eucalyptus ?decipiens*	
Myrtaceae	*Eucalyptus decipiens*	
Myrtaceae	*Eucalyptus foecunda*	
Myrtaceae	*Eucalyptus petrensis*	
Myrtaceae	*Kunzea glabrescens*	

Family	Taxon	Status
Myrtaceae	*Melaleuca huegelii*	
Myrtaceae	*Melaleuca* sp. Wanneroo (G.J. Keighery 16705)	P1
Myrtaceae	*Melaleuca systena*	
Orobanchaceae	*Orobanche minor*	*
Phyllanthaceae	*Phyllanthus scaber*	*
Poaceae	*Aira caryophyllea*	*
Poaceae	*Aristida* sp.	
Poaceae	*Austrostipa ?flavescens*	
Poaceae	*Avena* sp.	*
Poaceae	*Brachypodium distachyon*	*
Poaceae	*Briza maxima*	*
Poaceae	*Briza minor*	*
Poaceae	*Catapodium rigidum*	*
Poaceae	*Cynodon dactylon*	*
Poaceae	*Ehrharta calycina*	*
Poaceae	*Lolium rigidum*	*
Poaceae	*Poa drummondiana*	
Poaceae	sp.	
Poaceae	*Rostraria cristata*	*
Poaceae	*Rytidosperma occidentale*	
Polygalaceae	?*Comesperma* sp.	
Polygalaceae	*Comesperma confertum*	
Primulaceae	*Lysimachia arvensis*	*
Proteaceae	*Banksia attenuata*	
Proteaceae	*Banksia dallanneyi*	
Proteaceae	*Banksia grandis*	
Proteaceae	*Banksia nivea* subsp. *nivea*	
Proteaceae	*Banksia sessilis*	
Proteaceae	*Grevillea preissii*	
Proteaceae	*Hakea costata*	
Proteaceae	*Hakea erinacea*	
Proteaceae	*Hakea prostrata*	
Proteaceae	*Hakea trifurcata*	
Proteaceae	*Petrophile axillaris*	
Proteaceae	*Petrophile macrostachya*	
Restionaceae	*Desmocladus asper*	
Restionaceae	*Desmocladus fasciculatus*	
Restionaceae	*Desmocladus flexuosus*	
Rhamnaceae	*Trymalium ledifolium* var. *ledifolium*	
Rubiaceae	*Opercularia vaginata*	
Solanaceae	*Solanum nigrum*	*
Stylidiaceae	*Stylidium brunonianum*	
Stylidiaceae	*Stylidium maritimum*	P3

Family	Taxon	Status
Stylidiaceae	*Stylidium rigidulum*	
Violaceae	*Hybanthus calycinus*	
Xanthorrhoeaceae	*Xanthorrhoea preissii*	

Likelihood of occurrence	Definition
Known	Species definitely recorded within the survey area from previous records or field survey results.
Likely	Species previously recorded within 5 km and suitable habitat occurs at the survey area.
Possible	Species previously recorded within 5 km with marginally suitable habitat occurring at the survey area. OR Species not previously recorded within 5 km, but suitable habitat occurs at the survey area.
Unlikely	Species previously recorded within 5 km but suitable habitat does not occur at the survey area.
Highly unlikely	Species not previously recorded within 5 km, suitable habitat does not occur at the survey area and/ or survey area is outside the species' natural distribution.

