Biological Surveys of the State Barrier Fence – Merivale Road Reserve Realignment – Cape Arid

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CONTENTS

CONTENTS

LIST OF ATTACHMENTS

Figures

Appendices

EXECUTIVE SUMMARY

The State Barrier Fence (SBF) currently extends from the Zuytdorp Cliffs, north of Kalbarri, to 25km east of Ravensthorpe, covering a distance of approximately 1170km. In an effort to protect the more recently developed agricultural land east of Ravensthorpe from impacts associated with major emu migration events and wild dogs, the Department of Agriculture and Food Western Australia (DAFWA) proposes to extend the SBF from east of Ravensthorpe to the coast near Cape Arid, east of Esperance.

DAFWA has recently identified that topographic constraints will make the proposed alignment difficult to develop at some locations. One section located north of Merivale Road, Boyatup, approximately 100km east of Esperance, will need to be realigned through approximately 1.6km of vegetated UCL, rather than the private property previously proposed. The realignment is required to avoid steep slopes and creek crossings. Accordingly, DAFWA require the suite of biological surveys previously undertaken for the originally proposed SBF alignment to be performed at the proposed Merivale Rd realignment section.

During the field survey, three vegetation communities were recorded and 145 taxa from 39 families were recorded, including one priority three taxon, *Hibbertia hamata*. No declared rare flora was recorded. *Hibbertia hamata* occurred in 2 sub-populations distributed along an existing telecommunications cable alignment. Agricultural lands with introduced pasture species occur in close vicinity, however no introduced species were present in the study area. No significant range extensions were recorded, however many taxa recorded are at the eastern edge of their range.

Phytophthora dieback was identified on the eastern portion of the elevated ridge, extending into the creek line situated at the eastern end of the study area. The infested area extends northward beyond the study area boundary, however, it can be anticipated that the infestation runs into the series of minor creek lines that form the head of the Thomas River. Current disease expression was very obvious due to high impact. The western area of the site was disease free.

Fauna habitat is generally a function of local differences in structural vegetation types and other factors including substrate (soils, rocky outcrops) and drainage. During the site assessment, two main habitat types were identified, however several micro habitats were also present.

No conservation significant species were positively recorded at the site, however, several target species have potential to occur there including two specially protected species (a reptile and a bird), three (terrestrial) migratory species (birds), four Priority species (four mammals and a reptile) and eight Threatened species (five birds and three mammals).

Twenty-three fauna species (or evidence of) were observed at the site during the site reconnaissance. They included two frogs, 14 birds, one reptile, five mammals and the possible presence of an additional conservation significant species (the Priority 5 listed Southern Brown Bandicoot).

While there will be site specific considerations relating to the construction of the SBF across the study area, the majority of the site impacts will be consistent with previous impacts assessed by Ecoscape in the initial SBF biological surveys project. Additional impacts associated with the Merivale Road section involve the potential for spread of *Phytophthora* dieback, impacting a Priority 3 flora species and minor loss of habitats. These impacts may be mitigated by the adoption of appropriate management actions.

1 INTRODUCTION

1.1 Background

The State Barrier Fence (SBF) currently extends from the Zuytdorp Cliffs, north of Kalbarri, to 25km east of Ravensthorpe, covering a distance of approximately 1170km. In an effort to protect the more recently developed agricultural land east of Ravensthorpe from impacts associated with major emu migration events and wild dogs, the Department of Agriculture and Food Western Australia (DAFWA) proposes to extend the SBF from east of Ravensthorpe to the coast near Cape Arid, east of Esperance.

A scoping study was conducted in 2012 by GHD Pty Ltd to identify project constraints associated with several potential fence alignment options and a preferred alignment for the Esperance extension has since been identified. The majority of the proposed extension follows the boundary between agricultural land and unallocated Crown Land (UCL), with the fence to be sited on public lands in most circumstances. The proposed alignment south of Fisheries Road places the fence on private land.

The construction of the Esperance extension will require the clearing of native vegetation within an approximately 20m wide easement. Detailed biological surveys, including flora, fauna and dieback assessments, were undertaken by Ecoscape in 2013/14 and reported in 2015. These assessments were required to provide baseline data to be submitted by DAFWA to the Western Australian (WA) Environmental Protection Authority (EPA) and the Commonwealth Department of the Environment (DoE) as a part of project reviews and appraisal processes.

DAFWA has recently identified that topographic constraints will make the proposed alignment difficult to develop at some locations. One section located north of Merivale Road, Boyatup, approximately 100km east of Esperance, will need to be realigned through approximately 1.6km of vegetated UCL, rather than the private property previously proposed. The realignment is required to avoid steep slopes and creek crossings.

Accordingly, DAFWA require the suite of biological surveys previously undertaken for the originally proposed SBF alignment to be performed at the proposed Merivale Rd realignment section. Consistent with the Ecoscape survey, the study area includes a 100m buffer extending from Merivale Road northwards into the UCL, to allow flexibility in establishment of the fence to mitigate any environmental constraints identified. The regional location of the study area is shown in Figure 1.

1.2 Objectives

The biological surveys are designed as baseline data collection surveys only. Therefore the objectives of the surveys are to:

- Understand the current status of environmental values within the defined project area; and
- Assess and understand the current threat posed by *Phytophthora* dieback across the defined project area.

1.3 Scope of Works

In order to achieve the project objective identified above the following scope of works was conducted.

- Undertake a Level 1 flora survey within the project corridor to define vegetation complexes and determine the extent of any conservation significant taxa identified. The survey was conducted by a qualified botanist and performed in accordance with '*Terrestrial flora and vegetation surveys for environmental impact assessment in Western Australia, Guidance for the Assessment of Environmental Factors No 51* (EPA 2004). Accordingly the Level 1 survey incorporated both desktop and field survey techniques, as required by the guideline document.
- Undertake a *Phytophthora* dieback survey, inclusive of a strategic sampling program within the project corridor. The *Phytophthora* survey performed was consistent with the standards defined in the *'Phytophthora dieback interpreters manual for lands managed by the department'* (DPaW 2015). The survey was undertaken by a Department of Parks and Wildlife (DPaW) registered dieback interpreter, as required by the above guideline document.
- Undertake a Level 1 fauna survey, consistent with the general criteria for 'Level 1 fauna surveys' as defined in *Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia, Guidance for the Assessment of Environmental Factors No 56*, (EPA, 2004). Methods used were based on those detailed in the Environmental Protection Authority Technical Guide Terrestrial *Biological Surveys as an Element of Biodiversity Protection* (EPA 2010). Accordingly the Level 1 fauna survey incorporated a desktop survey and field survey techniques as required by the guideline document.
- Development of single project report detailing results of biological surveys.

All project components were undertaken by Great Southern Bio Logic staff or associates. Field visits were undertaken during optimum survey periods, specific for purpose, site location and seasonal conditions.

1.4 Site Characteristics

The study area is situated on the northern side of Merivale Road, approximately 100km to the east of the town of Esperance (Figure 1). It extends 100m to the north of Merivale Rd and consists of an elevated ridgeline with a north easterly aspect in the west, while a tributary of the Thomas River is situated at the eastern end. Soil profile excavations were not undertaken as a part of the survey, however, visual field observations identified a waterlogged sandy soil consistent with a duplex horizon of sand over clay.

The study area is situated in an uncleared road reserve and adjoins cleared agricultural land to the west and east, with the Cape Arid National Park situated to the south. Major disease vectors associated with the study area include Merivale Road and a below ground telecommunications cable running parallel to Merivale Road, situated approximately 10m north of the road alignment.

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2 METHOD

Survey methodology varied in accordance with the specific survey undertaken. Each survey methodology consisted of a desktop assessment followed by a site visit to both validate the desktop information and conduct tasks in accordance with the relevant guidelines. As defined in Section 1.3, the relevant guideline texts used to define the required project methods include:

- Terrestrial flora and vegetation surveys for environmental impact assessment in Western Australia, Guidance for the Assessment of Environmental Factors No 51 (EPA 2004);
- *Phytophthora* dieback interpreters manual for lands managed by the department (DPaW 2015; and
- Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia, Guidance for the Assessment of Environmental Factors No 56 (EPA 2004))

2.1 Desktop Assessments

The SBF re-alignment along Merivale Road study area was subject to a series of initial desktop assessments involving the review of available databases and literature. The desktop assessments were designed to gather existing information relating to environmental values and threats, as well as data relating to the environmental and physical context of the site. The sources of desktop information included:

- Bureau of Meteorology;
- Spatial information and Database searches including:
    - Beard vegetation mapping 'Native vegetation extent' dataset (DAFWA July 2013);
    - Soils mapping datasets (DAFWA 2004);
    - Aerial photography (ESRI and its data providers);
    - Vegetation Health Service, positive *Phytophthora* recovery database (DPaW, 2013);
    - GIS datasets (e.g. drainage lines and wetlands) sourced from the Shared Land Information Platform (SLIP) (2015);
- Previous surveys:
    - GHD (2012) Report for State Barrier Fence Esperance Extension Scoping Study, Unpublished report for DAFWA.
    - Ecoscape (2015) State Barrier Fence Biological Surveys, Draft report prepared for DAFWA.
- Relevant texts and publications

2.2 Field Survey

Field surveys were undertaken across two site visits. The fauna and dieback surveys were conducted on 12 August, 2015 while the vegetation and flora survey was conducted on 4 September 2015. Leading up to the fauna and dieback assessment field visit the weather had been wet and cool, however, on the day of survey conditions were clear and sunny with a

maximum temperature of 17.2°C (BoM, 2015). During the flora survey weather conditions were dry with a maximum daily temperature of 25.2°C recorded from Esperance (BoM, 2015)

2.2.1 Vegetation and Flora

Two previous assessments associated with the SBF extension have been undertaken and were reviewed as part of the desktop assessment. Surveys undertaken by Ecoscape in 2013 and 2014 provided many new records of rare and priority flora. The vegetation and flora survey involved the collation of both existing and new records of rare and priority flora records from within 20km of the study area (Appendix A). The presence of priority ecological communities (PECs) and threatened ecological communities (TECs) by was considered probable, and therefore all potentially significant communities highlighted by Ecoscape (2015) were considered.

The field survey area was assessed via a meandering traverse over a 100m wide corridor adjacent to Merivale Rd. Particular attention was given to an existing Telstra communication cable where the fence construction is most likely to occur. All vegetation boundaries and locations of significant flora were identified using a handheld GPS (Garmin 60). Vegetation communities were defined using releves ($100m^2$) in which the presence and abundance of all taxa was recorded according to National Vegetation Index Survey (NVIS) (NHT 2003), then compared with descriptions of Priority and Threatened Ecological Communities.

Selected plant specimens were collected for identification or lodgement at the Western Australian Herbarium (Perth).

An inventory of all vascular plant taxa recorded is presented in Appendix B. Criteria and descriptions of significant flora and vegetation are in accordance with DPaW (2013a, 2013a, 2013c, 2013d). All nomenclature is in accordance with the online herbarium database (2013b).

2.2.2 *Phytophthora* dieback

The *Phytophthora* dieback survey was undertaken using the comprehensive transect survey method, as defined in the *Phytophthora dieback interpreters manual for lands managed by the department* (DPaW 2015). The survey was undertaken by a DPaW registered disease interpreter, and involved traversing all potentially uninfested areas within the project area by walking transect lines spaced at a maximum distance of 50m apart. Field data including disease presence and vegetation information was collected using a hand held GPS unit and converted to ArcGIS™ shapefiles. Collected field data included all sample locations, a point file of all identified individual plant deaths attributed to *Phytophthora* and track files of the area covered during survey.

Sampling for *Phytophthora* dieback involves the collection of soil and tissue material from fresh deaths of plants considered to be reliable indicator species of *Phytophthora* expression. Where suspicious deaths were identified, soil and root tissue material was collected into heavy duty plastic bags using a sterilised sample axe. All samples were forwarded to the VHS laboratory for analysis.

The comprehensive transect survey method provides high confidence disease distribution information and hygiene classification data, and is defined in detail in the *Phytophthora dieback interpreters manual for lands managed by the department* (DPaW, Jan 2015).

2.2.3 Fauna Survey

Detailed survey methodology is presented in the attached fauna survey report (Appendix C). In summary, the field survey involved ground coverage of areas noted during the desktop review of aerial photography together with identification of specific ecological attributes including habitat features and physical site characteristics including drainage and topography.

Broad structural fauna habitat types were identified and mapped. Nine habitat assessment plots (each approximately 10 x 10m) were undertaken with at least one plot within each broad structural habitat type, although multiple plots were undertaken in some habitat types. Micro habitat elements that were assessed, where present, included vegetation structure, habitat condition, ground cover, rocky outcrops, ground litter, type of substrate, habitat trees and fallen logs. Habitat attributes with relevance to species of conservation significance were particularly considered.

Fauna observations were recorded and secondary evidence of fauna such as tracks, nests, scat, bones, diggings and characteristic feed signs were also noted. Some active searching was undertaken when suitable microhabitat was encountered during the habitat assessments and broader survey.

Hollow bearing trees (HBT) within the site were mapped and hollow height, size, and tree diameter (where species occur that typically form hollows) were noted into classes. Presence or absence of black cockatoo foraging habitat and roosting evidence was also noted.

Mapping was carried out using ArcGIS 10.0 geographic information system (GIS) software. Field data was captured using a Garmin GPS map 60CSx high sensitivity handheld GPS.

3 RESULTS AND DISCUSSION

3.1 Desktop assessment – Site

Site related desktop assessment data is presented below. Survey specific desktop assessment data is presented in the relevant result discussion sections following, and also in the detailed fauna survey report attached (Appendix C).

3.1.1 Climate

The nearest Bureau of Meteorology station is situated at Thomas River. Data from the Thomas River station shows an annual average rainfall of 557.6mm, which is within the accepted rainfall zone for the presence of *Phytophthora*. June is recorded as being the wettest month with an average of 76.2mm while December is recorded as having the lowest monthly rainfall average of 21.7mm. This data reflects the influence of tropical low pressure systems which often traverse the south west of WA in a south easterly direction, regularly delivering high intensity rain events in summer months.

The climate data for Thomas River from 2015, prior to survey, shows that rainfall was recorded as 40.8mm in June, 67mm in July and 85mm in August which, with the exception of June, can be considered average for the area. There is no temperature data recorded for Thomas River however the BoM station at Esperance recorded average temperatures of 19.2^{o}C in June and 16.7^{o}C in July. There was no recorded average for August, however, these temperatures are again consistent with long term averages for the site.

3.1.2 Interim Biogeographic Regionalisation of Australia (IBRA) values

The Interim Biogeographic Regionalisation for Australia (IBRA) classifies Australia's landscapes into 89 large geographically distinct bioregions based on common climate, geology, landform, native vegetation and species information. IBRA also provides the national and regional planning framework for the systematic development of a comprehensive, adequate and representative (CAR) national reserve system, endorsed by all levels of government as a key tool for identifying land for conservation under the Commonwealth *Australia's Strategy for the National Reserve System.*

According to the latest IBRA update (7), the study area is located within the ESP02 Recherche subregion of the Esperance Plains. The Esperance Plains bioregion is characterised by proteaceous scrub and mallee heaths on sandplain; herbfields and heaths occur on granite and quartzite ranges that rise from the plain. The heaths are rich in endemics. Eucalypt woodlands occur in gullies and alluvial foot-slopes (Comer et al. 2001).

3.1.3 Landforms and Soil

The ESP02 subregion has variable relief, consisting of Quaternary coastal sandplains and dunes overlying Proterozoic gneiss and granite as well as Eocene and more recent coastal limestones. Numerous granitic islands occur just off the coast of the mainland (Comer et al, 2001).

3.1.4 Vegetation

Vegetation at the site has been mapped broadly by Beard (in DAFWA 2013) as vegetation associations Esperance 4801 and Fanny Cove 516. Descriptions are provided below:

- Esperance 4801: Shrublands; heath with scattered Nuytsia floribunda on sandplain.

- Fanny Cove 516: Shrublands; mallee scrub, black marlock.

The Cape Arid NP, and the study area, represents an ecotone of changing habitat from the arid zone in the east to the wetter coastal zone in the south west (DEC 2012).

3.2 Level 1 Vegetation and Flora Survey

The Level 1 Flora survey was undertaken by Great Southern Bio Logic associate, South Coast Botanist Damien Rathbone.

During the field survey, 145 taxa from 39 families were recorded, including one priority three taxon as described below. No declared rare flora were recorded. Agricultural lands with introduced pasture species occur in close vicinity, however no introduced species were present in the study area. No significant range extensions were recorded, however many taxa recorded are at the eastern edge of their range.

Forty two species were recorded that were not observed in previous surveys of the Esperance extension of the State Barrier Fence (Ecoscape 2015). This is primarily due to the more coastal location of the present survey area and potentially due to the survey timing, which could account for the high number of previously unrecorded annual taxa.

3.2.1 Conservation Significant Species

Hibbertia hamata (Priority Three)

Two sub-populations comprising 35 individuals of *Hibbertia hamata* were recorded within the proposed clearing area for the fence alignment as indicated in Figure 2. These plants occurred primarily along an existing Telstra communications alignment that has previously been disturbed. No plants were observed outside the proposed clearing area, however, five other populations are known in close proximity (<20km) to the study area.

3.2.2 Vegetation Type, Condition and Status

Three vegetation communities were recorded from the study area. These are described below and presented in Figure 2.

Eucalyptus extrica, E. flocktoniae (Map Unit - ExEf)

Description: *Eucalyptus extrica, E. leptocalyx* mid open mallee shrubland over *Melaleuca calycina, Melaleuca scabra, Daviesia lancifolia* shrubland over *Gahnia ancistrophylla* sparse sedgeland. Other common species included *E. flocktoniae, E. tumida, Banksia media, Xanthorrhoea platyphylla* and *Grevillea oligantha*.

Plate1: *Eucalyptus extrica, E. flocktoniae (Map Unit - ExEf)*

This highly species rich community occurred over the majority of the survey area on the elevated plains and ridges in grey silt and clay soils. *Eucalyptus flocktoniae* became more dominant on subtle depressions. The majority of the community could be considered to be in excellent condition according to the Bushland Condition Scale (Keighery 1994). *Phytophthora* dieback is present in the eastern section of the community and is significantly impacting susceptible taxa, mainly *Banksia media* and *Xanthorrhoea platyphylla*. The construction of a Telstra communications line adjacent to Merivale Rd has caused only minor disturbance with no encroachment of weeds. This community includes the priority one taxon, *Hibbertia hamata* as shown on Figure 2.