Flora Likelihood of Occurrence Assessment

		Status		Source						
Scientific name	Common name	State	Federal	NatureMap search	WAHER B/TPFL	EPBC search	Description and habitat requirements (Western Australian Herbarium, 1998-)	Likelihood of occurrence	Efficacy of field survey	References
Andersonia gracilis	Slender Andersonia	T	E			X	Slender erect or open straggly shrub, 0.1-0.5(-1) m high. Fl. white-pink-purple, Sep to Nov. White/grey sand, sandy clay, gravelly loam. Winter-wet areas, near swamps. *Andersonia gracilis* is currently known from the Badgingarra, Dandaragan and Kenwick areas where it is found on seasonally damp, black sandy clay flats near or on the margins of swamps, often on duplex soils supporting low open heath vegetation with species such as *Calothamnus hirsutus, Verticordia densiflora* and *Kunzea recurva* over sedges.	Highly Unlikely: species not previously recorded within 5 km and suitable habitat does not occur at the Study Areas.	NA	Department of Environment and Conservation (2006). Slender Andersonia (*Andersonia gracilis*) Interim Recovery Plan 2006-2011. Interim Recovery Plan No. 228. Department of Environment (DotE) 2014, Species and Profile Database, retrieved January 2014 from http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=7669 Western Australian (WA) Herbarium 1998–, FloraBase—the Western Australian Flora, retrieved November, 2013, from http://florabase.dpaw.wa.gov.au/.
Anigozanthos viridis subsp. *terraspectans*	Dwarf Green Kangaroo Paw	T	V			X	Rhizomatous, perennial, herb, 0.05-0.2 m high. Fl. green/yellow-green, Aug to Sep. Grey sand, clay loam. Winter-wet depressions.	Highly Unlikely: species not previously recorded within 5 km and suitable habitat does not occur at the Study Areas. This species is restricted to the Cataby region (DotE, 2014).	NA	Western Australian (WA) Herbarium 1998–, FloraBase—the Western Australian Flora, retrieved November, 2013, from http://florabase.dpaw.wa.gov.au/. Department of Environment. 2013. *Approved Conservation Advice for Anigozanthos viridis subsp. terraspectans (Dwarf Green Kangaroo Paw)*. Available online at: http://www.environment.gov.au/biodiversity/threatened/species/pubs/3435-conservation-advice.pdf Department of Environment (DotE) 2014, Species and Profile Database, retrieved January 2014 from http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=7669
Acacia benthamii		P2		X	X		Shrub, ca 1 m high. Fl. yellow, Aug to Sep. Sand. Typically on limestone breakaways.	Likely: species previously recorded within 5 km and suitable habitat occurs at the Study Areas.	High	Western Australian (WA) Herbarium 1998–, FloraBase—the Western Australian Flora, retrieved November, 2013, from http://florabase.dpaw.wa.gov.au/.

		Status		Source						
Scientific name	Common name	State	Federal	NatureMap search	WAHER B/TPFL	EPBC search	Description and habitat requirements (Western Australian Herbarium, 1998-)	Likelihood of occurrence	Efficacy of field survey	References
Baeckea sp. Limestone (N. Gibson & M.N. Lyons 1425)		P1			X		Limestone.	Likely: species previously recorded within 5 km and suitable habitat occurs at the Study Areas.	Moderate	
Caladenia huegelii	King Spider-orchid, Grand Spider-orchid, Rusty Spider-orchid	T	E			X	Tuberous, perennial, herb, 0.25-0.6 m high. Fl. green & cream & red, Sep to Oct. Grey or brown sand, clay loam.	Unlikely: species not previously recorded within 5 km, but marginally suitable habitat occurs at the Study Areas.	Moderate	Western Australian (WA) Herbarium 1998–, FloraBase—the Western Australian Flora, retrieved November, 2013, from http://florabase.dpaw.wa.gov.au/.
Calectasia cyanea	Blue Tinsel Lily	T	CE	X			Rhizomatous, clump forming, woody perennial, herb, 0.1-0.6 m high, to 0.3 m wide. Fl. blue/purple, Jun to Oct. White, grey or yellow sand, gravel.	Highly Unlikely: species not previously recorded within 5 km and suitable habitat does not occur at the Study Areas. This species is known only from a single population approximately 10 km south of Albany (DotE, 2014).	NA	Western Australian (WA) Herbarium 1998–, FloraBase—the Western Australian Flora, retrieved November, 2013, from http://florabase.dpaw.wa.gov.au/. Department of Environment (DoE) 2014, Species and Profile Database, retrieved January 2014 from http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=7669
Centrolepis caespitosa		P4	E			X	Tufted annual, herb (forming a rounded cushion up to 25 mm across). Fl. Oct to Dec. White sand, clay. Salt flats, wet areas. *Centrolepis caespitosa* occurs in winter-wet clay pans dominated by low shrubs and sedges	Highly Unlikely: species not previously recorded within 5 km and suitable habitat does not occur at the Study Areas.	NA	Department of Conservation and Land Management (2004). Matted centrolepis (*Centrolepis caespitosa*) 2004-2008 Interim Recovery Plan No 159 (Gilfillan, S. & S. Barrett, 2004). Western Australian (WA) Herbarium 1998–, FloraBase—the Western Australian Flora, retrieved November, 2013, from http://florabase.dpaw.wa.gov.au/.