This community is not concordant with any PEC or TEC. It is represented in the adjacent Cape Arid National Park and is floristically similar to the community EsPmHh recorded by Ecoscape (2015) at four other sites on the fence alignment (R077, R079, R083, R085).

Eucalyptus occidentalis (Map Unit - Eo)

Description: *Eucalyptus occidentalis* woodland. Other species included *Calothamnus quadrifidus* subsp. *quadrifidus, Melaleuca incana* subsp. *tenella*.

Plate 2: *Eucalyptus occidentalis (Map Unit - Eo)*

This community occurred over an 80m section of study area in a moderately incised tributary flowing north east to the Thomas River. The community could be considered to be in excellent condition according to the Bushland Condition Scale (Keighery 1994). *Eucalyptus occidentalis* woodlands in seasonally inundated clay basins represent a PEC potentially occurring in the study area. This is not concordant with the described community as it does not occur on a clay basin.

Allocasuarina campestris, Banksia media (Map Unit - AcBm)

Description: *Allocasuarina campestris, Banksia media, Acacia cyclops, Thryptomene saxicola* mid shrubland. Other common species included *Eucalyptus extrica, Acacia cyclops, Acacia saligna* and *Muehlenbeckia adpressa*.

This assemblage of taxa represents an ecotone covering approximately 80m between the drainage line and the elevated plain. Diversion of a road drain, the presence of *Phytophthora* dieback and other potential other unknown disturbances have reduced the condition of this vegetation. The vegetation assemblage could be considered to be in very good condition according to the Bushland Condition Scale (Keighery 1994). As this is an ecotonal zone it does not represent a single clearly identifiable community and therefore is not comparable to any PEC or TEC.

Plate 3: *Allocasuarina campestris, Banksia media (Map Unit - AcBm)*

Several plant taxa could not be comprehensively identified during the survey due to the absence of reproductive material or because current taxonomic information is inadequate. None of these are likely to be of conservation significance based on comparison with currently known species. However, taxa recorded as “affinities” (eg *Cyathostemon* aff. *tenuifolia*) may become conservation listed in the future as taxonomic knowledge improves. The seasonal timing of the survey was considered adequate to detect the significant taxa with the potential to occur in the study area. The survey recorded a high number of taxa considering the small survey area and the level of survey intensity. A level two survey would be required for a comprehensive inventory of all taxa and would increase the likelihood of detecting conservation listed taxa not highlighted by the desktop assessment.

No vegetation communities were identified as PEC’s of TEC’s. However, the *Eucalyptus extrica, E. flocktoniae* community represented in the study site was highly species rich and provided habitat for at least one priority species. Several other taxa usually associated with granite were also recorded from this community, indicating it may have an assemblage of species otherwise uncommon in the region. Due to the paucity of detailed floristic survey conducted in the Esperance region, an accurate assessment of the conservation values of this and other communities recorded from the survey area is not possible.

3.3 *Phytophthora* Dieback Survey

The *Phytophthora* dieback field survey was performed as a comprehensive transect survey. There are six possible disease hygiene categories that may be applied to specific areas of a project site based on certain attributes and conditions. The hygiene categories are defined in detail in the *Phytophthora* dieback interpreters manual for lands managed by the department’ (DPaW 2015), however, a summary of the disease hygiene categories and the associated assessment criteria for each category is presented in Appendix D.

3.3.1 Desktop Assessment

A review of available aerial photography showed a distinct variation in vegetation density, with significantly more vegetation biomass associated with the elevated western ridge area in comparison to the vegetation in the eastern portion of the study area. While this visible pattern may be associated with a variation in soil type, it is also consistent with visual scarring associated with *Phytophthora* dieback infestations.

A review the VHS positive sample database identified a single positive recovery of *P. cinnamomi* within approximately 120m of the study area. This sample is shown on Figure 3 and is situated on the strategic fire break to the south of Merivale Road. Other previous recoveries of *P. cinnamomi* have been recorded along the Thomas River to the south of the study area and also along Merivale Road to the west of the study area. These, however, are not considered to have direct influence on the study area due to position in the landscape and distance.

3.3.2 Vegetation

As defined in Section 3.2 above, three vegetation complexes were identified. These are described as *Eucalyptus extrica, E. leptocalyx* mid open mallee shrubland; *Eucalyptus occidentalis* woodland; and *Allocasuarina campestris, Banksia media, Acacia cyclops, Thryptomene saxicola* mid shrubland.

The predominant indicator species used for detection of the disease included *Banksia media*, and *Xanthorrhoea platyphylla.*

3.3.3 Disease Distribution

The disease distribution information is shown on Figure 3 along with the locations of soil and tissue samples collected during the field survey.

Phytophthora dieback was identified on the eastern portion of the elevated ridge, extending into the creek line situated at the eastern end of the study area. The infested area extends northward beyond the study area boundary, however, it can be anticipated that the infestation runs into the series of minor creek lines that form the head of the Thomas River.

As described above, the disease distribution can be extrapolated, using the accepted mechanisms of disease spread, to include the drainage lines immediately north of the study area. While not included in the survey, these areas are directly influenced by drainage from infested areas and can be considered to be infested also. These drainage lines intersect the proposed SBF alignment to the east of the study area and represent a potential hygiene issue that has not yet been considered.

3.3.4 Disease Expression

Disease expression in the infested area ranged from moderate to high impact, expressed through multiple deaths of all indicator species listed in Section 3.3.2. Most obvious expression was through *B. media* and *X. platyphylla*. Observed deaths ranged in age with an readily observed pattern of disease extending from areas where the majority of indicator species had been removed through historic impact, through to very fresh expression on the disease boundary near the top of the ridge.

There was no disease expression in the creek line at the eastern end of the study area due to the absence of indicator species in this area. While the creek line intersecting the SBF alignment immediately east of the study area was not assessed, extrapolation of disease

distribution suggests that this creek is also likely to be infested. Because of the lack of indicator species, disease expression in the uninterpretable vegetation is not apparent.

3.3.5 Sample Program

The location of soil and tissue sample sites is shown on Figure 3 and the VHS certificate of analysis is presented in Appendix E. A total of 2 soil and tissue samples were collected from fresh deaths within the study area. At the time of reporting sample Merivale Rd 1 had been confirmed as *P. cinnamomi* while sample Merivale Rd 2 had been sent for DNA analysis and reported as subcultured. Subcultured samples may represent another species of *Phytophthora* or it may possibly be classified as negative for *Phytophthora*. However, due to the proximity of both samples to each other, the result of the subculture will not influence the classification of the area as infested based on the field expression and the result of sample Merivale 1.

3.4 Level 1 Fauna Survey

The Level 1 Fauna survey was undertaken by Great Southern Bio Logic associate, Shane Priddle from SW Environmental Pty Ltd. The full SW Environmental report is provided as Appendix C and should be referred to for detailed understanding of the survey, associated results and references. A summary of information, extracted from the SW Environmental report is presented below

3.4.1 Desktop Assessment

3.4.1.1 Important Bird Areas (IBA)

The closest IBA is located over five kilometres south and consists of islands recognised under the Recherche Archipelago IBA. The Recherche is an archipelago of about 300 islands, islets and rocks off the south coast, immediately south of the site.

3.4.1.2 Habitat Connectivity

The UCL lot associated with the project is approximately 230 ha and has value in connecting the vegetation associated with the upper reaches of the Thomas River to Cape Arid NP in the south. It is situated within Strategic Zone A of the South Coast macro corridor network (Wilkins et al 2006) indicating regional nature conservation significance. Existing barriers to connectivity include cleared tracks and Merivale Road between the National Park and the UCL. From a landscape perspective the UCL is overshadowed by the close proximity of Cape Arid NP which has contiguous reserved vegetation and fauna habitat and is of significantly greater extent than the UCL associated with the project.

3.4.1.3 Local Fauna Records

Two hundred and twenty-two terrestrial vertebrate fauna species have been recorded in local survey results and database records. This figure includes eight amphibians, 159 birds, 17 mammals and 38 reptiles. It generally does not include numerous invertebrates or marine or aquatic dependant species (fish, marine turtles, etc). Some records may refer to seasonal visitors or may be associated with coastal or marine environments not typical of the site.

3.4.1.4 Invertebrates and Short Range Endemics

The DPAW Naturemap (2015) and Department of Environment EPBC Projected Matters Search Tool (2015) did not identify any local records of invertebrates or short range endemics

of conservation significance. Short range endemic fauna, which includes species of insects, arachnids myriapods and crustaceans that have highly restricted distributions because of poor dispersal, slow growth, low fecundity or specific habitat preferences, are particularly vulnerable to extinction (Moir et al 2009b). Unfortunately very little is known regarding the abundance or extent of many of these species within the south-west, or which may be most important for conservation.

3.4.1.5 Conservation Significant Fauna

From the desktop assessment a number of conservation significant species may occur locally. These are detailed in the full report (Appendix C) and include:

- Two specially protected species (a reptile and a bird),
- Three (terrestrial) migratory species (birds),
- Four Priority species (four mammals and a reptile),
- Eight threatened species (five birds and three mammals).

3.4.2 Fauna Habitat

Fauna habitat is generally a function of local differences in structural vegetation types and other factors including substrate (soils, rocky outcrops) and drainage. Key habitats at the site include:

Mallee over sandy loams in depressions (Habitat Plot 2); Located in a moderate depression with a northerly aspect, on the eastern edge of the site, this habitat contained little mid or understorey vegetation. There were signs of recent washout, probably exacerbated by the road side drainage, but a creek bed, running or pooling water were absent. Mallee occurred over most of the site, although in other areas it was mostly sporadic or in clumps emerging over the scrub and heath layer. There was an abundant leaf litter with some small fallen timber.

Heath and closed scrub on sandy and gravelly loams (Habitat Plot 1, 3-9); This habitat type represents the majority of the site. Significant areas in the eastern portion of the site were impacted by *Phytophthora* dieback (see Section 3.3) resulting in significant decline in densities of susceptible species. The dieback affected areas contained significantly reduced biomass and constituted an open heath while the disease free areas were a dense, closed heath (up to 2m height). There were significant areas in very good to excellent condition, (e.g. east of the Mallee in the depression). Some pools of water had accumulated near the Merivale Rd culverts. Large fallen timber and leaf litter was generally sparse.

Extensive vegetation extends to the north of the study area and Cape Arid NP is located to the south, while cleared agricultural land lies both east and west. Cape Arid NP and the vegetation to the north of the site remain intact, well connected and also generally in very good condition except for where it is affected by dieback, minor tracks or fire breaks. Habitat within the site itself was continuous.

Ecotones such as those between the road or paddock edge and scrub vegetation, or the heath and woodland, may provide foraging opportunities for predators such as raptors. The site offers a range of habitat opportunities for a variety of fauna and is well connected at a landscape scale.

The mallee species on site were generally not thick enough to develop hollows of sufficient quality to be utilised by hollow dependent fauna. No large trees (greater than 50 cm at breast

height or with hollows) were observed within the site. Further, the site is well outside of the breeding range for black cockatoos (SEWPaC, 2012).

3.4.3 Species Recorded

Twenty-three fauna species (or evidence of) were observed at the site during the site reconnaissance. They included two frogs, 14 birds, one reptile, five mammals and the possible presence of an additional conservation significant species (the Priority 5 listed Southern Brown Bandicoot). Possible bandicoot diggings were observed at several locations but weren't clear enough to be confirmed as bandicoot due to the confirmed presence of rabbit (scat and diggings) and Short-beaked Echidna (scat). In addition to rabbits, evidence of introduced cat and fox tracks were also observed.

A small network of runways through the heath created by a species of small mammal were observed approximately 50m north of Merivale Road (51 H 500745 6259706). They were considered too small to be used by rabbits or bandicoots and are likely to be made by *Rattus fuscipes* (Bush Rat), (Pers comm. Dr Kenny Travouillon, Curator - Mammology, WA Museum). Other small mammals that occur locally, but not necessarily at the site, may include:

- *Mus musculus* (House Mouse) (introduced)
- *Notomys michellii* (Mitchells Hopping Mouse)
- *Pseudomys occidentalis* (Western Mouse)
- *Rattus fuscipes* (Bush Rat)
- *Sminthopsis crassicaudata* (Fat-tailed Dunnart)
- *Sminthopsis granulipes* (White-tailed Dunnart)
- *Sminthopsis griseoventer* (Grey-bellied Dunnart)

3.4.4 Conservation Significant Fauna

No conservation significant species were positively recorded at the site, however, several target species have potential to occur there. These are outlined below.

3.4.4.1 Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*) (T En)

Black cockatoos are long-lived, slow-breeding birds that display strong pair bonds. The species is suffering the effects of population decline and habitat loss. Carnaby's Black Cockatoo breed in hollows that are usually only found in trees that are more than 200 years old and are generally known to breed throughout the southwest, to the west of Ravensthorpe in the higher rainfall areas (SEWPAC, 2012). Suitable breeding habitat does not occur at the site, however, the study location is within the known foraging habitat for the species. A lone male was observed five kilometres west of the site.

3.4.4.2 Malleefowl (*Leipoa ocellata*) (T, Vu, M)

Malleefowl are mostly located to the south and west of a line extending from Cape Farquhar, which lies north of Carnarvon, to the Eyre Bird Observatory in the south-east of Western Australia. They occur in semi-arid and arid zones of temperate Australia, where they occupy shrublands and low woodlands that are dominated by mallee vegetation. They also occur in other habitat types including *Eucalyptus* or native pine *Callitris* woodlands, *Acacia* shrublands, Broombush (*Melaleuca uncinata*) vegetation or coastal heathlands. The breeding habitat of the Malleefowl, within its home range, is characterised by light soil and abundant leaf litter

(DEC 2010). There are no local records from Naturemap (2015), however, suitable habitat does occur at the site, along with marginal breeding habitat within the mallee through the depression. No nesting mounds were observed during the site visit.

3.4.4.3 Western Ground Parrot (*Pezoporus flaviventris*) (T, CE)

The Western Ground Parrot inhabits low, dry or swampy, near-coastal heathlands on sandplains and uplands in areas that receive 400-500 mm of rainfall annually. In recent years, confirmed records of the Western Ground Parrot have only been obtained within Fitzgerald River NP, Cape Arid NP and Nuytsland NR. It is also possible that a small subpopulation could persist in Waychinicup NP (SPRAT 2014).

Western Ground Parrot occur in long unburnt (5 to 40 or more years), floristically diverse, near-coastal dry heath (400 to 500 millimetres rainfall). This vegetation is usually less than 0.5 metres high, but may reach up to one metre, with more than 50 per cent cover. Sedges are generally abundant, making up 40 per cent of total cover. Although Western Ground Parrots are usually found in long unburnt vegetation, they have been observed to feed in habitats two to three years post-fire, provided there is older vegetation nearby (DPaW 2014). In addition Ground Parrots fly mainly at dawn and dusk, covering short distances, low over vegetation, nest on or close to the ground and have good dispersal ability (DPaW 2014).

The South Coast Threatened Birds Recovery Plan identifies that the site is within the Management Area for the species.

Alan Burbidge and Sarah Comer (DPaW) (August 2015), both of which have published numerous articles on the species, indicated that whilst there are no recent records, Ground Parrots have been known to occur further north (near Fisheries Rd). Also, possibly in response to fox and cat control programs, local known populations of Western Ground Parrots may be spreading to other areas, possibly including the site.

3.4.4.4 Southern Brown Bandicoot, Quenda (*Isodon obesulus fusciventers*) (P5)

Quenda habitat consists of dense scrubby, often swampy vegetation with a dense cover up to one metre high, particularly near watercourses and wetlands. Quenda often feed in adjacent forests and woodlands that are burnt on a regular basis. Nests can be concealed, next to or under old logs, shrubs or piles of debris and are made up of ground litter piled up over a shallow depression providing internal chambers. Home ranges vary with population density, and range from 5-8.6ha for males and 1-6ha for females (DEC 2010). They feed on a variety of ground-dwelling invertebrates and the fruit-bodies of hypogeous fungi. During their search for food, Quenda often create distinctive conical holes in the soil (DECCW 2010). If present at the site, the species would be at the edge of its known distribution (Menkorst and Knight 2013), however, possible Quenda diggings were observed during the field visit. There are no Naturemap records of sightings within the study area (2015).

3.4.4.5 Western Brush Wallaby (*Macropus irma*) (P4)

Optimum habitat for the Western Brush Wallaby includes open Jarrah forest or woodland and seasonally wet flats with low grasses and scrubby thickets, but also areas of mallee and heathland. Common dietary flora includes *Carpobrotus edulis*, *Cynodon dactylon* and *Nuytsia floribunda* (DEC, 2007). The site would be at the edge of the species' distribution if present (Menkorst and Knight 2013). There are no local Naturemap records (2015).

3.4.4.6 Southern Death Adder (*Acanthopis antarcticus*) (P3)

Southern Death Adders inhabit a range of habitats, including rainforest, scrubland, semi arid zones and rocky outcrops. Typically during the day they remain mostly buried beneath sand, soil or debris, with just the tail and top of the head exposed (Pilbara Pythons 2014).

3.4.4.7 Southern Carpet Python (*Morelia spilota imbricata*) (S)

Southern Carpet Python may shelter in burrows made by other animals, hollow tree limbs or logs (especially 150mm diameter hollows extending at least to one metre deep), or rock crevices. The species commonly uses hollow logs for shelter (Wilson and Swan, 2008). This subspecies has been recorded from semi-arid coastal and inland habitats, *Banksia* woodland, *Eucalyptus* woodlands, and grasslands. If present at the site, the species would need to rely on heath due to lack of other good refuge (hollow timber, trees, or rocky areas).

4 SITE SPECIFIC IMPACTS AND MANAGEMENT CONSIDERATIONS

The construction of the SBF extension will require the clearing of approximately 3ha of intact remnant vegetation. It is understood that, where possible, the alignment will be positioned within the 100m wide survey corridor in a manner that will avoid any sensitive environmental values.

As previously discussed, Ecoscape have previously undertaken extensive flora, fauna and dieback surveys along the majority of the alignment, to the north and west of Fisheries Road. As a part of the project reporting, potential impacts of the SBF extension were addressed in the context of the entire extension, which is beyond the scope of this report. Accordingly, the broad landscape and general ecological impacts associated with the SBF extension have not been considered in this report.

The impacts associated with the proposed construction of the SBF within the study area are described below. Some of these can be mitigated through the recommendations included in Section 5:

4.1 Clearing of native vegetation

Typical impacts associated with clearing native vegetation include

- direct loss of habitat;
- loss of mature vegetation (provides more flowers, nectar, fruit, seeds, refuge);
- loss of below ground biomass (such as seed banks);
- changes to faunal assemblages near the fence; and
- fragmentation of habitat connectivity and populations (discussed further below).

Based on a 20 m clearing width, approximately 2.8 ha of heath and closed scrub will require clearing and 0.2 ha of mallee through the drainage depression. The heath and scrub is by the far the most common vegetation locally and is well represented within the adjacent Cape Arid NP. Therefore the clearing required is unlikely to affect the quality and quantity of fauna habitat available locally given the abundance of similar habitat within the remaining UCL and in Cape Arid NP.

4.2 Impact to Conservation Significant Flora and Vegetation

As discussed in Section 3.2.1, the priority 3 species *Hibbertia hamata* was identified within the study area, which represents a previously unknown population of this taxon. According to existing records this species occurs in 16 populations over a narrow range of 61 km, often in the vicinity of granite. At least five populations are known from within 20 km of the study site. A paucity of floristic survey has been conducted in this region, therefore the actual abundance of many priority flora is likely to be greater than existing records indicate.

While Priority flora have no formal legislative protection, authorities expect that appropriate actions to mitigate impacts are undertaken by proponents. Realignment of the fence within the 100m corridor could potentially be undertaken to avoid direct impacts on this species, however, this is not recommended. In this instance it is considered that due to the existing site disturbances including the road and communication cable, and the potential spread of *Phytophthora* dieback which would be associated with a fence location away from the existing disturbances, positioning the fence close to Merivale road will reduce the overall impact to floristic values in the study area and surrounds. In this instance, the occurrence of *Hibbertia hamata* in a site of minor disturbance and its abundance in the vicinity of the study area

indicate the removal of approximately 35 individuals will not have a significant impact on the taxon.

4.3 Introduction/Spread of *Phytophthora* dieback

Phytophthora dieback is present within the site and is having a significant impact in the infested areas. The most common method of disease spread is human vectoring through the movement of infested soil and plant materials. Clearing, construction and maintenance activities present a risk of moving infested soil to currently uninfested areas both within the study area and also external to the study area.

Subsequent impacts through the spread of the pathogen include significant loss of biodiversity and an associated loss of potential habitat and foraging flora species for dependent fauna.

4.4 Construction Environment

Construction, including clearing, would lead to a number of direct impacts such as injury and possibly death of reptiles, small mammals and birds that may occur within nests or hollows. Clearing would have greater impacts during spring, which is the nesting period for most fauna.

Introduction of disease or pathogens as a result of clearing may also have direct impacts, at a community level (*Phytophthora* dieback), or species level (amphibian chytrid fungus). Chytridiomycosis is caused by the amphibian chytrid fungus *Batrachochytrium dendrobatidis* which occurs in waterbodies or in soil (DPaW 2012).

4.5 Collision risk

The fence itself may present a risk of collision, entanglement or entrapment for some fauna species, including birds and large mammals (e.g. Western Grey Kangaroo). This is discussed in more detail in Ecoscape (2015). There may be some risk to Ground Parrots if they do occur near the site.

4.6 Habitat connectivity

Clearing will increase fragmentation of the UCL and the cumulative impact of the gap in habitat already associated with Merivale Rd. The fence may act as a direct barrier to some species, in particular those in the size/weight range that are targeted by the fence (e.g. Emu), but also including Mallee Fowl, Western Grey Kangaroo, Wallabies, etc should they occur). The impacts of the SBF on fauna at a landscape scale are discussed further in Ecoscape (2015).

5 RECOMMENDATIONS

Recommendations to assist in the mitigation of potential impacts associated with the construction of SBF within the study area include

- Construct the fence as close as possible to Merivale Road to minimise the depth of impact into the UCL and associated habitat.
- All clearing and construction activities should be performed in accordance with a project specific operational hygiene plan designed to mitigate the risk of spreading *Phytophthora* dieback.
- Should fence construction occur 12 months or more from the date of the *Phytophthora* dieback field assessment (12 August 2015), disease boundaries will require a re-check survey to be completed before operational activities can be undertaken. Should fence construction occur 36 months or more from the date of the *Phytophthora* dieback field assessment then the entire study area will require a full re-survey due to the potential for disease movement and additional infestation.
- Ensure a licensed and experienced fauna surveyor conducts pre clearance surveys to ensure appropriate management and relocation of injured or displaced fauna.
- Avoid clearing between August and November for Western Ground Parrot (and if possible between August and February to include the breeding range for other species).
- Installation of visual identifiers along the top of the fence at appropriate, defined intervals (e.g. 10m) to decrease the likelihood of accidental collision of wildlife with the fence.
- General controls and mitigation measures should be implemented through an Environmental Management Plan (EMP). The EMP would ensure roles and responsibilities are clearly defined, site audits are conducted and construction staff are inducted to the fauna habitat values of the site. *Phytophthora* dieback management and soil hygiene and fauna preclearance survey requirements. Appropriate reporting would also be addressed through the EMP in line with standard operating procedures.
- Final designs should quantify the amount of native vegetation required to be cleared and this should be assessed against any matters of National Environment Significance (e.g. Carnaby's Black Cockatoo foraging habitat).

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7 LIMITATIONS

This report was prepared for The Department of Agriculture and Food Western Australia, solely for the purposes set out in the scope of works and it is not intended that any other person use or rely on the contents of this report.

Whilst the information contained in the Report is accurate to the best of our knowledge and belief, Great Southern Bio Logic and its agents cannot guarantee the completeness or accuracy of any of the descriptions or conclusions based on the information supplied to it or obtained during the site investigations, site surveys, visits and interviews. Furthermore, field and / or regulatory conditions are subject to change over time, and this should be considered if this report is to be used after any significant time period after its issue.

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Figures

Biological Surveys of the State Barrier Fence – Merivale Road Reserve Realignment – Cape Arid

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Great Southern Bio Logic does not guarantee that this map is without flaw of any kind and disclaims all liability for any errors, loss or other consequence which may arise from relying on any information depicted.

Ref: GSBL188
Date: 23/09/2015
Image: Landgate Travellers Atlas 2009

Figure 1: Regional Location

Biological surveys of the State Barrier Fence alignment - Merivale Road Reserve Realignment - Cape Arid prepared for the Department of Agriculture and Food Western Australia
September, 2015

LEGEND

Project Study Area

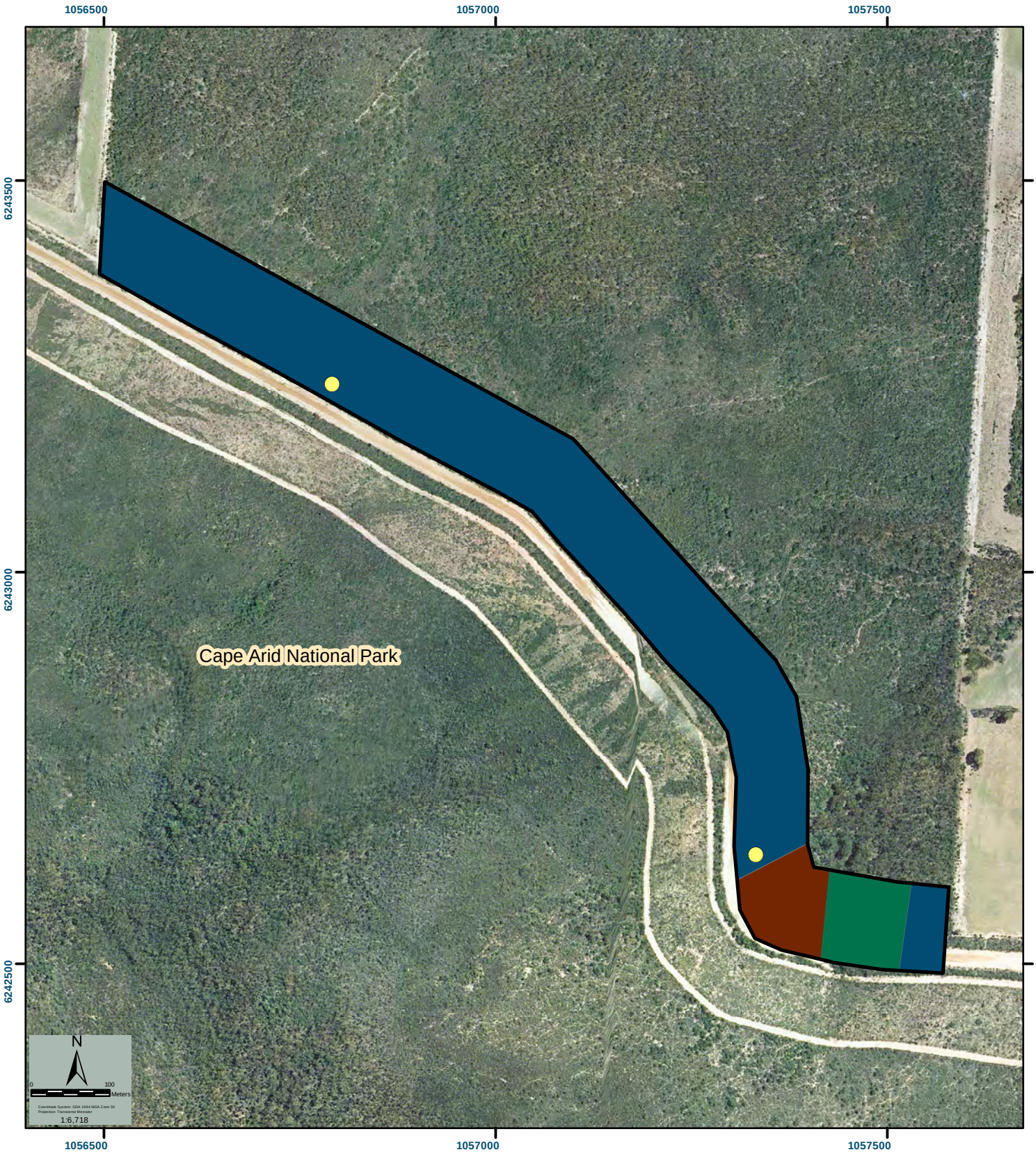

Figure 2: Priority Flora and Vegetation units within the study area

LEGEND

Vegetation units

- Eucalyptus extrica, E. flocktoniae
- Allocasuaria campestris, Banksia media
- Eucalyptus occidentalis

Conservation flora

- Hibbertia hamata (Priority 3)
- Study Area

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Date: 25/09/2015

Biological surveys of the State Barrier Fence - Merivale Road Reserve Realignment - Cape Arid prepared for the Department of Agriculture and Food Western Australia, September, 2015

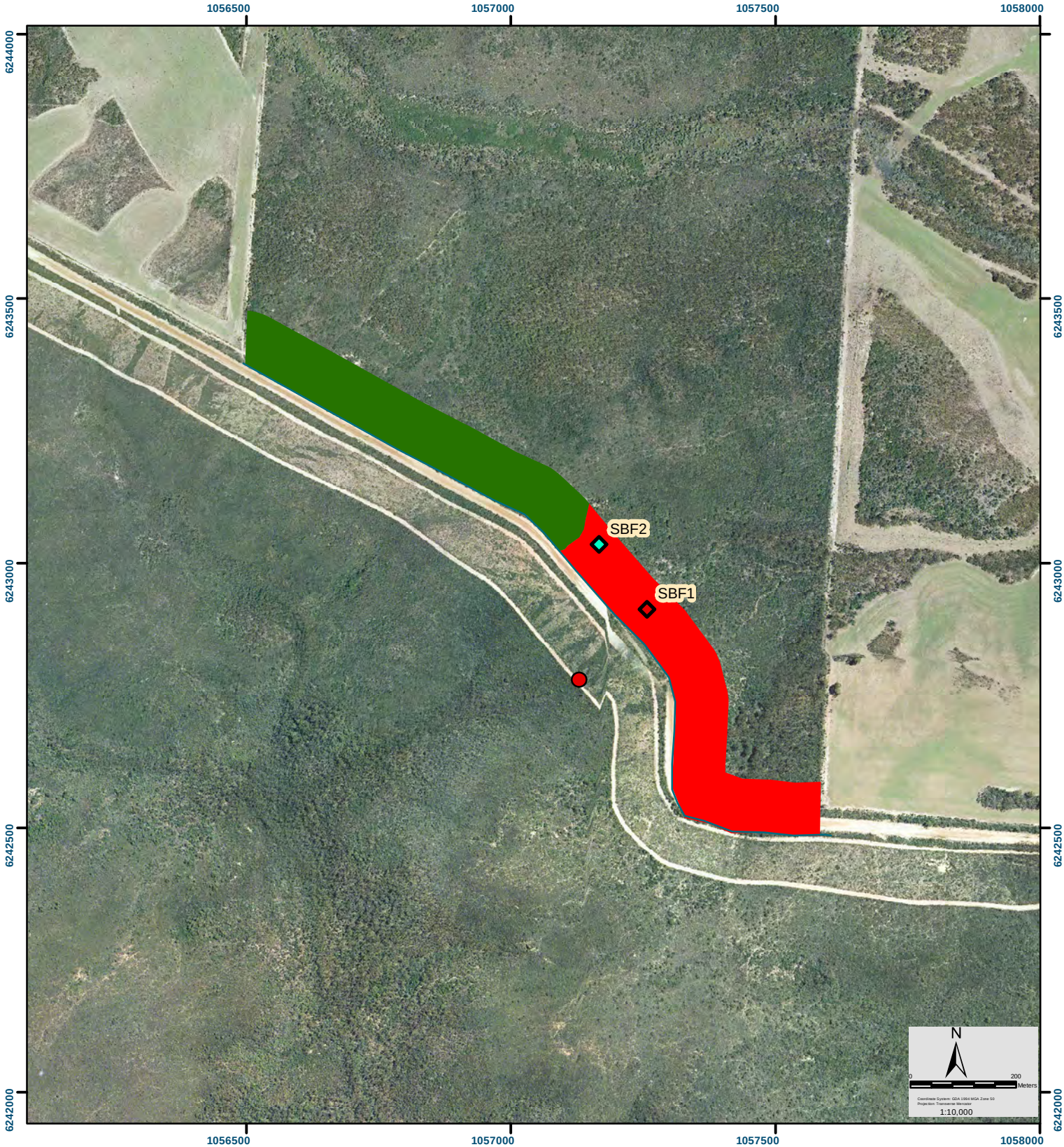


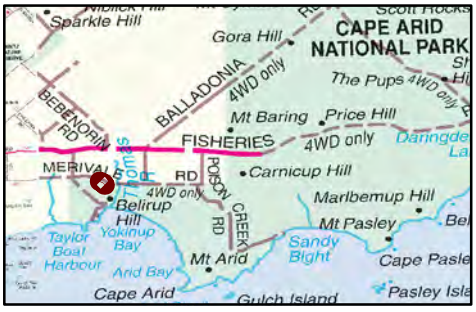
Figure 1: Phytophthora Dieback distribution for the Proposed State Barrier Fence alignment, Merivale Road

LEGEND

Disease status
- Infested
- Uninfested

Sample Result
- CINNAMOMI
- SUB-CULTURED
- VHS Positive Pc (2013)

Phytophothra Dieback distribution for the proposed State Barrier Fence alignment Merivale Road prepared for the Department of Parks and Wildlife, September, 2015



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Date: 17/09/2015

Appendix A

Rare and priority flora records from within 20km

Appendix A: Rare and priority taxa recorded by ecoscape (2015) or DPaW databases within a 20 km radius of the survey area. Status, Description and habitat according to DPaW (2013b).

Taxon	Status	Description & Habitat
Acacia nitidula	2	Spreading shrub, (0.2-)0.6-2(-3) m high. Fl. yellow. Granitic sandy Gravelly soils. Amongst granite boulders.
Andersonia carinata	2	Erect slender shrub, 0.1-0.45(-0.8) m high. Fl. pink/pink-white/pink-purple, Aug to Oct. White sand, gravelly lateritic soils. Plains.
Anigozanthos bicolor subsp. *minor*	T	Rhizomatous, perennial, herb, 0.05-0.2 m high. Fl. green&red, Aug to Oct. Sand. Well-watered sites.
Caesia viscida	2	Rhizomatous and tuberous, tufted perennial, herb, to 0.3 m high. Fl. white, Nov. Aeolian sand. Low dunes.
Eucalyptus semiglobosa	3	Mallee, to 6 m high, bark smooth grey over tan. Fl. cream-white-yellow, May or Oct to Dec or Jan. White sand over laterite, silty sand on edge of granite shelf, limestone. Hillslopes, gullies, cliffs.
Gonocarpus pycnostachyus	3	Erect annual, herb, 0.1-0.15 m high. Fl. green-red. Sand or clay soils. Wet depressions, granite rocks.
Grevillea baxteri	4	Erect to spreading shrub, 0.8-3.6 m high. Fl. green-yellow-orange-brown-red, Feb or May to Jul or Sep to Dec. Sand. Sandplains.
Hibbertia hamata	3	Erect shrub, to 0.5 m high. Fl. yellow, Oct to Dec. Granite. Inland outcrops.
Isopogon alcicornis	3	Low, lignotuberous shrub, 0.3-0.5 m high, up to 0.6 m wide. Fl. yellow/white/pink, Oct to Dec or Feb. Sandy soils, skeletal loam on granite. Sandhills, salt lakes, sandplains.
Kennedia beckxiana	4	Prostrate or twining shrub or climber. Fl. red, Sep to Dec. Sand, loam. Granite hills & outcrops.
Leucopogon florulentus	3	Erect slender shrub, 0.3-0.8 m high. Fl. white, Jun to Nov. White/grey or yellow sand, sandy clay, gravelly lateritic soils. Sandplains, gentle slopes.
Myoporum velutinum	T	Shrub, 1-2 m high. Fl. white, Sep. Sandy soils. Creek banks.
Myriophyllum petraeum	4	Aquatic annual, herb, stems 0.15-0.3 m long. Fl. white, Aug to Dec. Strictly confined to ephemeral rock pools on granite outcrops.
Paracaleana parvula	2	Perennial, herb, to 0.18 m high. Fl. yellow/green, Oct to Nov. Deep white sands. Plains.
Persoonia spathulata	2	Erect, spreading shrub, 0.2-0.6 m high. Fl. yellow, Dec or Jan. Sand.
Pterostylis sp. Ongerup (K.R. Newbey 4874)	4	Upright annual, herb, to 0.12 m high. Stony red loamy clay, calcareous grey sand, spongeolite. Sheltered slopes, base of cliffs and valley floors, in soil pockets.