		Status		Source						
Scientific name	Common name	State	Federal	NatureMap search	WAHER B/TPFL	EPBC search	Description and habitat requirements (Western Australian Herbarium, 1998-)	Likelihood of occurrence	Efficacy of field survey	References
Darwinia foetida	Muchea bell	T	CE			X	Erect, or spreading, shrub to 0.7 m high, often using other shrubs for support. Young branches are slender, green-brown with prominent, decurrent leaf bases, becoming grey and woody. Fl. Green, Oct to Nov. Grey or white sand, swampy, seasonally wet sites. The Muchea Bell is known from three populations in swampy, seasonally wet habitat in the Muchea area, approximately 70km north of Perth.	Highly Unlikely: species not previously recorded within 5 km and suitable habitat does not occur at the Study Areas. This species is restricted to the Muchea region.	NA	Commonwealth Conservation Advice on *Darwinia* sp. *Muchea* (B.J.Keighery 2458) (Muchea Bell) (Threatened Species Scientific Committee (TSSC), 2009ab) [Conservation Advice]. Department of Environment (DotE) 2014, Species and Profile Database, retrieved January 2014 from http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=7669 Western Australian (WA) Herbarium 1998–, FloraBase—the Western Australian Flora, retrieved November, 2013, from http://florabase.dpaw.wa.gov.au/.
Diuris micrantha	Dwarf Bee-orchid	T	V			X	Tuberous, perennial, herb, 0.3-0.6 m high. Fl. yellow & brown, Sep to Oct. Brown loamy clay. Winter-wet swamps, in shallow water. Dwarf Bee-orchid is known from seven populations, from east of Kwinana and south towards the Frankland area, Western Australia. It is found in small populations, on dark, grey to blackish, sandy clay-loam substrates in winter wet depressions or swamps. The bases of the flowering plants are often covered with shallow water	Highly Unlikely: species not previously recorded within 5 km and suitable habitat does not occur at the Study Areas.	NA	Commonwealth Conservation Advice on *Diuris micrantha* (Threatened Species Scientific Committee, 2008mo) [Conservation Advice]. Department of Environment (DotE) 2014, Species and Profile Database, retrieved January 2014 from http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=7669 Western Australian (WA) Herbarium 1998–, FloraBase—the Western Australian Flora, retrieved November, 2013, from http://florabase.dpaw.wa.gov.au/.

		Status		Source						
Scientific name	Common name	State	Federal	NatureMap search	WAHER B/TPFL	EPBC search	Description and habitat requirements (Western Australian Herbarium, 1998-)	Likelihood of occurrence	Efficacy of field survey	References
Diuris purdiei	Purdie's Donkey Orchid	T	E			X	Tuberous, perennial, herb, 0.15-0.35 m high. Fl. yellow, Sep to Oct. Grey-black sand, moist. Winter-wet swamps. It grows on sand to sandy clay soils, in areas subject to winter inundation, and amongst native sedges and dense heath and emergent trees	Highly Unlikely: species not previously recorded within 5 km and suitable habitat does not occur at the Study Areas.	NA	Commonwealth Conservation Advice on Diuris purdiei (Purdie's Donkey-orchid) (Threatened Species Scientific Committee, 2008j) [Conservation Advice]. Department of Environment (DotE) 2014, Species and Profile Database, retrieved January 2014 from http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=7669 Western Australian (WA) Herbarium 1998–, FloraBase—the Western Australian Flora, retrieved November, 2013, from http://florabase.dpaw.wa.gov.au/.
Drakaea elastica	Glossy-leaved Hammer-orchid, Praying Virgin	T	E			X	Tuberous, perennial, herb, 0.12-0.3 m high. Fl. red & green & yellow, Oct to Nov. White or grey sand. Low-lying situations adjoining winter-wet swamps. Preferred habitat is low-lying areas of deep sand supporting banksia woodland or spearwood thicket	Highly Unlikely: species not previously recorded within 5 km and suitable habitat does not occur at the Study Areas.	NA	Department of Environment and Conservation (2009). National recovery plan for the Glossy-leafed Hammer Orchid (*Drakaea elastica*) (Department of Environment and Conservation, 2009l) Department of Environment (DotE) 2014, Species and Profile Database, retrieved January 2014 from http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=7669 Western Australian (WA) Herbarium 1998–, FloraBase—the Western Australian Flora, retrieved November, 2013, from http://florabase.dpaw.wa.gov.au/.