Appendix B
Flora Species List

Appendix 2: Inventory of vascular plant taxa recorded in the flora survey of the State Barrier Fence (SBF) extension. New records on the SBF alignment and conservation status are noted. Voucher No. relevant to specimens forwarded to the Western Australian Herbarium, Kensington, Perth.

FAMILY & Taxon	New to SBF	Status	Voucher No.
ANARTHRIACEAE			
Anarthria gracilis	*		
APIACEAE			
Xanthosia huegelii			
ASPARAGACEAE			
Chamaescilla corymbosa	*		
Laxmannia sessiliflora	*		
Lomandra micrantha subsp. *teretifolia*			
BORAGINACEAE			
Halgania anagalloides var. Southern (A.E. Orchard 1609)			
CASUARINACEAE			
Allocasuarina campestris			
Allocasuarina humilis			
Allocasuarina thuyoides			
CELASTRACEAE			
Stackhousia monogyna			
Cupressaceae			
Callitris drummondii	*		
CYPERACEAE			
Caustis dioica			
Gahnia ancistrophylla			
Lepidosperma aff. *brunonianum*			DAR 1002
Lepidosperma aff. *gracile*	*		DAR 1003
Schoenus obtusifolius			
Schoenus subbarbatus	*		
DILLENIACEAE			
Hibbertia gracilipes			
Hibbertia hamata	*	Priority 3	DAR 1001
Hibbertia psilocarpa			
ERICACEAE			
Acrotriche cordata			
Acrotriche ramiflora			

FAMILY & Taxon	New to SBF	Status	Voucher No.
Andersonia parvifolia			
Leucopogon carinatus			
Leucopogon fimbriatus			
Leucopogon sp. Coujinup (M.A. Burgman 1085)			
Lysinema ciliatum			
EUPHORBIACEAE			
Monotaxis paxii			
FABACEAE			
Acacia cochlearis			
Acacia cyclops			
Acacia glaucoptera			
Acacia gonophylla			
Acacia lasiocarpa var. *bracteolata*			
Acacia mutabilis subsp. *mutabilis*			
Acacia myrtifolia	*		
Acacia nigricans			
Acacia saligna			
Acacia varia var. *parviflora*	*		
Bossiaea preissii			
Chorizema aciculare subsp. *aciculare*			
Daviesia incrassata subsp. *incrassata*			
Daviesia lancifolia			
Daviesia teretifolia			
Gompholobium knightianum	*		
Gompholobium marginatum			
Hovea pungens	*		
Isotropis cuneifolia subsp. *cuneifolia*	*		
Kennedia prostrata			
Pultenaea heterochila	*		
Pultenaea indira subsp. *indira*			
Templetonia retusa	*		
GOODENIACEAE			
Anthotium rubriflorum	*		
Dampiera fasciculata	*		
Dampiera lavandulacea			
Goodenia concinna			
Goodenia scapigera subsp. *scapigera*			

FAMILY & Taxon	New to SBF	Status	Voucher No.
Lechenaultia formosa			
Velleia trinervis			
HEMEROCALLIDACEAE			
Johnsonia acaulis	*		
IRIDACEAE			
Patersonia occidentalis var. *occidentalis*			
LAURACEAE			
Cassytha glabella			
Cassytha racemosa	*		
LOGANIACEAE			
Logania buxifolia			
MALVACEAE			
Lasiopetalum indutum	*		
Thomasia angustifolia	*		
MYRTACEAE			
Beaufortia schaueri			
Calothamnus quadrifidus subsp. *quadrifidus*			
Calothamnus gracilis			
Calytrix decandra			
Calytrix leschenaultii			
Chamelaucium ciliatum	*		
Conothamnus aureus			
Cyathostemon aff. *tenuifolius*			DAR 1000
Eucalyptus conglobata			
Eucalyptus extrica			
Eucalyptus flocktoniae			
Eucalyptus leptocalyx			
Eucalyptus occidentalis			
Eucalyptus phenax subsp. *phenax*			
Eucalyptus tumida			
Eucalyptus uncinata			
Melaleuca calycina			
Melaleuca incana subsp. *tenella*	*		
Melaleuca pulchella			
Melaleuca scabra			
Melaleuca societatis			
Melaleuca striata			

FAMILY & Taxon	New to SBF	Status	Voucher No.
Melaleuca suberosa			
Melaleuca undulata			
Taxandria spathulata			
Thryptomene saxicola	*		
OLACACEAE			
Olax benthamiana			
ORCHIDACEAE			
Caladenia longicauda subsp. *rigidula*	*		
Diuris laxiflora	*		
Elythranthera brunonis			
Pheladenia deformis	*		
Pterostylis recurva	*		
Thelymitra antennifera	*		
Thelymitra vulgaris	*		
PHYLLANTHACEAE			
Phyllanthus calycinus			
PITTOSPORACEAE			
Billardiera heterophylla			
Marianthus bicolor	*		
POACEAE			
Amphipogon turbinatus			
Neurachne alopecuroidea			
POLYGONACEAE			
Muehlenbeckia adpressa			
PROTEACEAE			
Banksia alliacea	*		
Banksia armata var. *ignicida*	*		
Banksia media			
Banksia nivea subsp. *nivea*	*		
Banksia obovata			
Banksia tenuis var. *tenuis*			
Grevillea nudiflora			
Grevillea oligantha			
Hakea cinerea			
Hakea denticulata			
Hakea laurina			
Hakea marginata			

FAMILY & Taxon	New to SBF	Status	Voucher No.
Hakea nitida			
Hakea trifurcata	*		
Hakea varia			
Isopogon formosus subsp. *formosus*	*		
Isopogon sp. Fitzgerald River (D.B. Foreman 813)			
Persoonia teretifolia			
Petrophile squamata subsp. northern (J. Monks 40)			
Petrophile teretifolia			
Stirlingia anethifolia			
Synaphea petiolaris subsp. *petiolaris*	*		
RANUNCULACEAE			
Clematis pubescens	*		
RESTIONACEAE			
Hypolaena exsulca			
RHAMNACEAE			
Cryptandra nutans			
Pomaderris brevifolia	*		
Spyridium globulosum	*		
Spyridium microcephalum	*		
RUBIACEAE			
Opercularia vaginata			
RUTACEAE			
Boronia crassifolia			
Boronia inornata subsp. *inornata*			
SANTALACEAE			
Exocarpos sparteus			
SAPINDACEAE			
Dodonaea pinifolia			
SOLANACEAE			
Solanum symonii	*		
STYLIDIACEAE			
Stylidium sp.			
THYMELAEACEAE			
Pimelea sp.			
VIOLACEAE			
Hybanthus floribundus			

FAMILY & Taxon	New to SBF	Status	Voucher No.
XANTHORRHOEACEAE			
Xanthorrhoea platyphylla			
ZAMIACEAE			
Macrozamia dyeri	*		

Appendix C

Level 1 Fauna Survey – Merivale Rd Esperance

Great Southern Bio Logic
environmental solutions

Level 1 Fauna Survey

Merivale Road, Esperance

SEPTEMBER 2015

SW environmental
www.swenvironmental.com.au

Version control

Project number:	SW044			
Project file path:	SW044 Merivale Rd Level 1 fauna survey v20150923			
Client:	Jeremy Spencer, Great Southern Bio Logic			
Revision	Date	Prepared by (name)	Reviewed by (name)	Approved by (name)
V1.1 20150923	1/09/15	Shane Priddle	KP	Shane Priddle
V1.1 20150923	23/09/15	Shane Priddle		Shane Priddle

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Contents

FIGURES

TABLES

Executive Summary

The site contains approximately 15.28 ha of good quality fauna habitat, including heath and closed scrub on sandy and gravelly loams and Mallee over sandy loams in the depression. Assuming an impact width of 20m, about 2.8 ha of heath and scrub will be cleared and about 0.2 ha of Mallee. No specific fauna habitat attributes were identified as constraints during the fieldwork.

The site may provide suitable habitat for several conservation significant species; three birds (Carnaby's Black Cockatoo, Malleefowl, Western Ground Parrot), two reptiles (Southern Death Adder, Southern Carpet Python) and two mammals (Quenda, Western Brush Wallaby). Impacts are likely to be low for all species.

The site is located as potential habitat within the western extent of the Management Area 2 outlined in the South Coast Threatened Birds Recovery Plan (DPaW 2014). Whilst impacts to Western Ground Parrot at the site are likely to be low, as noted by Ecoscape (2015) any deleterious impact on this Critically Endangered species should not be an acceptable risk. Recommendations are made in Section 7 to ensure impacts to conservation significant fauna are low or less.

It is understood that the project will be referred to the federal Department of the Environment (DoE).

1 Introduction

1.1 Background

The State Barrier Fence (SBF) currently extends from the Zuytdorp Cliffs, north of Kalbarri, to 25 km east of Ravensthorpe, over a distance of about 1170 km. In an effort to protect the more-recently developed land east of Ravensthorpe from major emu migration events and wild dogs, the Department of Agriculture and Food Western Australia (DAFWA) proposes to extend the SBF by up to 622 km from east of Ravensthorpe to east of Esperance.

A scoping study was conducted in 2012 to identify project constraints associated with several potential fence alignment options by GHD Pty Ltd. A preferred alignment for the Esperance extension has since been identified. The majority of the proposed extension occurs on the boundary between agricultural land and Unallocated Crown Land (UCL).

The construction of the Esperance extension will require the clearing of native vegetation within a 20 m wide easement. Detailed biological surveys, including flora, fauna and dieback assessments, were undertaken by Ecoscape (2015). These assessments were required to provide baseline data and inform the need to refer the project to the Western Australian (WA) Environmental Protection Authority (EPA), Commonwealth Department of the Environment (DoE) and clearing permit application to the WA Department of Environmental Regulation (DER).

DAFWA has recently identified that topographic constraints will make the (previously assessed) alignment difficult to develop at some locations. One particular section located north of Merivale Road, Boyatup, approximately 100 km east of Esperance, will need to be realigned through approximately 1.6 km of vegetated UCL rather than the private property previously proposed, to avoid steep slopes and creek crossings. This Level 1 fauna survey is required to assess the fauna and habitat values of the proposed realignment within 100 m of Merivale Road, to supplement the existing surveys carried out by Ecoscape (2015). SW Environmental were commissioned to carry out this survey by Great Southern Bio Logic on behalf of DAFWA.

The study area includes a 100 m buffer from Merivale Road within the UCL to allow the fence to be micro-sited if needed to avoid any environmental constraints. The location of the study area is shown in Figure 1-1. For the purposes of this survey the 'locality' includes the areas within 20 km of the study area.

This report addresses the fauna values and impacts associated only with additional minor realignment proposed for the study area. It does not seek to address the broader implications of the SBF Esperance extension on fauna or the across the wider landscape. This was the focus of the Ecoscape (2015) report. It is understood that the project will be referred to the federal Department of the Environment (DoE).

1.2 Scope of works

The scope of work includes a Level 1 terrestrial vertebrate fauna survey of the study area (referred to above), consistent with the general criteria for 'Level 1 fauna surveys' (EPA Guidance Statement No. 56, EPA, 2004) within 100 m of the UCL north of Merivale Road. The fauna survey includes

- Desktop assessment,
- Field validation and general habitat assessment,
- Consultation, reporting (including a discussion on impacts), mapping and recommendations.

Figure 1-1 Location of the site

1.3 Regulatory context

1.3.1 Legislative framework

The conservation status of fauna species in Western Australia is assessed under the federal *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and the state administered *Western Australian Wildlife Conservation Act 1950 (*WC Act*)*.

Species listed as threatened, migratory or priority under the above legislation are referred to collectively in this document as 'conservation significant fauna' or 'target species'.

WC Act

Species of fauna are afforded Declared Rare or Priority conservation status where their populations are restricted geographically or threatened by local processes. The Department of Parks and Wildlife (DPaW) administers this Act. DPaW recognises these threats of extinction and consequently applies regulations towards population and species protection. The Western Australian Minister for the Environment regularly gazettes a notice where taxa are listed as protected and classified under Schedule 1 through to Schedule 4 according to their conservation status or need for protection. The most recent was issued on 4 December 2014.

- S1 - Schedule 1 Rare or likely to become extinct
- S2 - Extinct
- S3 - Protected under International agreements
- S4 - Other specially protected fauna

For the purposes of this report S1 scheduled species are also referred to as T – Threatened. DPaW also produces a list of priority species that have not been assigned statutory protection under the WC Act, but are under consideration as 'Scheduled' taxa, and are in urgent need of further survey or regular monitoring, and although not currently threatened may become so in the future.

- P 1: Taxa with few, poorly known populations on threatened lands.
- P 2: Taxa with few, poorly known populations on conservation lands.
- P 3: Taxa with several, poorly known populations, some on conservation lands.
- P 4: Taxa in need of monitoring.
- P 5: Taxa in need of monitoring.

EPBC Act

In accordance with Commonwealth legislation, the EPBC Act provides a list of matters of 'National Environmental Significance' (NES), which includes significant fauna, flora and communities. Under the EPBC Act threatened fauna may be listed in any one of the following categories as defined in *Section 179* of the Act:

- Extinct;
- *Extinct in the wild;
- *Critically endangered;
- *Endangered;
- *Vulnerable; and
- Conservation dependent.

*Only species in those categories marked with an asterix are matters of NES under the Act.

The EPBC Act also lists migratory species that are recognized under international treaties including the Japan Australia Migratory Bird Agreement (JAMBA), the China Australia Migratory Bird Agreement (CAMBA) and the Bonn Convention (The Convention on the conservation of Migratory Species of Wild Animals). Species listed under JAMBA are also protected under Schedule 3 of the WC Act.

IUCN Red List

The IUCN Red List is an inventory of the global conservation status of species and used to assist DPAW and other agencies in attributing a given threatened species status. It does not have any statutory authority.

1.3.2 Guidelines

The survey also considers the guidelines below.

Federal, Department of Environment

- Commonwealth *'Matters of National Environmental Significance – Significant impact guidelines 1.1 Environmental Protection and Biodiversity Conservation Act 1999, Department of the Environment, Water, Heritage and the Arts (DEWHA)*', (2009),
- Commonwealth *'EPBC Act referral guidelines for three threatened black cockatoo species: Carnaby's cockatoo (endangered),* Calyptorhynchus latirostris*, Baudin's cockatoo (vulnerable),* Calyptorhynchus baudinii*, Forest red-tailed black cockatoo (vulnerable)* Calyptorhynchus banksii naso', (SEWPaC 2012),

WA, Office of the Environmental Protection Authority (OEPA)

- '*Environmental Protection of Native Vegetation in Western Australia Position Statement No. 2*', EPA (2000),
- 'T*errestrial Biological Surveys as an Element of Biodiversity Protection. Position Statement No. 3*', EPA (2002).
- EPA Guidance Statement No. 56 '*Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia*', (2004), in particular 'Level 1 surveys', outlined in Appendix 2 of the Guidance Statement,
- '*Technical Guide – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment'* EPA and DEC (2010).

2 Methods

2.1 Desktop Assessment

Prior to field surveys, a desktop assessment was undertaken to develop an understanding of the ecological values of the study area and to assist in identifying the likelihood of target species (threatened, migratory or priority listed fauna) occurring there. This involved a review of relevant databases, previous survey reports, the results of consultation and a review of books and other publications.

Information about target species records was also obtained from literature (books and scientific journals), management plans, recovery plans, and government species profile databases. Experts involved in ecological research were also consulted in the preparation of this report.

2.1.1 Database searches

Searches within the locality, i.e. 20 kilometres of the study area, were carried out using the Atlas of Naturemap (2015) and Living Australia (ALA, 2015)[1] databases. Both of these amalgamate records from sources including but not limited to

- WA Museum,
- Department of Parks and Wildlife (DPaW),
- Birds Australia.

GIS datasets were also queried, including

- Beard vegetation mapping dataset from the Department of Agriculture and Food WA (DAFWA) 'Native vegetation extent' dataset (current July 2013),
- Soils mapping datasets from DAFWA (2004),
- Aerial photography (ESRI and its data providers),
- GIS datasets (e.g. drainage lines and wetlands) sourced from the Shared Land Information Platform (SLIP) (2015).

2.1.2 Previous surveys and consultation

Few fauna surveys appeared to have been conducted locally or were available at the time of writing. Those that were available are listed below:

- Fauna records from Cape Le Grand, National Park derived from surveys conducted by DPaW (Esperance) through the Western Shield Program (provided by Stephen Butler 30.07.2014),
- Cowan. M. (2011) A preliminary fauna survey of New Island Bay, Cape Le Grand National Park. Department of Environment and Conservation, Woodvale, WA,
- Ecoscape (2015) State Barrier Fence Biological Surveys, Draft report prepared for DAFWA.
- GHD (2012) Report for State Barrier Fence Esperance Extension Scoping Study, Unpublished report for DAFWA.
- SW Environmental (2014) Level 1 Fauna survey for the Lucky Bay Recreation Site extension, Unpublished report to Great Southern Bio Logic on behalf of WA Department of Parks and Wildlife (DPaW).

2.1.3 Publications

Publications consulted for general distribution of fauna included:

- A Field Guide to the Mammals of Australia (Menkhorst and Knight, 2011),
- Common Birds of the South West Forests (Thomson-Dans and Hunter, 2009),
- Common Trees of the South West (Wheeler, 2007),
- Field guide to frogs of Western Australia (Doughty and Tyler, 2009)
- Frogs of Western Australia (Thomson-Dans and Wardell-Johnson, 2002),
- Mammals of the South West (Johnson and Thompson Dans, 2003),
- Michael Morcombe's Birds of Australia eGuide, (2011),
- Reptiles and Frogs in the Bush: Southwestern Australia (Bush et al., 2007),
- Scats, Tracks and Other Traces: A field guide to Australian mammals (Triggs, 2004),
- The Field Guide to the Birds of Australia (Pizzey and Knight, 2007),
- Threatened and Rare Birds of Western Australia (Burbidge and Blight, 2008),

[1] ALA (2015) search was only available within 10 kilometres of the study area.

- Waterbirds of South-west Wetlands (Thomson-Dans and Halse, 2001).
- Numerous online publications (see References section)
- Numerous other general species references are included in the References section.

2.2 Site Reconnaissance

Field work consisted of a site reconnaissance carried out on Wednesday 12th August (winter) 2015, by an experienced fauna and habitat surveyor (Shane Priddle). The days leading up to and immediately after the survey were wet, however the conditions during the survey were cool but sunny. The weather conditions from Esperance Airport are provided below.

Table 2-1 Weather conditions (Esperance Airport: station 009542, BOM 2015, 120km from the site)

Date	Min temp (°C)	Max temp (°C)	Rainfall (mm)	Temperature (°C), Wind (direction, km/hour)	
				9am	3pm
12/08/2015	10.9	17.2	6	12.2, WNW, 13	15.5, SW, 17

Survey methodology is described below and shown in Figure 2-1.

2.2.1 Validation of desktop study

The site attributes visible by aerial photo interpretation and habitat types identified during the desktop study were validated by walking over the study area. Other ecological features were identified, such as specific habitat features (see microhabitat elements below), presence or absence of ephemeral or permanent drainage features, during the fieldwork.

2.2.2 Habitat assessment plots

Broad structural fauna habitat types were identified and mapped. Nine habitat assessment plots (each approximately 10 x 10m) were undertaken (Figure 2-1). Sampling included at least one plot within each broad structural habitat type; multiple plots were undertaken in some types. Micro habitat elements assessed, where present, included vegetation structure, habitat condition, ground cover, presence of rocky outcrops, ground litter, type of substrate, habitat trees and fallen logs. In particular habitat attributes were considered with respect to species of conservation significance. Photos were taken. Notes were made about the quality of habitat based on the descriptions in Table 2-2 below.

Table 2-2 Fauna habitat quality categories and descriptions (from nghenvironmental, undated)

Quality	Description
Good	• Diverse habitat structure, structural components present at a range of stratum levels (ground, understorey, midstorey, canopy) and age classes. • Presence of shelter and refuges, that is, low shrub or tussock, rocky outcrop, hollow logs (ground dwelling fauna). • If forest or woodland: moderate to high abundance of hollow-bearing trees, including mature trees which are more likely to bear hollows of a range of sizes, including those with large internal dimensions. Mature trees also produce more foraging resources for nectar and seed eating fauna.

Quality	Description
	• Habitat complexity, that is, areas of ecotones between vegetation types or areas with different management regimes, which produce a habitat mosaic. This increases the range of foraging and shelter opportunities within a habitat. • Presence of key foraging and microhabitat components, which depend on subject species. • Little to no obvious weed invasion. • May be large patch in extent and connected to other areas of native vegetation.
Moderate	• Medium complexity of habitat structure appropriate to vegetation type. Ground litter layer intact or slightly disturbed. More than one age class present. • Some shelter and refuge present for ground dwelling fauna. • If forest or woodland: hollow-bearing trees present in low to moderate abundance. • Habitat complexity, that is, areas of ecotones between vegetation types or areas with different management regimes, which produce a habitat mosaic. This increases the range of foraging and shelter opportunities within a habitat. • Presence of key microhabitat components, which depend on subject species. • Native flora species dominant. • May be small or large in scale, and isolated or well connected.
Poor	• Habitat highly disturbed and simplified with very little structural complexity. Ground litter layer absent or highly modified. Complexity reduced by only one age class present. • Little or no shelter and refuge for ground dwelling fauna. • If forest or woodland: low abundance of hollow-bearing trees. • Lack of key foraging and microhabitat components, which depend on subject species. • May be narrow or small area and substantially influenced by edge effects, and isolated from other areas of native vegetation.

2.2.3 Fauna survey

Fauna observations were recorded. Secondary evidence of fauna such as tracks, nests, scat, bones, diggings, characteristic feed sign were also recorded.

Some active searching was also undertaken when suitable microhabitat was encountered during the habitat assessments and broader survey. These aimed to locate the more elusive frog and reptile species that may inhabit the site. Active searching included investigating burrows, investigating scats, tracks and other traces, turning fallen timber and rocks, opening standing timber crevices, peeling bark.

2.2.4 HBT mapping and black cockatoo surveys

Hollow bearing trees (HBT) within the site were mapped and hollow height, size, and tree diameter (where species occur that typically form hollows) were noted into classes. Presence or absence of black cockatoo forage habitat and roosting evidence was also noted.

2.2.5 Mapping and data collection

Mapping was carried out using ArcGIS 10.0 geographic information system (GIS) software. Field data was captured using a Garmin GPSmap 60CSx high sensitivity handheld GPS.

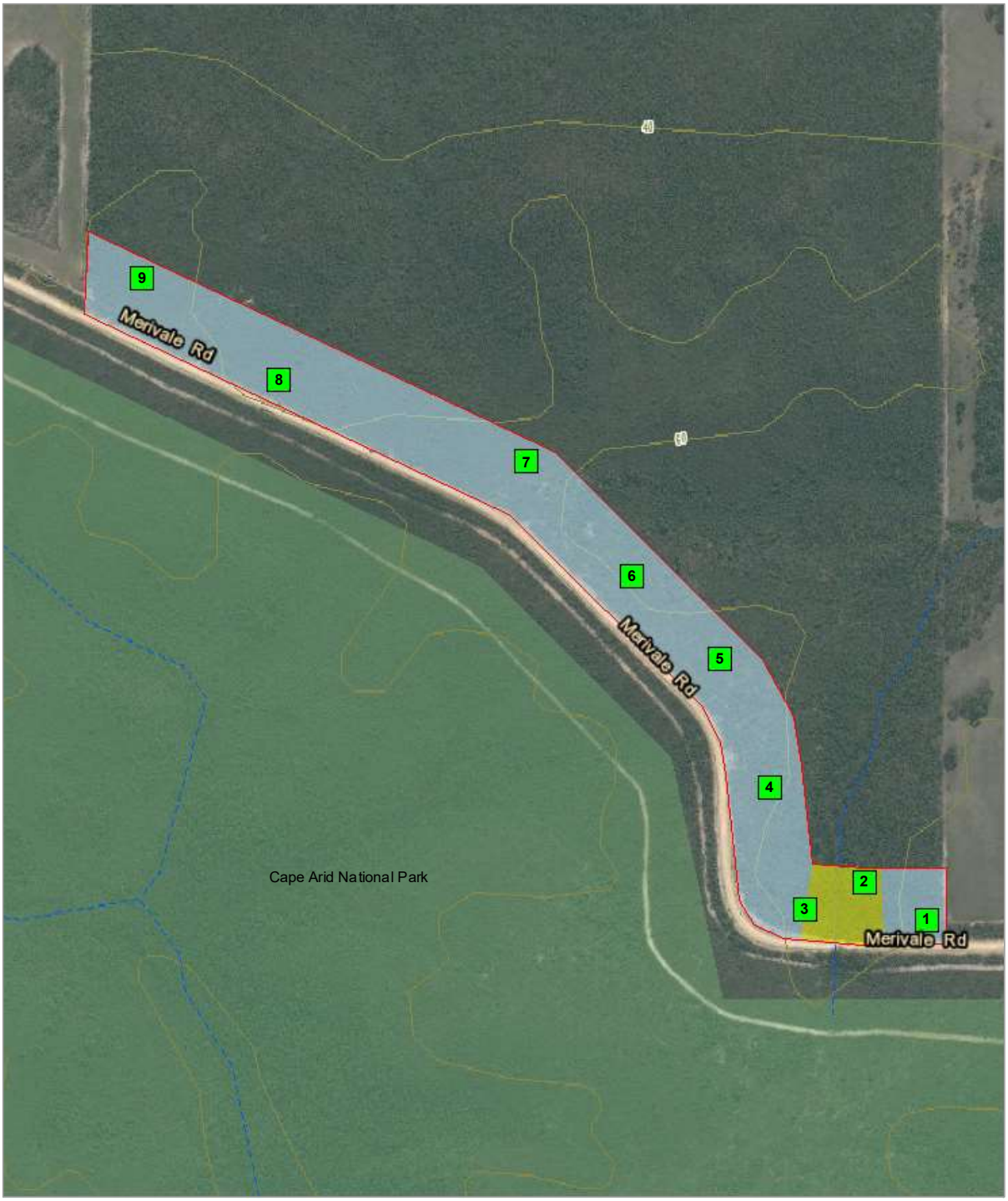

Figure 2-1 Habitat plot locations

2.3 Limitations

In accordance with the EPA Guidance Statement No. 56 (EPA 2004), potential limitations of the fauna survey have been identified below:

Competency	A suitably qualified individual carried out the site reconnaissance and habitat assessment: Shane Priddle, Certified Environmental Practitioner (EIANZ).
Access problems	The site was accessible and surveyed on foot.
Timing	Field surveys were undertaken in winter. Fauna, particularly reptiles, are generally likely to be less active in the winter months which may negatively affect detectability.
Scope	A level 1 vertebrate fauna survey was undertaken. Invertebrates and other short range endemics were not considered in the site reconnaissance. The single site visit and climate conditions are likely to have had some impact on the effectiveness of the survey though the survey effort applied is considered adequate to have met the scope of works required.
Hollow-bearing trees	No hollow bearing trees were observed. While every effort has been made to obtain accurate and reliable data about presence of hollow-bearing trees, it is difficult to be certain about whether an apparent hollow is actually hollow, and vice versa, without physical inspection. Thus, it is possible that some hollows may have been overlooked but it considered unlikely based on the type of vegetation present (i.e. mallee over shrubland, that trees were either not of sufficient diameter to develop hollows or not species that do not normally develop hollows).
Remoteness	The site is relatively remote and few surveys were available for referencing in the desktop assessment.
Seasonal or occasional visitations	Given the narrow width of the site (100m), that it is located on the edge of a larger patch of remnant vegetation and close to Cape Arid NP, there may be some species that utilise the site intermittently for foraging. It is probable that many of these species have not been identified in this survey and that the species list provided is only a small subset of fauna that may utilise the site.
Precautionary approach	As it is difficult to rule out the presence of any particular species without rigorous scientific surveys, a precautionary approach has been adopted. If suitable habitat is present and desktop assessment has determined the species could occur in the area, the species has been assumed to have potential to utilise habitat within the site.

3 Desktop Review

3.1 Environmental Context

3.1.1 Interim Biogeographic Regionalisation of Australia (IBRA) values

The Interim Biogeographic Regionalisation for Australia (IBRA) classifies Australia's landscapes into 89 large geographically distinct bioregions based on common climate, geology, landform, native vegetation and species information. IBRA also provides for the national and regional planning framework for the systematic development of a comprehensive, adequate and representative (CAR) National Reserve System, endorsed by all levels of government as a key tool for identifying land for conservation under the Commonwealth's *Australia's Strategy for the National Reserve System 2009-2030* (DE, 2015).

According to the latest IBRA update (7), the study area is located within the ESP02 Recherche subregion of the Esperance Plains. The Esperance Plains bioregion is characterised by proteaceous scrub and mallee heaths on sandplain; herbfields and heaths occur on granite and quartzite ranges that rise from the plain. The heaths are rich in endemics. Eucalypt woodlands occur in gullies and alluvial foot-slopes (Comer et al. 2002).

3.1.2 Landform, soils and climate

ESP02 subregion has variable relief, consisting of Quaternary coastal sandplains and dunes overlying Proterozoic gneiss and granite as well as Eocene and more recent coastal limestones. Numerous granitic islands occur just off the coast of the mainland. Vegetation types are diverse and comprise of heath, coastal dune scrub, mallee, mallee-heath and granite heath. The subregion has a Temperate Mediterranean climate, with 400-700 mm annual rainfall (Comer et al. 2002).

3.1.3 Brief land use summary

Local land is typically used for grazing (improved pasture) and cultivation (dry-land agriculture), with some areas of conservation, UCL and Crown reserves, easements, and forestry plantations and National Park.

The study area is located immediately north (within 100 m) of Merivale Road within UCL containing remnant vegetation.

3.1.4 Important Bird Areas (IBA)

Important Bird Areas (IBAs) are areas identified by Birdlife International. IBAs are considered conservation priorities, sites able to be conserved in their entirety and are usually part of a protected-area network and recognised as having global bird conservation importance (Birdlife International, 2012). IBAs

- contain significant numbers of one or more globally threatened species,
- are one of a set of sites that together hold a suite of restricted-range species or biome-restricted species, or
- support exceptionally large numbers of migratory or congregatory species.

The closest IBA is located over five kilometres south and consists of islands recognised under the Recherche Archipelago IBA. The Recherche is an archipelago of about 300 islands, islets and rocks off the south coast, immediately south of the site.

According to Birdlife International (2015), this archipelago supports more than one percent (1%) of the world population of western subspecies of Cape Barren Goose *Cereopsis novaehollandiae grisea* and is the only breeding place for this species. Flesh-footed Shearwater *Ardenna carneipes*, Sooty Oystercatcher *Haematopus fuliginosus*, Fairy Tern *Sternula nereis* and probably White-faced Storm-

Petrel *Pelagodroma marina* also occur. Red-eared Firetail S*tagonopleura oculata* and Rock Parrots *Neophema petrophila* have been recorded. The Islands also provide refugial habitat for terrestrial fauna and relictual populations of fauna once widespread on the mainland (DEC 2012), and are therefore ecologically significant.

3.1.5 Conservation lands

The study area is located adjacent to the western end of the Cape Arid National Park (NP) (*c.* 280 000 ha), which is located south of Merivale Road. Recherche Archipelago Nature Reserve includes the islands south of the Cape Arid NP.

Numerous Nature Reserves occur within the region with the closest being the Alexander Nature Reserve located about 20 km south west of the study area.

The Cape Arid NP is managed under the *Esperance and Recherche parks and reserves draft management plan*, (DEC 2012) along with 70 other Parks and Reserves and 82 proposed additions. Extensive areas of UCL north of Fisheries Road, about five kilometres north of the study area, are proposed for NP status.

The site is not in close proximity to any RAMSAR wetland sites, the closest being the Lake Warden System at Esperance.

3.2 Fauna Habitat Values

3.2.1 Vegetation

Vegetation at the site has been mapped broadly by Beard (in DAFWA 2013) as vegetation associations Esperance 4801 and Fanny Cove 516. Descriptions are provided below:

- Esperance 4801: Shrublands; heath with scattered *Nuytsia floribunda* on sandplain.
- Fanny Cove 516: Shrublands; mallee scrub, black marlock.

The Cape Arid NP, and the study area, represents an ecotone of changing habitat from the arid zone in the east to the wetter coastal zone in the south west (DEC 2012).

3.2.2 Drainage lines and wetlands

An upper tributary of the non-perennial Thomas River passes through the UCL block associated with the study area. The closest section of this is about 400 m north of the study area. Several minor ephemeral depressions through the topography do occur through the study area but they are not likely to be considered actual drainage lines. Some localised and temporary pooling was present immediately downslope of some of the Merivale Road culverts. No other water features are associated with the study area.

3.2.3 Habitat connectivity, linkage and corridor values

The UCL block associated with the project is of a reasonable size (about 230 ha) and has some value in connecting the vegetation associated with the upper reaches of the Thomas River to Cape Arid NP in the south. It should be noted that existing barriers include cleared tracks and Merivale Road itself between the Cape Arid NP and the UCL block. From a landscape perspective the UCL block is overshadowed by the close proximity of Cape Arid NP which has contiguous reserved vegetation and fauna habitat and is significantly larger than the UCL associated with the project.

3.3 Fauna Records

3.3.1 Local records

Much of the local area however has not been systematically surveyed for fauna. Two hundred and twenty-two terrestrial vertebrate fauna species have been recorded in local survey results and database records (Appendix B). This figure includes eight amphibians, 159 birds, 17 mammals and 38 reptiles. It generally does not include numerous invertebrates or marine or aquatic dependant species (fish, marine turtles, albatrosses etc) as they will not be impacted by the project. Conversely some records may be seasonal visitors or may be associated with coastal or marine environments and may not occur at the site.

The *Esperance and Recherche parks and reserves draft management plan*, (DEC 2012) also identifies a higher number of locally occurring species within Plan's broader management area (*c*. 845 000 ha from Lake Shaster Nature Reserve in the west, the end of Wylie Scarp in Nuytsland Nature Reserve in the east):

- 16 amphibians,
- 258 birds, with 182 recorded within Cape Arid National Park alone,
- 31 mammals, and
- 72 reptiles.

At least three species from the list above are introduced (Fox, Rabbit and House Mouse).

3.3.2 Invertebrates and short range endemics

The Naturemap (2015) and EPBC PMST (2015) did not identify any local records of invertebrates or short range endemics of conservation significance. Short range endemic fauna, which includes species of insects, arachnids myriapods and crustaceans that have highly restricted distributions because of poor dispersal, slow growth, low fecundity, specific habitat preferences, are particularly vulnerable to extinction (Moir et al 2009b). Unfortunately very little is known about how many species there are or which areas within the south-west are most important for conservation.

Millipedes are a good example of short range endemic fauna with many species of conservation significance. Moir et al (2009b) identified the nearby Cape Arid as one of five main areas that as having a particularly speciose millipede fauna or were areas where the millipede fauna was highly endemic. The predicted decline in rainfall for the southwest through global climate change may result in less moist refugia required by many species of millipedes species have narrow geographic ranges.

Moir and Harvey (2008) note that one conservation significant species of millipede *E. sarahae* prefer coastal gullies, well shaded and with dense leaf litter. These areas are wetter with taller and denser canopy than surrounding heath/mallee. Other millipedes may also prefer similar habitats.

3.3.3 Conservation significant fauna

From the desktop assessment a number of conservation significant species may occur locally:

- Two specially protected species (a reptile and a bird),
- Three (terrestrial) migratory species (birds),
- Four Priority species (four mammals and a reptile),
- Eight threatened species (five birds and three mammals).