		Status		Source						
Scientific name	Common name	State	Federal	NatureMap search	WAHERB/TPFL	EPBC search	Description and habitat requirements (Western Australian Herbarium, 1998-)	Likelihood of occurrence	Efficacy of field survey	References
Drakaea micrantha	Dwarf Hammer-orchid	T	V			X	Tuberous, perennial, herb, 0.15-0.3 m high. Fl. red & yellow, Sep to Oct. White-grey sand. The species is usually found in cleared fire breaks or open sandy patches that have been disturbed, and where competition from other plants has been removed. It occurs in infertile grey sands, in Banksia, Jarrah and Common Sheoak woodl and thickets of Spearwood (*Kunzea ericifolia*)	Possible: species not previously recorded within 5 km but some suitable habitat does occur at the Study Areas.	Moderate	Commonwealth Conservation Advice on *Drakaea micrantha* Hopper & A.P.Brown nom. inval. (Dwarf Hammer-orchid) (Threatened Species Scientific Committee, 2008k) [Conservation Advice]. Department of Environment (DotE) 2014, Species and Profile Database, retrieved January 2014 from http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=7669 Western Australian (WA) Herbarium 1998–, FloraBase—the Western Australian Flora, retrieved November, 2013, from http://florabase.dpaw.wa.gov.au/.
Eucalyptus argutifolia	Yanchep Mallee, Wabling Hill Mallee	T	V	X	X	X	Mallee, 1.5-4 m high, bark smooth. Fl. white, Mar to Apr. Shallow soils over limestone. Slopes or gullies of limestone ridges, outcrops.	Unlikely: species previously recorded within 5 km and suitable habitat occurs at the Study Areas.	High	Western Australian (WA) Herbarium 1998–, FloraBase—the Western Australian Flora, retrieved November, 2013, from http://florabase.dpaw.wa.gov.au/.
Hibbertia spicata subsp. *leptotheca*		P3		X			Erect or spreading shrub, 0.2-0.5 m high. Fl. yellow, Jul to Oct. Sand. Near-coastal limestone ridges, outcrops & cliffs.	Likely: species previously recorded within 5 km and suitable habitat occurs at the Study Areas.	Moderate	Western Australian (WA) Herbarium 1998–, FloraBase—the Western Australian Flora, retrieved November, 2013, from http://florabase.dpaw.wa.gov.au/.
Jacksonia sericea		P4		X	X		Low spreading shrub, to 0.6 m high. Fl. orange, usually Dec or Jan to Feb. Calcareous & sandy soils.	Likely: species previously recorded within 5 km and suitable habitat occurs at the Study Areas.	Moderate	Western Australian (WA) Herbarium 1998–, FloraBase—the Western Australian Flora, retrieved November, 2013, from http://florabase.dpaw.wa.gov.au/.
Lepidosperma rostratum	Beaked Lepidosperma	T	E			X	Rhizomatous, tufted perennial, grass-like or herb (sedge), 0.5 m high. Fl. brown. Peaty sand, clay. Beaked Lepidosperma is associated with Marsh Banksia (*Banksia telmatiaea*) and Hairy Clawflower (*Calothamnus hirsutus*), and grows in sandy soil among low heath in a winter-wet swamp	Highly Unlikely: species not previously recorded within 5 km and suitable habitat does not occur at the Study Areas.	NA	Commonwealth Conservation Advice on *Lepidosperma rostratum* (Threatened Species Scientific Committee, 2008rh) [Conservation Advice]. Western Australian (WA) Herbarium 1998–, FloraBase—the Western Australian Flora, retrieved November, 2013, from http://florabase.dpaw.wa.gov.au/.
Leucopogon sp. Yanchep (M. Hislop 1986)		P3		X			Low hill, grey sand over limestone. Limestone heath.	Known: species recorded within Study Areas during the 2013 survey.	High	

		Status		Source						
Scientific name	Common name	State	Federal	NatureMap search	WAHER B/TPFL	EPBC search	Description and habitat requirements (Western Australian Herbarium, 1998-)	Likelihood of occurrence	Efficacy of field survey	References
Melaleuca sp. Wanneroo		P1		X	X		Rugged limestone ridge. Mossy black sand. Melaleuca cardiophylla, M. sp., M. systena tall closed shrubland.	Known: species recorded within Study Areas during the 2013 survey.	High	Western Australian (WA) Herbarium 1998–, FloraBase—the Western Australian Flora, retrieved November, 2013, from http://florabase.dpaw.wa.gov.au/.
Pimelea calcicola		P3		X	X		Erect to spreading shrub, 0.2-1 m high. Fl. Pink, Sep to Nov. Sand. Coastal limestone ridges.	Likely: species previously recorded within 5 km and suitable habitat occurs at the Study Areas.	Moderate	Western Australian (WA) Herbarium 1998–, FloraBase—the Western Australian Flora, retrieved November, 2013, from http://florabase.dpaw.wa.gov.au/
Stylidium longitubum	Jumping Jacks	P3		X	X		Erect annual (ephemeral), herb, 0.05-0.12 m high. Fl. pink, Oct to Dec. Sandy clay, clay. Seasonal wetlands.	Unlikely: species previously recorded within 5 km but suitable habitat does not occur at the Study Areas.	Moderate	Western Australian (WA) Herbarium 1998–, FloraBase—the Western Australian Flora, retrieved November, 2013, from http://florabase.dpaw.wa.gov.au/
Stylidium maritimum		P3		X	X		Caespitose perennial, herb, 0.3-0.7 m high, Leaves tufted, linear to narrowly oblanceolate, 10-40 cm long, 1-5.5 mm wide, apex acute to mucronate, margin involute, glabrous. Membraneous scale leaves present at base of mature leaves. Scape glandular throughout. Inflorescence paniculate. Fl. white/purple, Sep to Nov. Sand over limestone. Dune slopes and flats. Coastal heath and shrubland, open Banksia woodland.	Known: species recorded within Study Areas during the 2013 survey.	Moderate	Western Australian (WA) Herbarium 1998–, FloraBase—the Western Australian Flora, retrieved November, 2013, from http://florabase.dpaw.wa.gov.au/
Tripterococcus paniculatus		P4		X	X		Perennial, herb, to 1 m high. Fl. yellow-green, Oct to Nov. Grey, black or peaty sand. Winter-wet flats.	Highly Unlikely: species not previously recorded within 5 km and suitable habitat does not occur at the Study Areas.	NA	Western Australian (WA) Herbarium 1998–, FloraBase—the Western Australian Flora, retrieved November, 2013, from http://florabase.dpaw.wa.gov.au/

Appendix E –Fauna likelihood of occurrence assessment

Fauna likelihood of occurrence assessment of conservation significant fauna identified in the desktop assessment as potentially occurring within the Study Areas

Fauna Likelihood of Occurrence Assessment

Species name	Status			Source		Habitiat requirements and species ecology	Likelihood of occurrence
	EPBC Act	WC Act	DPaW	EPBC Act PMST	NatureMap search		
Birds							
Calyptorhynchus baudinii Baudin's Black Cockatoo	Vu	T		X		This species occurs in high-rainfall areas, usually at sites that are heavily forested and dominated by Marri and Eucalyptus species, especially Karri and Jarrah. The species is known to forage in heath lands with proteaceious shrubs.	**Present**. Recorded during the field survey. This species was recorded in the Study Area even though the EPBC Act Referral Guidelines (DoE 2012b) map the Study Area as outside the recognised foraging and breeding range for this species
Calyptorhynchus latirostris Carnaby's Black Cockatoo	En	T	X	X		This species mainly occurs in uncleared or remnant native eucalypt woodlands and in shrublands or kwongan heathland dominated by Hakea, Dryandra, Banksia and Grevillea species. The species also occurs in forests containing Marri, Jarrah or Karri (DoE 2012	**Likely**. This species was recorded in the area during previous studies (Western Wildlife, 2008). There is suitable foraging habitat in the Study Area for the Black Cockatoos.
Leipoa ocellata Malleefowl	Vu, Mi	T		X		The Malleefowl generally occurs in semi-arid areas of Western Australia, from Carnarvon to south east of the Eyre Bird Observatory (south-east Western Australia). It occupies shrublands and low woodlands that are dominated by mallee vegetation, as well as native pine Callitris woodlands, Acacia shrublands, Broombush Melaleuca uncinata vegetation or coastal heathlands. The nest is a large mound of sand or soil and organic matter (Jones and Goth 2008; Morcombe, 2004).	Unlikely. The Study Area is outside the currently known distribution for this species.