No fish of conservation significance are likely to occur at the site given the lack of water courses and other suitable habitat. A habitat evaluation table has been prepared for conservation significant fauna (Appendix A).

Table 3-1 Threatened, migratory and priority listed fauna that may occur locally (habitat may not necessarily be suitable within the study area for all species). Refer to Appendix A for habitat potential and risk assessment for impacts against each species.

Species Status*	Scientific name	Vernacular name	Status (State, Cth)
INVERTEBRATES			
-			
VERTEBRATES			
AMPHIBIA	-		
AVES	*Calyptorhynchus latirostris*	Carnaby's Black Cockatoo	T, E
	Cereopsis novaehollandiae subsp. grisea	Recherche Cape Barren Goose	T, V
	Falco peregrinus subsp macropus	Peregrine Falcon	S, -
	Falco hypoleucos	Grey Falcon	T, -
	Haliaeetus leucogaster	White-bellied Sea eagle	-, M
	Leipoa ocellata	Malleefowl	T, V, M
	Merops ornatus	Rainbow Bee-eater	-, M
	Pezoporus flaviventris	Western Ground Parrot	T, CE
MAMMALIA	*Dasyurus geoffroii*	Western Quoll, Chudich	T, V
	Isodon obesulus fusciventers	Quenda	P5, -
	Macropus eugenii subsp. derbianus	Tammar Wallaby	P5, -
	Macropus irma	Western Brush Wallaby	P4, -
	Parantechinus apicalis	Dibbler	T, E
	Petrogale lateralis subsp. Hacketti	Recherche Black-footed Rock-wallaby	T, V
REPTILIA	*Acanthopis antarcticus*	Southern Death Adder	P3, -
	Morelia spilota imbricata	Southern Carpet Python	S, -

WA
T: Threatened which includes
S1: Schedule 1 Rare or likely to become extinct
S2 - Extinct
S3 - Protected under International agreements
S4 - Other specially protected fauna
This status criterion has been set by the *Wildlife Conservation Act 1950.*

Priority Fauna
P 1: Taxa with few, poorly known populations on threatened lands.
P 2: Taxa with few, poorly known populations on conservation lands.
P 3: Taxa with several, poorly known populations, some on conservation lands.
P 4: Taxa in need of monitoring.
P 5: Taxa in need of monitoring.
S: Specially protected
These status criterions have been set by the WA Department of Environment and Conservation.

Federal
VU: Vulnerable
EN: Endangered
CE: Critically Endangered
Mig: Species listed under the JAMBA, CAMBA, ROKAMBA and Bonn Convention
These status criterions have been set by the *Environmental Protection and Biodiversity Conservation Act 1999*.

4 Results

4.1 Fauna Habitat

4.1.1 General habitat condition

Fauna habitat is generally a function of local differences in structural vegetation types and other factors such as substrate (soils, rocky outcrops) and drainage. Key habitats at the site include

- Mallee over sandy loams in the depressions.
- Heath and closed scrub and on sandy and gravelly loams.

Rocky outcrops, dead wood and trees are essential habitat components for a variety of fauna. Where present these resources provide shelter and invertebrate, microbial and vertebrate species are supported by decaying wood and in turn provide food for other species. No rocky outcrops were observed within the project site and fallen timber was also typically small and not large enough to provide hollows or good refuge other than for small reptiles. Habitat condition (see Table 2-2 for the scale) was still considered to be good due to the dense cover provided by the heath and the diversity of flora and structure of vegetation, providing not only cover and refuge but abundant feed resources.

The two fauna habitat types are described below. See Figure 2.1 for approximate locations of each habitat type.

- Mallee over sandy loams in the depressions (Habitat Plot 2).

Located in a moderate depression with a northerly slope, at the eastern edge of the site, it contained little mid or understorey vegetation. There were signs of recent washout, probably exacerbated by the road side drainage, but a creek bed, running or pooling water were absent. Mallee occurred over most of the site, though in other areas it was mostly sporadic or in clumps emerging over the scrub and heath layer. There was an abundant leaf litter with some small fallen timber.

Figure 4-1 Mallee over sandy loams in the depressions

- Heath and closed scrub on sandy and gravelly loams (Habitat Plot 1, 3-9)

This habitat type was present over most of the site. Large and patchy areas over the site were dieback affected with dead or dying *Xanthorrhoea, Banksia* and other susceptible species. Where they weren't dead the scrub was generally dense (up to 2m height) however where it had died back it was more open and seemed to be dominated by the lower heath (*c.* 50m height). There were however still significant areas in very good to excellent condition, (e.g. east of the Mallee in the depression). Some pools of water had accumulated near the Merivale Road culverts. Large fallen timber and leaf litter was generally sparse.

Figure 4-2 Closed scrub on sandy and gravelly loams (east of the Mallee in the depression; Merivale Road spoil is present on the left)

Figure 4-3 Closed scrub on sandy and gravelly loams (intact and located west of the Mallee in the depression).

Figure 4-4 Dieback affected closed scrub on sandy and gravelly loams.

Figure 4-5 Heath on sandy loams

The site is bordered each side (east and west) by cleared paddocks with improved pastures. Extensive vegetation is connected to the north and Cape Arid NP is located to the south. Cape Arid NP and the vegetation to the north of the site is intact, well connected and also generally in very good condition except for where it is affected by dieback, minor tracks or fire breaks. Habitat within the site itself was continuous.

Ecotones such as those between the road or paddock edge and scrub vegetation, or the heath and woodland, may provide foraging opportunities for predators such as raptors. The site offers a range of habitat opportunities for a variety of fauna and is well connected at a landscape scale.

The seasonal pooling associated with the roadside drains and culverts may also provide watering opportunities for some fauna and may be important for some species such as frogs and Tiger snakes that feed on them.

4.1.2 Corridor value

The remnant vegetation patch associated with the site is fairly well connected locally including to Cape Arid NP along its southern boundary. The largest area of fauna habitat locally, Cape Arid NP provides similar habitat types to those occurring at the site, and is likely to provide habitat for similar fauna assemblages to those at the site. It is noted that whilst the local parks including Cape Arid NP are fairly secure in terms of connectivity, linkages with other areas of remnant vegetation are required to provide fauna with

- migratory routes,

- access to areas containing seasonally variable food and other resources,
- escape and recolonisation routes, especially relevant in terms of large bushfires and potential longterm climatic impacts of global warming.

(DEC 2012)

Given the site is connected to the larger areas if intact habitat, wider ranging fauna may use the site as part of the larger patch. The *c.* 30m clearing associated with Merivale Road may present a barrier to some fauna.

4.1.3 Habitat trees

The mallee trees on site were generally not thick enough to develop hollows of sufficient quality to be utilised by hollow dependent fauna. No large trees (greater than 50 cm at breast height or with hollows) were observed within the site. Further the site is well outside of the breeding range for black cockatoos (SEWPaC, 2012).

4.2 Species recorded

Twenty-three fauna species (or evidence of) were observed at the site during the site reconnaissance. They included two frogs, 14 birds, one reptile, five mammals and the possible presence of an additional conservation significant species (the Priority 5 listed Southern Brown Bandicoot). Possible Bandicoot diggings were observed at several locations but weren't clear enough to be definitively Bandicoot due to the confirmed presence of Rabbit (scat and diggings) and Short-beaked Echidna (scat). In addition to Rabbits, evidence of introduced Cat and Fox tracks were also observed.

Table 4-1 Fauna observed at the site (see Appendix B for additional information)

Scientific name	Vernacular
Crinia georgiana	Quacking frog
Litoria cyclorhyncha	Spotted-thighed tree frog
Acanthiza (Acanthiza) apicalis	Inland Thornbill
Anthochaera (Anellobia) lunulata	Western Wattlebird
Anthochaera (Anthochaera) carunculata	Red Wattlebird
Cacomantis (Vidgenia) flabelliformis	Fan-tailed Cuckoo
Coracina (Coracina) novaehollandiae	Black-faced Cuckoo-shrike
Corvus coronoides	Australian Raven
Dromaius novaehollandiae	Emu
Grallina cyanoleuca	Magpie-lark
Hirundo (Hirundo) neoxena	Welcome Swallow
Ocyphaps lophotes	Crested Pigeon
Phaps (Phaps) chalcoptera	Common Bronzewing
Phaps (Phaps) elegans	Brush Bronzewing
Phylidonyris (Meliornis) novaehollandiae	New Holland Honeyeater
Smicrornis brevirostris	Weebill
Isoodon obesulus fusciventer	Southern Brown Bandicoot (possible)
Macropus fuliginosus	Western Grey Kangaroo
Oryctolagus cuniculus	Rabbit *
Tachyglossus aculeatus	Short-beaked Echidna

Felix catus	Cat *
Vulpes vulpes	Fox *
Acritoscincus trilineatum	Southwestern Cool Skink

* denotes introduced species.

The number of fauna observed is significantly less than the total fauna that occurs at the site or that may visit the site periodically. Many of the fauna listed in Section 3.3.1 (and Appendix B) may occur at least periodically.

Figure 4-6 Cat track, note claws are retracted (circled red), with Emu track on the left and Western Grey Kangaroo scat on the right.

Figure 4-7 Fox track, note the presence of claws.

A small network of runways through the heath created by a species of small mammal were observed approximately 50 m north of Merivale Road (51 H 500745 6259706). They were considered too small to be used by Rabbits or Bandicoots and they are likely to be made by *Rattus fuscipes* (Bush Rat),

(Figures 4-8 and 4-9) (Pers comm. Dr Kenny Travouillon, Curator – Mammology, WA Museum, 17.08.2015). Other small mammals that occur locally, but not necessarily at the site, may include:

- *Mus musculus* (House Mouse) (introduced)
- *Notomys michellii* (Mitchells Hopping Mouse)
- *Pseudomys occidentalis* (Western Mouse)
- *Rattus fuscipes* (Bush Rat)
- *Sminthopsis crassicaudata* (Fat-tailed Dunnart)
- *Sminthopsis granulipes* (White-tailed Dunnart)
- *Sminthopsis griseoventer* (Grey-bellied Dunnart)

There is a very slight chance that *Parantchinus apicalis* (Dibbler)[2] could occur locally but the likelihood that it would occur within the site are very low, given its known distribution has contracted much further to the west (CALM 2003).

Figures 4-8 and 4-9 Heath runways (in red) likely to be used by a small mammal.

[2] EN under the WC and EPBC Acts

4.3 Conservation significant fauna

No conservation significant fauna were positively recorded at the site, however several target species have potential to occur there. These are outlined below.

Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*) (T En)

Black cockatoos are long-lived, slow-breeding birds that display strong pair bonds that are suffering the effects of population decline and habitat loss. Carnaby's Black Cockatoo breed in hollows that are usually only found in trees that are more than 200 years old and are generally known to breed throughout the southwest, west of Ravensthorpe in the higher rainfall areas (SEWPAC 2012). Suitable breeding habitat does not occur at the site. Carnaby's Black Cockatoo has specific requirements though they generally forage on Eucalypt woodlands and forest, and proteaceous woodland and heaths (often Marri (seeds, flowers, nectar and grubs) and proteaceous trees and shrubs). A lone male was observed five kilometres west of the site whilst travelling to the site. Suitable forage habitat does occur at the site.

Malleefowl (*Leipoa ocellata*) (T, Vu, M)

Malleefowl are mostly located to the south and west of a line extending from Cape Farquhar, which lies north of Carnarvon, to the Eyre Bird Observatory in the south-east of Western Australia. It occurs in semi-arid and arid zones of temperate Australia, where it occupies shrublands and low woodlands that are dominated by mallee vegetation. It also occurs in other habitat types including *Eucalypt* or native pine *Callitris* woodlands, *Acacia* shrublands, Broombush (*Melaleuca uncinata*) vegetation or coastal heathlands. The breeding habitat of the Malleefowl, within its home range, is characterised by light soil and abundant leaf litter (DEC 2010). There are no local records from Naturemap (2015) however suitable habitat does occur at the site, along with marginal breeding habitat within the Mallee through the depression. No nesting mounds were observed during the site visit.

Western Ground Parrot (*Pezoporus flaviventris*) (T, CE)

The Western Ground Parrot inhabits low, dry or swampy, near-coastal heathlands on sandplains and uplands in areas that receive 400-500 mm of rainfall annually. In recent years, confirmed records of the Western Ground Parrot have only been obtained within Fitzgerald River NP, Cape Arid NP and Nuytsland NR. It is also possible that a small subpopulation could persist in Waychinicup NP (SPRAT 2014).

They occur in long unburnt (5 to 40 or more years); floristically diverse, near-coastal dry heath (400 to 500 millimetres rainfall). This vegetation is usually less than 0.5 metres high, though often up to one metre high, with more than 50 per cent cover. Sedges are generally abundant, making up 40 per cent of total cover. Although these parrots are usually found in long unburnt vegetation, they have been observed to feed in habitats two to three years post-fire, provided there is older vegetation nearby (DPaW 2014). In addition Ground Parrots fly mainly at dawn and dusk, fly short distances, low over vegetation, nest on or close to the ground and have good dispersal ability (DPaW 2014). The South Coast Threatened Birds Recovery Plan identifies that the site is within the Management Area for the species.

Alan Burbidge and Sarah Comer (DPaW) (August 2015), both of which have published numerous articles on the species, indicated that whilst there are no recent records, Ground Parrots have been known to occur further north (near Fisheries Rd). Also possibly due to fox and cat control programs local known populations of Western Ground Parrots may be spreading to other areas, possibly including the site.

Southern Brown Bandicoot, Quenda (*Isodon obesulus fusciventers*) (P5)

Quenda's habitat consists of dense scrubby, often swampy vegetation with a dense cover up to one metre high particularly near watercourses and wetlands. It often feeds in adjacent forest (Jarrah and Wandoo) and woodlands that are burnt on a regular basis. Nests can be concealed next to or under old logs, shrubs or piles of debris and are made up of ground litter piled up over a shallow depression providing internal chambers. Home ranges vary with population density, and range from

5-8.6 ha for males and 1-6 ha for females (DEC 2010). Feed on a variety of ground-dwelling invertebrates and the fruit-bodies of hypogeous fungi. Their searches for food often create distinctive conical holes in the soil (DECCW 2010). It would be at the edge of its distribution if present (Menkorst and Knight 2013). Possible Quenda diggings were observed though there are no local Naturemap records (2015).

Western Brush Wallaby (*Macropus irma*) (P4)

Optimum habitat for the Western Brush Wallaby includes open Jarrah forest or woodland and seasonally wet flats with low grasses and scrubby thickets, but also areas of mallee and heathland. Common dietary flora includes *Carpobrotus edulis, Cynodon dactylon* and *Nuytsia floribunda* (DEC, 2007). The site would be at the edge of the species' distribution if present (Menkorst and Knight 2013). There are no local Naturemap records (2015).

Southern Death Adder (*Acanthopis antarcticus*) (P3)

Southern Death Adders inhabit a range of habitats, including rainforest, scrubland, semi arid zones and rocky outcrops. Typically during the day they remain mostly buried beneath sand, soil or debris, with just the tail and top of the head exposed (Pilbara Pythons 2014).

Southern Carpet Python (*Morelia spilota imbricata*) (S)

It may shelter in burrows made by other animals, hollow tree limbs or logs (especially 150mm diameter hollows extending at least to one metre deep), or rock crevices. It commonly uses hollow logs for shelter (Wilson and Swan, 2008). This subspecies has been recorded from semi-arid coastal and inland habitats, *Banksia* woodland, *Eucalypt* woodlands, and grasslands. The species would need to rely on heath due to lack of other good refuge (hollow timber, trees, or rocky areas).

5 POTENTIAL IMPACTS

Details on the fence specifications (height, cell size, etc) and exact location were not available at the time of writing. It is understood that the fence would however be approximately 1-2 m in height, constructed within a 20 m wide clearing and within 100 m of Merivale Rd. Impacts associated with clearing and construction activities will be both direct and indirect, short term and long term. Ecoscape (2015) provides a detailed assessment with references to other literature of general impacts associated with the SBF expansion. Subsequently the sections below generally only address issues that are relevant specifically for the site.

5.1 DIRECT IMPACTS

Anticipated direct impacts of the proposal are described below. Some of these can be mitigated through the recommendations included in Section 7.

5.1.1 Clearing of native vegetation

Typical impacts associated with clearing native vegetation include

- direct loss of habitat,
- loss of mature vegetation (provides more flowers, nectar, fruit, seeds, refuge),
- loss of below ground biomass (such as seed banks)
- changes to faunal assemblages near the fence, and
- fragmentation of habitat connectivity and populations (discussed further below).

Based on a 20 m clearing width, approximately 2.8 ha of heath and closed scrub will require clearing and 0.2 ha of mallee through the drainage depression. The heath and scrub is by the far the most common vegetation locally and is well represented within the adjacent Cape Arid NP. The clearing

required is unlikely to affect the quality and quantity of fauna habitat available locally given the abundance of similar habitat within the remaining UCL and in Cape Arid NP.

5.1.2 Construction environment

Construction, including clearing, would lead to a number of indirect impacts (see below) however there are risks of direct impacts such as injury and possibly death of reptiles, small mammals and birds that may occur within nests or hollows. Clearing would have greater impacts during spring, which is the nesting period for most fauna.

Introduction of disease or pathogens as a result of clearing may also have direct impacts, at a community level (*Phytophthora* dieback), or species level (amphibian chytrid fungus). Chytridiomycosis is caused by the amphibian chytrid fungus *Batrachochytrium dendrobatidis* which occurs in waterbodies or in soil (DPaW 2012).

5.1.3 Collision risk

The fence itself may present a risk of collision, entanglement or entrapment for some fauna species, including birds and large mammals (e.g. Western Grey Kangaroo). This is discussed in more detail in Ecoscape (2015). There may be some risk to Ground Parrots if they do occur near the site.

5.1.4 Habitat connectivity

Connectivity and corridor value is discussed in Sections 4.1.1 and 4.1.2. Clearing will increase fragmentation of the UCL and the cumulative impact of the gap in habitat already associated with Merivale Rd. The fence may act as a direct barrier to some species, in particular those in the size/weight range that are targeted by the fence (e.g. Emu, Mallee Fowl, Western Grey Kangaroo, Wallabies, etc should they occur). The impacts of the SBF on fauna at a landscape scale are discussed further in Ecoscape (2015).