Species name	Status			Source		Habitiat requirements and species ecology	Likelihood of occurrence
	EPBC Act	WC Act	DPaW	EPBC Act PMST	NatureMap search		
Rostratula benghalensis australis Australian Painted Snipe	En, Mi,Ma	T		X		The Australian Painted Snipe generally inhabits shallow terrestrial freshwater (occasionally brackish) wetlands, including temporary and permanent lakes, swamps and claypans. Australian Painted Snipe breeding habitat requirements may be quite specific: shallow wetlands with areas of bare wet mud and both upper and canopy cover nearby. The species rarely occurs in south-western Australia, where it was once more common (Marchant & Higgins 1993; Garnett and Crowley 2000).	Unlikely. There is no suitable habitat for the species within the Study Area or in proximity to the Study Area.
Sternula nereis nereis Australian Fairy Tern	Vu	T		X		Within Australia, the Fairy Tern occurs along the coasts of Victoria, Tasmania, South Australia and Western Australia; occurring as far north as the Dampier Archipelago near Karratha. The Fairy Tern (Australian) nests on sheltered sandy beaches, spits and banks above the high tide line and below vegetation. The subspecies has been found in embayments of a variety of habitats including offshore, estuarine or lacustrine (lake) islands, wetlands and mainland coastline. The bird roosts on beaches at night (Garnett and Crowley 2000; Nevill, 2008)	Unlikely. There is no suitable habitat for the species within the Study Area or in proximity to the Study Area.

Species name	Status			Source		Habitiat requirements and species ecology	Likelihood of occurrence
	EPBC Act	WC Act	DPaW	EPBC Act PMST	NatureMap search		
Apus pacificus Fork-tailed Swift	Mi, Ma	S3		X		In south-west WA there are sparsely scattered records along the south coast, ranging from the Eyre Bird Observatory and west to Denmark. They are widespread in coastal and sub-coastal areas between Augusta and Carnarvon, including some on nearshore and offshore islands. There are no breeding records in Australia. This species is almost exclusively aerial, flying less than 1 m to at least 300 m above ground. This species is considered rare in the south-west region (DSEWPaC 2013).	Possible. The closest known record of this species are less than 2 km east of Wanneroo Road recorded in 2009 (DPaW and WAM 2013). There is potential this species may occur as an occasional vagrant however considering it is an almost exclusively aerial species with scattered records in the area the rate of occurance is likely to be low.
Pandion haliaetus Osprey	Ma	S3		X		Ospreys occur in littoral and coastal habitats and terrestrial wetlands of tropical and temperate Australia and offshore islands. They are mostly found in coastal areas but occasionally travel inland along major rivers, particularly in northern Australia. They require extensive areas of open fresh, brackish or saline water for foraging (Marchant & Higgins 1993). They frequent a variety of wetland habitats including inshore waters, reefs, bays, coastal cliffs, beaches, estuaries, mangrove swamps, broad rivers, reservoirs and large lakes and waterholes. They exhibit a preference for coastal cliffs and elevated islands in some parts of their range, but may also occur on low sandy, muddy or rocky	Possible. Given the proximity of the Study Area to coastal habitats (which are the prefered habitat of the species) it is possible that the Osprey will ocasionally occur in the Study Area.

Species name	Status			Source		Habitiat requirements and species ecology	Likelihood of occurrence
	EPBC Act	WC Act	DPaW	EPBC Act PMST	NatureMap search		
						shores and over coral cays.	
Ardea modesta Eastern Great Egret	Mi, Ma	S3			X	The eastern Great Egret is widespread in Australia. They have been reported in a wide range of wetland habitats, include swamps and marshes; margins of rivers and lakes; damp or flooded grasslands, pasture or agricultural lands; reservoirs; sewerage treatment ponds; drainage channels; salt pans; salt marshes; mangrove, and a range of coastal/marine habitats (DSEWPaC 2013)	Unlikely. There is no suitable habitat for the species within the Study Area or in proximity to the Study Area.
Ardea alba Great Egret, White Egret	Mi, Ma	S3		X		The Great Egret is a common and widespread species. They have been reported in a wide range of habitats including tropical and temperate grasslands, reservoirs; sewerage treatment ponds; drainage channels; wooded lands and terrestrial wetlands. It often forages away from water on low lying grasslands, improved pastures and croplands and roosts in trees, or amongst ground vegetation in or near lakes and swamps (Morcombe, 2004).	Unlikely. There is no suitable habitat for the species within the Study Area or in proximity to the Study Area.
Ardea ibis Cattle Egret	Mi, Ma	S3		X		The Cattle Egret is a common and widespread species. Typical habitat includes tropical and temperate	Unlikely. There is no suitable habitat for the species within the Study Area or in proximity to the Study Area.

Species name	Status			Source		Habitiat requirements and species ecology	Likelihood of occurrence
	EPBC Act	WC Act	DPaW	EPBC Act PMST	NatureMap search		
						grasslands, wooded lands and terrestrial wetlands. It often forages away from water on low lying grasslands, improved pastures and croplands and roosts in trees, or amongst ground vegetation in or near lakes and swamps (Morcombe, 2004).	
Haliaeetus leucogaster White-bellied Sea-Eagle	Mi, Ma	S3		X		The White-bellied Sea-Eagle occurs in coastal habitats (especially those close to the sea-shore as well as any habitat characterized by the presence of large areas of open water (larger rivers, swamps, lakes, the sea). It also occurs in the vicinity of estuaries, mangroves, swamps, lagoons and floodplains, often far inland along major rivers (Morcombe, 2004).	Possible. Given the proximity of the Study Area to coastal habitats (which are the prefered habitat of the species) it is possible that the Eagle will ocasionally occur in the Study Area.
Merops ornatus Rainbow Bee-eater	Mi, Ma	S3		X	X	Open forests and woodlands, shrublands, and in various cleared or semi-cleared habitats, including farmland and areas of human habitation. It also inhabits sand dune systems in coastal areas and at inland sites that are in close proximity to water (Morcombe, 2004).	Likely.The Rainbow Bee-eater has previously been recorded in the area and is known to utlise a wide variety of habitat types including those represented in the Study Area. Whilst the rate of is occurance is likely to be low the Rainbow Bee-eater is likley to ocasionally occur in the Study Area.
Mammals							
Bettongia penicillata ogilbyi Woylie	En	T			X	Preferred habitat for the Woylie includes dense undergrowth, logs and rock-cavities and occasionally in burrows (Burbidge 2004). Scattered Woylie populations may be found	Unlikely. This Woylie has not been recorded on the Swan Coastal Plain for over 40 years and is now restricted to isolated population in Wheatbelt Conservation Estate.

Species name	Status			Source		Habitiat requirements and species ecology	Likelihood of occurrence
	EPBC Act	WC Act	DPaW	EPBC Act PMST	NatureMap search		
						throughout the Jarrah forest in the south-west corner of Western Australia. Extant naturally occurring populations of the species are restricted to three small wheatbelt reserves in WA – Dryandra Woodland, Tutanning Nature Reserve and Perup Forest. All are characterised by the presence of thickets of the plant Gastrolobium (Van Dyck and Strahan 2008). The species historically occurred in a wide variety of habits, however is now restricted to forests and areas where predation has been controlled (or excluded).	
Dasyurus geoffroii Chuditch	Vu	T		X	X	The Chuditch inhabits eucalypt forest (especially Jarrah, Eucalyptus marginata), dry woodland and mallee shrublands. In Jarrah forest, Chuditch populations occur in both moist, densely vegetated, steeply sloping forest and drier, open, gently sloping forest. Most diurnal resting sites in sclerophyll forest consist of hollow logs or earth burrows (Van Dyke & Strahan, 2008). The species can travel large distances, has a large home range and is sparsely populated through a large portion of its range.	Possible. A Chuditch was sited in Neerabup on Waneroo Road (DPaW pers. comm. 2013).

Species name	Status			Source		Habitiat requirements and species ecology	Likelihood of occurrence
	EPBC Act	WC Act	DPaW	EPBC Act PMST	NatureMap search		
Isoodon obesulus fusciventer Southern Brown Bandicoot / Quenda			P5		X	The Quenda prefers dense scrubby, often swampy, vegetation with dense cover up to one metre high. However, it also occurs in woodlands, and may use less ideal habitat where this habitat occurs adjacent to the thicker, more desirable vegetation. The species often feeds in adjacent forest and woodland that is burnt on a regular basis and in areas of pasture and cropland lying close to dense cover (Van Dyck and Strahan, 2008).	Likely. The Study Area provides some suitable habitat for this species which is known to occur in scattered populations across the Swan Coastal Palin and prefers habitat associated with a dense understorey. This species is known to occur in the Neerabup National Park and the nearby Nowergup Lake and Joondalup Lake (DPaW and WAM)
Macropus irma Western Brush Wallaby			P4		X	The Western Brush Wallaby is a grazer found primarily in open forest or woodland,particularly favouring open, seasonally wet flats with low grasses and open scrubby thickets. It is also found in some areas of mallee and heathland, and is uncommon in karri forest. This species was once very common in the south-west of Western Australia but has undergone a reduction in range and a significant decline in abundance in its current habitat. (Van Dyke & Strahan, 2008).	Likely. The Study Area provides some suitable habitat for this species. This species has been recorded previously within the Study Area in the Neerabup National Park (DPaW and WAM 2013).
Petrogale lateralis lateralis Black-flanked Rock-wallaby		T			X	The Black-flanked Rock-wallaby has undergone a large range restriction, formerly being known from suitable habitat across central and southern Western Australia. The current known populations remain restricted to suitable habitat in the Little Sandy Desert, Cape Range, the Wheatbelt	Highly unlikely. There is no suitable habitat present for this species within the Study Area or on the Swan Coastal Pain