5.2 INDIRECT IMPACTS

Indirect impacts may be associated with the construction period (short term) and ongoing impacts associated with the fence (long term). Activities that are likely to cause indirect impacts include

- accidental clearing and disturbance of native vegetation surrounding the site,
- machinery access to site,
- compaction of soils,
- noise, dust and vibration, and
- increased visitation and human use of the site.

Potential indirect impacts of the proposal may include

- Increased negative edge effects (degradation of habitat in the UCL) and impact of the 20 m wide corridor causing ingress of weeds, changes to microhabitat and increased access for invasive predators such as foxes and cats. Rabbits compete with native fauna, such as macropods, for feed resources and the habitat degradation caused by rabbits is well documented. Populations of small mammals and birds may be impacted further by foxes and cats.
- Further introduction or spread of pathogens. Localised dieback already appears to have had some impact on vegetation structure at the site, with dead or dying Proteaceous plants in some areas,
- Disruptions to fauna breeding cycles, for example Quendas are known to abandon their young if they sense danger, or the fence may present a risk to dispersing juvenile Western Ground Parrots.

Some potential indirect impacts are able to be mitigated through appropriate environmental management and implementing the recommendations below.

5.3 ADDITIONAL ASSESSMENT

5.3.1 Potential impact to conservation significant species

Ecoscape (2015) in an assessment of the entire SBF extension notes that potential impacts on conservation significant species may be 'minor' in proportion to the current distribution and populations, and result from:

- the fence acting as a barrier (Western Brush Wallaby), or
- collision/entanglement hazard (some birds, possibly including Western Ground Parrot, Malleefowl)
- loss of habitat area by clearing (some mammals, birds, reptiles)
- loss of habitat connectivity (some mammals, small birds, reptiles), or
- increased exposure to feral predators using the fence and associated clearing as a corridor.

An evaluation of the potential for conservation significant species to be impacted by direct and indirect effects of the proposal is given in Appendix A. The following species are considered to have potential to be impacted.

Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*) (T, En) – Low impacts

The proposal may result in the clearing of approximately 2.8 ha of heath and closed scrub which contains numerous species of plants (e.g. *Banksia*) that are commonly grazed upon by black cockatoos. The loss of this amount of foraging habitat though at a local scale is considered to only have a low impact on the species.

Malleefowl (*Leipoa ocellata*) (T, Vu, M) – Low impacts

Impacts on Malleefowl, if they do occur, are likely to be low due to direct loss of habitat, risk of collision and potentially fragmentation though these impacts are generally likely to be low given the abundant similar habitat locally. Ecoscape (2015) note that 'clearing will result in marginal reduction of available foraging habitat. The fence may present a collision hazard during flights, but not a significant barrier to movement (adults can easily fly above fence height, juveniles can pass through the mesh) and also provide a corridor facilitating access to occupied habitat by feral predators.' No mounds were observed within the Mallee habitat which would be the most suitable for breeding.

Western Ground Parrot (*Pezoporus flaviventris*) (T, CE) – Low impacts

Western ground parrots are known to exist in only FRNP and CANP and nearby parts of Nuytsland Nature Reserve. Following post-natal dispersal, western ground parrots can occur away from known populations, sometimes in sub-optimal habitat. The site is located as potential habitat within the western extent of the Management Area 2 outlined in the South Coast Threatened Birds Recovery Plan DPaW (2014).

Burbidge and Comer (DPaW) (Pers comm. August 2015) indicated that whilst there are no recent records, Ground Parrots have historically been known to occur further north (near Fisheries Rd). Also possibly due to fox and cat control programs local known populations of Western Ground Parrots may be spreading to other areas, possibly including the site.

The Ecoscape (2015) assessment which only extended to Fisheries Road, north of the site, notes that the proposed fence extension will not result in habitat fragmentation for this species, or affect habitat quality or likelihood of predation, but would have some potential to cause injury and mortality to dispersing birds: mortality from fence and vehicle collisions are documented in the closely related Night Parrot *Pezoporus occidentalis* (Boles et al. 1994; McDougall et al. 2009 in Ecoscape 2015).

In consideration of this impacts to Western Ground Parrot at the site are likely to be low. However as noted by Ecoscape (2015) any deleterious impact on this Critically Endangered species should not be an acceptable risk. It is expected that visibility enhancement features (fluorescent orange droppers at regular intervals) will reduce the potential for bird collisions with the fence to an acceptable level (Ecoscape 2015). Additional recommendations to reduce potential impacts are provided in Section 7.

Southern Brown Bandicoot, Quenda (*Isodon obesulus fusciventers*) (P5) – Low impacts

Impacts to Quendas are likely to be associated directly with loss of habitat or direct impacts (injury/mortality) as a result of clearing. Possible Quenda diggings were observed though there are no local Naturemap records (2015). Given the abundance of habitat locally and that Quenda are unconfirmed from the site, impacts are assessed as being low.

Western Brush Wallaby (*Macropus irma*) (P4) – Low impacts

Ecoscape (2015) note that there may be minor impacts associated with barrier impacts, collision risk and direct loss of habitat. The site is at the very eastern edge of the species distribution; although the home range for the species is not known there are large areas of similar habitat on either side of the proposed fence at the site. Impacts to this species are likely to be low.

Southern Death Adder (*Acanthopis antarcticus*) (P3) – Low impacts

Southern Carpet Python (*Morelia spilota imbricata*) (S) – Low impacts

Individuals might be directly affected during clearing of vegetation or disruption of refuge sites by excavation, but no significant lasting impact on habitat is likely (Ecoscape 2015). Impacts on either species are assessed as being low.

6 Management Considerations

Fauna are generally most sensitive to disturbance during breeding periods. This is a particularly important consideration for threatened species. Birds disturbed from the nest (for example, from excessive noise or changes to light) may disrupt incubation or cease to feed their young (Webster 1999). Marsupials under stress may eject pouch young or change their nesting behaviour, e.g. Quenda (Rhind 2003). Stress may occur for a range of reasons including environmental factors such as drought as well as from anthropogenic habitat disturbance such as clearing. Many marsupials display a strong fidelity to their territory (Rhind 2003), and therefore disturbance can cause stress. An example of a stress factor may include loss of foraging resources (such as through clearing), thereby necessitating an increase in foraging effort, potential for loss of physical condition and potential for neglect or ejection of young.

In relation to the conservation significant fauna identified in Section 5 that may be impacted (particularly Western Ground Parrot, but also to a lesser degree Quenda and Malleefowl) clearing during the breeding periods between August to November (and through to February for Quenda and Malleefowl) should be avoided if possible.

7 Conclusions and Recommendations

The site contains approximately 15.28 ha of good quality fauna habitat, including heath and closed scrub on sandy and gravelly loams and Mallee over sandy loams in the depression. Assuming an impact width of 20 m about 2.8 ha of heath and scrub will be cleared and about 0.2 ha of Mallee. No particular fauna habitat attributes were identified as constraints during the fieldwork.

The site may provide suitable habitat for several conservation significant species; three birds (Carnaby's Black Cockatoo, Malleefowl, Western Ground Parrot), two reptiles (Southern Death

Adder, Southern Carpet Python) and two mammals (Quenda, Western Brush Wallaby). Impacts are likely to be low for all species.

It is understood that the project will be referred to the federal Department of the Environment (DoE) for assessment under the EPBC Act.

Recommendations to ensure that impacts are low (or less), include

- Construct the fence as close as possible to Merivale Road to minimise the depth of impact into the UCL patch and associated habitat.
- Ensure a licensed and experienced fauna surveyor conducts pre clearance surveys to ensure appropriate management and relocation of injured or displaced fauna.
- Avoid clearing between August and November for Western Ground Parrot (and if possible between August and February to include the breeding range for other species).
- Tie flagging tape along the top of the fence at appropriate defined intervals (e.g. 10 m) to decrease the likelihood of accidental entanglement of fauna (Western Ground Parrot in particular).
- General controls and mitigation measures should be implemented through an Environmental Management Plan (EMP). The EMP would ensure roles and responsibilities are clearly defined, site audits are conducted and construction staff are inducted to the fauna habitat values of the site. Dieback management and soil hygiene, fauna preclearance survey requirements and reporting, would also be addressed through the EMP in line with standard operating procedures.
- Final designs should quantify the amount of native vegetation required to be cleared and this should be assessed against any Matters of NES (e.g. Carnaby's Black Cockatoo forage habitat).

8 References

Note the not all of the following references are necessarily cited in the report text.

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Appendix A Threatened Fauna Evaluation

This table provides an evaluation of the presence of habitat and the likelihood of occurrence for conservation significant fauna species. The latter is based on habitat in the site and information from literature, nearby records, database searches and expert consultation. The following have been excluded from the tables as they are not likely to occur:

- Marine (e.g. seals, dolphins, whales, penguins).
- Marine migratory species (e.g. Albatrosses) or where breeding is in the northern hemisphere, e.g. those from the family Scolopacidae: Sandpipers and other shorebirds and waders.
- Wetland dependant species.
- Species considered to be regionally extinct.

Species Status* (State, Cth)	Ecology	Presence of habitat	Likelihood of occurrence	Potential to be impacted?
INVERTEBRATES				
-				
VERTEBRATES				
AMPHIBIA				
-	-	-	-	-
AVES				

Species Status* (State, Cth)	Ecology	Presence of habitat	Likelihood of occurrence	Potential to be impacted?
Calyptorhynchus latirostris (Carnaby's Black Cockatoo) T, E	This species is a postnuptial nomad, tending to move west after breeding. Carnaby's Black Cockatoo mainly occurs in or near eucalypt woodlands, especially those dominated by Wandoo or Salmon Gum, and sometimes reported in forests of Marri, Jarrah, Karri and Tuart. Nesting hollows may be located anywhere from 2 m to >10 m from ground, mainly in the Wheatbelt (Cale 2003, SPRAT 2009, WA Museum 2010). The Project is approximately 350km east of the species known eastern breeding range (SEWPAC 2012). It has been observed locally though and the Project Area is within the species non-breeding range (ALA and Naturemap, accessed 2015). It is known to forage in native shrubland, kwongan heathland and woodland dominated by proteaceous plant species such as Banksia spp. (including Dryandra spp.), Hakea spp. and Grevillea spp. Forages in pine plantations (Pinus spp.), eucalypt woodland and forest that contains foraging species. Also individual trees and small stands of these species (SEWPAC 2012). Dieback has reduced the availability of most of the forage species that would have been available originally. Sixteen records in Naturemap occur around the site, including some in close proximity (within 2 km).	Forage habitat only. No breeding habitat	Possible	Possible due to loss of forage habitat.
Cereopsis novaehollandiae subsp. grisea (Recherche Cape Barren Goose) T, V	There is little published information available on the habitat of the Cape Barren Goose. It occurs on offshore islands and rocks, and at adjacent sites on the mainland. It inhabits grasslands and low fields of succulent herbs (comprised of Carpobrotus sp.), and occasionally occurs in open areas in taller and denser vegetation. The bird has also been recorded on beaches, and near lakes and freshwater 'soaks', on the mainland (SPRAT 2014). Halse and colleagues (1995, in SPRAT 2015) surveys in April 1993 recorded a total of 631 birds; including 612 birds on 79 islands and rocks in the Archipelago of the Recherche, four birds on Red Island (to the west of the archipelago) and a total of 15 birds at two sites on the mainland (near Pink Lake, north-west of Esperance, and at Cape Arid). The number and coverage of surveys suggests that the distribution, and to a lesser extent the population size, of the Cape Barren Goose is fairly well known. One Naturemap record occurs about 15km south east.	Unlikely No breeding habitat	Unlikely	Unlikely
Falco peregrinus subsp macropus (Peregrine Falcon) S, -	Peregrine Falcons occur in woodland, plains, gorges, wetlands etc but tend to breed either in stick-nests in trees or nest on cliff ledges. It appears that stick-nests may be used where cliff ledges are limited. Breeds Aug-Nov. Cliff sites are chosen for protection from dominant weather direction and in well drained areas. Where good habitat occurs and the density of Peregrine Falcons is high, active nests may occur within 2.5km of each other. The diet of the Peregrine Falcon includes wood duck, pigeons and doves, galahs, rosellas and cockatoo, starlings and larks (Olsen et al. 2006).	Potential foraging habitat No breeding habitat	Possible but sporadic	Unlikely

Species Status* (State, Cth)	Ecology	Presence of habitat	Likelihood of occurrence	Potential to be impacted?
Falco hypoleucos (Grey Falcon) T,	Inhabits lightly timbered county especially stony plains and lightly timbered Acacia scrub mostly through central Australia (Morcombe 2011). Nests in the highest trees locally in old stick nests. Observed from Naturemap about 5km south of the site where it is on the edge of its range (Morcombe 2011) or perhaps well outside (Pizzey 2007).	Present No large stick nests observed.	Unlikely	Unlikely
Haliaeetus leucogaster (White-bellied Sea eagle) -, M	This species occurs around coastal areas, islands and estuaries, but is also found in inland areas where it is known from large rivers, wetlands and reservoirs (DECC, 2009). Usually forages, perches and roosts around waterways and nests in a huge nest of sticks in a tall live tree near water (Schodde and Tidemann, 2007) (Pizzey and Knight 2007).	Marginal foraging habitat No breeding habitat	Possible but sporadic	Unlikely
Leipoa ocellata (Malleefowl) T, V, M	It is mostly located to the south and west of a line extending from Cape Farquhar, which lies north of Carnarvon, to the Eyre Bird Observatory in the south-east of Western Australia. Occurs in semi-arid and arid zones of temperate Australia, where it occupies shrublands and low woodlands that are dominated by mallee vegetation. It also occurs in other habitat types including eucalypt or native pine Callitris woodlands, acacia shrublands, Broombush (*Melaleuca uncinata*) vegetation or coastal heathlands. The breeding habitat of the Malleefowl, within its home range, is characterised by light soil and abundant leaf litter (DEC 2010). There are no local records from Naturemap (2015).	Present Possible breeding habitat within the Mallee in the depression.	Possible	Possible
Merops ornatus (Rainbow Bee-eater) -, M	This species occupies a wide range of habitats including mangroves, heathland, vine thickets and open woodland on sandy soils, throughout Australia (Pizzey and Knight 2007). *M. ornatus* lay eggs in a burrow or sandy bank or cutting. The southern populations migrate north over winter to northern Australia, Papua New Guinea and eastern Indonesia. There are no local records from Naturemap (2015).	Present No breeding burrows were observed	Possible but sporadic	Unlikely

Species Status* (State, Cth)	Ecology	Presence of habitat	Likelihood of occurrence	Potential to be impacted?
Pezoporus flaviventris (Western Ground Parrot) T, CE	The Western Ground Parrot inhabits low, dry or swampy, near-coastal heathlands on sandplains and uplands in areas that receive 400-500 mm of rainfall annually. In recent years, confirmed records of the Western Ground Parrot have only been obtained within Fitzgerald River NP, Cape Arid NP and Nuytsland NR. It is also possible that a small subpopulation could persist in Waychinicup NP (SPRAT 2014). They occur in long unburnt (5 to 40 or more years); floristically diverse, near-coastal dry heath (400 to 500 millimetres rainfall). This vegetation is usually less than 0.5 metres high, though often up to one metre high, with more than 50 per cent cover. Sedges are generally abundant, making up 40 per cent of total cover. Although these parrots are usually found in long unburnt vegetation, they have been observed to feed in habitats two to three years post-fire, provided there is older vegetation nearby (DPaW 2014). In addition Ground Parrots fly mainly at dawn and dusk, fly short distances, low over vegetation, nest on or close to the ground and have good dispersal ability (DPaW 2014). The South Coast Threatened Birds Recovery Plan identifies that the site is within the western extent of Management Area for the species (DPaW 2014).	Possible	Possible	Possible
MAMMALIA				
Dasyurus geoffroii (Western Quoll, Chudich) T, V	Quolls may occupy a range of habitats including forest, woodland and desert, though in the SW they are largely restricted to Jarrah forest or scattered through the southern and eastern wheat belt in mallee shrubland (DEC 2010). Current records indicated that this only represents approximately 5% of their former range. Habitat attributes which are likely to be critical to the life cycle for the Western Quoll are large areas of undisturbed habitat which a sufficient variety of key food and other resources such as large hollow logs, burrows or small caves at ground level for denning. To be suitable as den sites, logs must have a diameter of at least 30 cm but usually greater than 50 cm, a hollow diameter of 7–20 cm and generally 1m long (Orell & Morris 1994). Annually, an adult female Chuditch will utilise an estimated average of 66 logs and 110 burrows within her home range. A large amount of den sites are required for both sexes. They occupy relatively large home ranges, with males utilising over 15 km^2 and females 3-4 km^2 (Orell & Morris 1994). A single record in Naturemap occurs about 13km east in Cape Arid NP though from distribution maps in Menkorst and Knight (2013) and others, the site is probably no longer within the species current distribution.	Marginal more likely to occur in the Cape Arid NP or areas to the west.	Unlikely due to contraction of distribution	Unlikely

Species Status* (State, Cth)	Ecology	Presence of habitat	Likelihood of occurrence	Potential to be impacted?
Isodon obesulus fusciventers (Southern Brown Bandicoot, Quenda) P5, -	Quenda's habitat consists of dense scrubby, often swampy vegetation with a dense cover up to one metre high particularly near watercourses and wetlands. It often feeds in adjacent forest (Jarrah and Wandoo) and woodlands that are burnt on a regular basis. Nests can be concealed next to or under old logs, shrubs or piles of debris and are made up of ground litter piled up over a shallow depression providing internal chambers. Home ranges vary with population density, and range from 5-8.6 ha for males and 1-6 ha for females (DEC 2010). Feed on a variety of ground-dwelling invertebrates and the fruit-bodies of hypogeous fungi. Their searches for food often create distinctive conical holes in the soil (DECCW 2010). It would be at the edge of its distribution if present (Menkorst and Knight 2013). Possible Quenda diggings were observed. There are no local Naturemap records (2015).	Present	Possible	Possible
Macropus eugenii subsp. derbianus (Tammar Wallaby) P5, -	Occurs throughout much of south-west WA from Kalbarri NP to Cape Arid east of Esperance on the south coast, and extending to the western parts of the Wheatbelt. Inhabits thickets (often Melaleuca or Gastrolobium) near to more open woodlands with grass understorey (Wildlife Australia 1996). Also inhabits ecotone between dense scrub and more open pasture including coastal scrub, heath, dry sclerophyll woodland, and mallee. Browses vegetation. It would be at the edge of its distribution if present (Menkorst and Knight 2013). There are no local Naturemap records (2015) and Ecoscape (2015) notes that it is likely to be extinct in the Cape Arid mainland area.	Marginal	Unlikely, likely to be locally extinct	Unlikely
Macropus irma (Western Brush Wallaby) P4, -	Optimum habitat for the Western Brush Wallaby includes open Jarrah forest or woodland and seasonally wet flats with low grasses and scrubby thickets, but also areas of mallee and heathland. Common dietary flora includes *Carpobrotus edulis, Cynodon dactylon* and *Nuytsia floribunda* (DEC, 2007). It would be at the edge of its distribution if present (Menkorst and Knight 2013). There are no local Naturemap records (2015).	Marginal	Unlikely, but possible	Unlikely to be direct impact but potential for habitat fragmentation through construction of a barrier