Species name	Status			Source		Habitiat requirements and species ecology	Likelihood of occurrence
	EPBC Act	WC Act	DPaW	EPBC Act PMST	NatureMap search		
						region, Barrow Island and Salisbury Island. In the south-west, colonies are largely confined to scattered granite outcrops in remnants of mallee scrub surrounded by cleared agricultural land. The habitat of Black-flanked Rock-wallaby varies between colonies but always involves grassland feeding habitat for feeding in close proximity to cliff, rock-pile, talus or escarpment refuge habitat. Rock cliffs or other steep substrates with adequate shelter and refuge are essential for breeding. Populations have been re-established via translocation to a number of sites along the Avon Valley, wheatbelt and southern coastline (Van Dyck and Strahan, 2008)	
Reptiles							
Morelia spilota imbricata Carpet Python		S4			X	The Carpet Python occurs in a large range of habitats including woodlands, forests and dense coastal scrub, on granite and limestone outcrops and along watercourses. The distribution of the species is from Geraldton and Yalgoo in the North east to Pinjin, Kalgoorlie, Fraser Range and most of the remaining south west. It is often arboreal and preys on birds, other reptiles and small to medium size mammals. The carpet python generally occurs in large, undisturbed bush; and	Present. This species was identified in the Study Area from a snake skin slough during the field survey.

Species name	Status			Source		Habitat requirements and species ecology	Likelihood of occurrence
	EPBC Act	WC Act	DPaW	EPBC Act PMST	NatureMap search		
						areas, preferring coastal limestone and woodlands on the Swan Coastal Plain (Bush et al. 1995; 2010).	
Invertebrates							
Austrosaga spinifer Cricket			P3		X	This species of cricket is an endemic to Australia. There is no habitat description available for this species.	Likely. There are two records of this species within the Study Area, along Wanneroo Road, recorded in 1981 and 1982
Hylaeus globuliferus Bee			P3		X	This native bee is thought to favour flowers of Adenanthos cygnorum for feeding, but has also been recorded on Banksia attenuata.	Likely. The closest known records of this species are less than 3 km east of the Study Area, recorded in 1995 and 1996 (DPaW and WAM 2013). Suitable habitat is present within the Study Area
Synemon gratiosa Graceful Sun Moth			P4		X	The Graceful Sun-moth (GSM) is closely associated with Banksia woodland. The species is also dependent upon *Lomandra maritima* and *L. hermaphrodita* being present for breeding.	Likely. There is excellent habitat for this species in the Study Areas and there are a number of records of this species in the surrounding region. Lomandra species were recorded during the 2013 survey.
Westralunio carteri Carter's Freshwater Mussel			P4		X	This species of mussel is south-west WA's only freshwater mussel. It is known from the Avon, Blackwood and Canning Rivers and is found in ponds, lakes, rivers, streams, and has been collected from a dam in WA. It is tolerant to human disturbance and	Highly unlikely. There is no suitable habitat for this species within the Study Area

Species name	Status			Source		Habitiat requirements and species ecology	Likelihood of occurrence
	EPBC Act	WC Act	DPaW	EPBC Act PMST	NatureMap search		
						organic pesticides, but sensitive to salinity levels.	

GHD

GHD House, 239 Adelaide Tce. Perth, WA 6004
P.O. Box 3106, Perth WA 6832
T: 61 8 6222 8222 F: 61 8 6222 8555 E: permail@ghd.com.au

G:\61\30230\WP\138169.docx

Document Status

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	M Longman G. Owen	C. Grabham M. Dilly		T Moulds		10/02/2014

www.ghd.com