Species Status* (State, Cth)	Ecology	Presence of habitat	Likelihood of occurrence	Potential to be impacted?
Parantechinus apicalis (Dibbler) T, E	Surviving populations of dibblers (as opposed to reintroduced populations) are currently known only from FRNP and Boullanger and Whitlock Islands. The recovery plan for the species however notes that '*given the recorded disappearances and rediscoveries of the species it is likely that other populations exist, possibly in western coastal areas between Lancelin and Dongara, but most likely on the south coast between Denmark and Israelite Bay*' (CALM 2003). Dibblers have been recorded over an extensive area and it is likely that they can occupy a diverse range of habitats. Mainland occurrences of dibblers have been characterised by the presence of long unburnt heathland. Typically, captures have been on sandy substrates although occasional records are on laterite soils (CALM 2003). No longer In summary, surviving populations of dibblers (as opposed to reintroduced populations) are currently known only from FRNP and Boullanger and Whitlock Islands.	Marginal	Possible but unlikely	Unlikely
Petrogale lateralis subsp. Hacketti (Recherche Black-footed Rock-wallaby) T, V	Three populations of the Recherche Rock-wallaby exist on Mondrain Island (810 ha), Wilson Island (90 ha) and Westall Island (70 ha) in the Recherche Archipelago, near Esperance, WA (SPRAT 2015).	No	None	None
REPTILIA				
Acanthopis antarcticus (Southern Death Adder) P3, -	Southern Death Adders inhabit a range of habitats, including rainforest, scrubland, semi arid zones and rocky outcrops. Typically during the day they remain mostly buried beneath sand, soil or debris, with just the tail and top of the head exposed. Pilbara Pythons website, accessed 24.07.2014, http://www.pilbarapythons.com/stndeathadder.htm .	Possible	Possible	Possible
Morelia spilota imbricata (Southern Carpet Python) S, -	It may shelter in burrows made by other animals, hollow tree limbs or logs (especially 150mm approx diameter hollows extending at least to 1m deep), or rock crevices. It commonly uses hollow logs for shelter (Wilson and Swan, 2008). This subspecies has been recorded from semi-arid coastal and inland habitats, *Banksia* woodland, eucalypt woodlands, and grasslands. The lack of good refuge (hollow timber, trees, or rocky areas) means the site probably has limited habitat opportunities for the spp.	Marginal	Possible but sporadic	Possible

Federal
VU: Vulnerable
EN: Endangered

WA
T: Threatened which includes

Priority Fauna
P 1: Taxa with few, poorly known populations on threatened lands.
P 2: Taxa with few, poorly known populations on conservation lands.

CE: Critically Endangered
Mig: Species listed under the JAMBA, CAMBA, ROKAMBA and Bonn Convention
These status criterions have been set by the *Environmental Protection and Biodiversity Conservation Act 1999*.

S1: Schedule 1 Rare or likely to become extinct
S2 - Extinct
S3 - Protected under International agreements
S4 - Other specially protected fauna
This status criterion has been set by the *Wildlife Conservation Act 1950.*

P 3: Taxa with several, poorly known populations, some on conservation lands.
P 4: Taxa in need of monitoring.
P 5: Taxa in need of monitoring.
S: Specially protected
These status criterions have been set by the WA Department of Environment and Conservation.

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Appendix B Fauna list (updated)

SW Environmental (2015) refers to this report.

Class	*Species Name*	Vernacular Name	Naturemap (2015)	ALA (2015)	CLG (2014)	Cowan (2011)	SW Environmental (2014)	SW Environmental (2015)
AMPHIBIA	*Crinia georgiana*	Quacking frog	x	x	x	x		x (heard)
AMPHIBIA	*Crinia pseudinsignifera*	False Western Froglet			x			
AMPHIBIA	*Crinia subinsignifera*	Small Western Froglet			x			
AMPHIBIA	*Heleioporus eyrei*	Moaning Frog			x			
AMPHIBIA	*Limnodynastes dorsalis*	Western Banjo Frog			x	x		
AMPHIBIA	*Litoria adelaidensis*	Slender Tree Frog			x	x		
AMPHIBIA	*Litoria cyclorhyncha*	Spotted-thighed tree frog	x	x	x	x		x
AMPHIBIA	*Neobatrachus pelobatoides*	Humming Frog			x			
AVES	*Acanthiza (Acanthiza) apicalis*	Inland Thornbill	x	x				x
AVES	*Acanthiza (Geobasileus) chrysorrhoa*	Yellow-rumped Thornbill	x	x				
AVES	*Acanthiza (Geobasileus) pusilla*	Brown Thornbill		x				
AVES	*Acanthorhynchus superciliosus*	Western Spinebill	x	x	x		x	
AVES	*Accipiter (Leucospiza) fasciatus*	Brown Goshawk	x	x				
AVES	*Anas (Anas) superciliosa*	Pacific Black Duck		x				
AVES	*Anas (Nettion) gracilis*	Grey Teal	x	x				
AVES	*Anas castanea*	Chestnut Teal	x					
AVES	*Anas rhynchotis*	Australasian Shoveler	x					
AVES	*Anas superciliosa*	Pacific Black Duck	x					
AVES	*Anhinga novaehollandiae*	Australasian Darter		x				
AVES	*Anthochaera (Anellobia) lunulata*	Western Wattlebird	x	x	x		x	x
AVES	*Anthochaera (Anthochaera) carunculata*	Red Wattlebird	x	x			x	x
AVES	*Anthus (Anthus) novaeseelandiae*	Australasian Pipit		x				
AVES	*Aquila (Uroaetus) audax*	Wedge-tailed Eagle	x	x				
AVES	*Ardea (Ardea) pacifica*	White-necked Heron	x	x				
AVES	*Ardea modesta*	Eastern Great Egret	x					
AVES	*Ardeotis australis*	Australian Bustard	x					
AVES	*Arenaria interpres*	Ruddy Turnstone	x					
AVES	*Artamus (Angroyan) cinereus*	Black-faced Woodswallow	x	x				
AVES	*Artamus (Angroyan) cyanopterus*	Dusky Woodswallow	x	x				
AVES	*Artamus (Campbellornis) personatus*	Masked Woodswallow					x	

Class	*Species Name*	Vernacular Name	Naturemap (2015)	ALA (2015)	CLG (2014)	Cowan (2011)	SW Environmental (2014)	SW Environmental (2015)
AVES	*Barnardius zonarius*	Australian Ringneck		x				
AVES	*Biziura lobata*	Musk Duck	x	x				
AVES	*Cacomantis (Vidgenia) flabelliformis*	Fan-tailed Cuckoo	x	x				x
AVES	*Cacomantis (Vidgenia) pallidus*	Pallid Cuckoo	x	x				
AVES	*Calamanthus (Calamanthus) campestris*	Rufous Fieldwren	x	x				
AVES	*Calidris (Ereunetes) ruficollis*	Red-necked Stint	x	x				
AVES	*Calidris acuminata*	Sharp-tailed Sandpiper	x					
AVES	*Calyptorhynchus latirostris*	Carnaby's Cockatoo	x					
AVES	*Cereopsis novaehollandiae*	Cape Barren Goose	x		x			
AVES	*Charadrius (Charadrius) ruficapillus*	Red-capped Plover	x	x	x			
AVES	*Charadrius rubricollis*	Hooded Plover	x					
AVES	*Chenonetta jubata*	Australian Wood Duck	x	x				
AVES	*Chroicocephalus novaehollandiae*	Silver Gull		x			x	
AVES	*Chrysococcyx basalis*	Horsfield's Bronze-cuckoo		x			x	
AVES	*Chrysococcyx lucidus*	Shining Bronze-cuckoo		x				
AVES	*Cincloramphus (Cincloramphus) cruralis*	Brown Songlark		x				
AVES	*Circus approximans*	Swamp Harrier	x	x				
AVES	*Circus assimilis*	Spotted Harrier	x	x				
AVES	*Colluricincla (Colluricincla) harmonica*	Grey Shrike-thrush	x	x				
AVES	*Coracina (Coracina) novaehollandiae*	Black-faced Cuckoo-shrike	x	x				x
AVES	*Corvus bennetti*	Little Crow		x				
AVES	*Corvus coronoides*	Australian Raven	x	x			x	x
AVES	*Coturnix pectoralis*	Stubble Quail	x					
AVES	*Coturnix ypsilophora*	Brown Quail	x					
AVES	*Cracticus tibicen*	Australian Magpie	x	x	x			
AVES	*Cracticus torquatus*	Grey Butcherbird	x	x				
AVES	*Cygnus (Chenopis) atratus*	Black Swan	x	x				
AVES	*Dromaius novaehollandiae*	Emu	x	x				x
AVES	*Egretta garzetta*	Little Egret		x				
AVES	*Egretta novaehollandiae*	White-faced Heron		x				
AVES	*Elanus axillaris*	Black-shouldered Kite		x				

Class	*Species Name*	Vernacular Name	Naturemap (2015)	ALA (2015)	CLG (2014)	Cowan (2011)	SW Environmental (2014)	SW Environmental (2015)
AVES	*Elseyornis melanops*	Black-fronted Dotterel		x				
AVES	*Eopsaltria (Eopsaltria) griseogularis*	Western Yellow Robin		x				
AVES	*Epthianura (Epthianura) albifrons*	White-fronted Chat	x	x				
AVES	*Esacus magnirostris*	Beach Stone-curlew		x				
AVES	*Eudyptes pachyrhynchus*	Fiordland crested penguin			x			
AVES	*Eudyptula minor novaehollandiae*	Little Penguin			x			
AVES	*Eurostopodus (Eurostopodus) argus*	Spotted Nightjar	x	x				
AVES	*Falco (Falco) longipennis*	Australian Hobby	x	x				
AVES	*Falco (Ieracidea) berigora*	Brown Falcon	x	x				
AVES	*Falco (Tinnunculus) cenchroides*	Nankeen Kestrel	x	x				
AVES	*Falco hypoleucos*	Grey Falcon	x					
AVES	*Falco peregrinus*	Peregrine Falcon	x					
AVES	*Fulica atra*	Eurasian Coot	x	x				
AVES	*Gavicalis virescens*	Singing Honeyeater		x	x		x	
AVES	*Gliciphila melanops*	Tawny-crowned Honeyeater		x				
AVES	*Glossopsitta porphyrocephala*	Purple-crowned Lorikeet	x	x	x			
AVES	*Grallina cyanoleuca*	Magpie-lark	x	x				x
AVES	*Haematopus fuliginosus*	Sooty Oystercatcher	x	x				
AVES	*Haematopus longirostris*	Australian Pied Oystercatcher	x	x				
AVES	*Haliaeetus (Pontoaetus) leucogaster*	White-bellied Sea-eagle	x	x				
AVES	*Hieraaetus (Hieraaetus) morphnoides*	Little Eagle		x				
AVES	*Himantopus himantopus*	Black-winged Stilt	x	x				
AVES	*Hirundo (Hirundo) neoxena*	Welcome Swallow	x	x			x	x
AVES	*Larus (Larus) dominicanus*	Kelp Gull					x	
AVES	*Larus (Larus) pacificus*	Pacific Gull	x	x				
AVES	*Leucophaeus atricilla*	Laughing Gull		x				
AVES	*Lichenostomus cratitius*	Purple-gaped Honeyeater	x	x				
AVES	*Lichenostomus leucotis*	White-eared Honeyeater		x				
AVES	*Lichmera (Lichmera) indistincta*	Brown Honeyeater	x	x				
AVES	*Limosa lapponica*	Bar-tailed Godwit	x					
AVES	*Malacorhynchus membranaceus*	Pink-eared Duck	x					
AVES	*Malurus (Leggeornis) pulcherrimus*	Blue-breasted Fairy-wren	x	x				

Class	*Species Name*	Vernacular Name	Naturemap (2015)	ALA (2015)	CLG (2014)	Cowan (2011)	SW Environmental (2014)	SW Environmental (2015)
AVES	*Manorina (Myzantha) flavigula*	Yellow-throated Miner	x	x	x			
AVES	*Megalurus gramineus*	Little Grassbird		x				
AVES	*Melanodryas (Melanodryas) cucullata*	Hooded Robin		x				
AVES	*Melithreptus (Eidopsarus) brevirostris*	Brown-headed Honeyeater	x	x				
AVES	*Melithreptus (Melithreptus) lunatus*	White-naped Honeyeater		x				
AVES	*Merops (Merops) ornatus*	Rainbow Bee-eater		x				
AVES	*Microcarbo melanoleucos*	Little Pied Cormorant		x				
AVES	*Morus serrator*	Australasian Gannet		x				
AVES	*Myiagra inquieta*	Restless Flycatcher	x					
AVES	*Neophema (Neonanodes) elegans*	Elegant Parrot		x				
AVES	*Neophema (Neonanodes) petrophila*	Rock Parrot	x	x				
AVES	*Ninox (Ninox) novaeseelandiae*	Southern Boobook	x	x				
AVES	*Nycticorax caledonicus*	Nankeen Night-heron		x				
AVES	*Nycticorax caledonicus hilli*	Rufous Night-heron			x			
AVES	*Ocyphaps lophotes*	Crested Pigeon	x	x				x
AVES	*Oreoica gutturalis*	Crested Bellbird	x	x				
AVES	*Oxyura australis*	Blue-billed Duck		x				
AVES	*Pachycephala (Alisterornis) rufiventris*	Rufous Whistler	x	x				
AVES	*Pachycephala (Pachycephala) pectoralis*	Golden Whistler	x	x				
AVES	*Pardalotus (Pardalotinus) striatus*	Striated Pardalote	x	x				
AVES	*Pardalotus (Pardalotus) punctatus*	Spotted Pardalote	x	x				
AVES	*Pardalotus punctatus subsp. xanthopyge*	Yellow-rumped Pardalote	x					
AVES	*Pelagodroma marina*	White-faced Storm-petrel		x				
AVES	*Pelecanus conspicillatus*	Australian Pelican	x	x				
AVES	*Petrochelidon (Hylochelidon) nigricans*	Tree Martin		x				
AVES	*Petrochelidon ariel*	Fairy Martin		x				
AVES	*Petroica (Petroica) boodang*	Scarlet Robin		x				
AVES	*Pezoporus wallicus*	Ground Parrot	x	x				
AVES	*Phalacrocorax (Anacarbo) fuscescens*	Black-faced Cormorant	x	x				
AVES	*Phalacrocorax (Phalacrocorax) carbo*	Great Cormorant	x	x				

Class	*Species Name*	Vernacular Name	Naturemap (2015)	ALA (2015)	CLG (2014)	Cowan (2011)	SW Environmental (2014)	SW Environmental (2015)
AVES	*Phalacrocorax (Phalacrocorax) sulcirostris*	Little Black Cormorant	x	x				
AVES	*Phalacrocorax (Phalacrocorax) varius*	Pied Cormorant	x	x				
AVES	*Phaps (Phaps) chalcoptera*	Common Bronzewing	x	x			x	x
AVES	*Phaps (Phaps) elegans*	Brush Bronzewing	x	x				x
AVES	*Phylidonyris (Meliornis) niger*	White-cheeked Honeyeater		x				
AVES	*Phylidonyris (Meliornis) novaehollandiae*	New Holland Honeyeater	x	x			x	x
AVES	*Pluvialis fulva*	Pacific Golden Plover	x					
AVES	*Pluvialis squatarola*	Grey Plover	x					
AVES	*Podargus strigoides*	Tawny Frogmouth	x	x				
AVES	*Podiceps cristatus*	Great Crested Grebe	x	x				
AVES	*Poliocephalus poliocephalus*	Hoary-headed Grebe	x	x				
AVES	*Porphyrio (Porphyrio) porphyrio*	Purple Swamphen		x				
AVES	*Porzana (Porzana) tabuensis*	Spotless Crake		x				
AVES	*Porzana fluminea*	Australian Crake	x	x	x			
AVES	*Pterodroma macroptera macoptera*	Grey-faced petrel			x			
AVES	*Puffinus assimilis assimilis*	Little Shearwater			x			
AVES	*Puffinus tenuirostris*	Short-tailed Shearwater	x					
AVES	*Purnella albifrons*	White-fronted Honeyeater		x				
AVES	*Rhipidura (Rhipidura) albiscapa*	Grey Fantail		x			x	
AVES	*Rhipidura (Sauloprocta) leucophrys*	Willie Wagtail	x	x			x	
AVES	*Sericornis frontalis maculatus*	White-browed scrubwren	x	x	x		x	
AVES	*Smicrornis brevirostris*	Weebill	x	x				x
AVES	*Stagonopleura (Zonaeginthus) oculata*	Red-eared Firetail	x	x			x	
AVES	*Sternula nereis*	Fairy Tern		x				
AVES	*Stipiturus malachurus*	Southern Emu-wren	x	x				
AVES	*Strepera (Neostrepera) versicolor*	Grey Currawong	x	x				
AVES	*Streptopelia (Spilopelia) senegalensis*	Laughing Dove		x				
AVES	*Sturnus vulgaris*	European Starling			x			
AVES	*Tachybaptus novaehollandiae*	Australasian Grebe		x				
AVES	*Tadorna (Casarca) tadornoides*	Australian Shelduck	x	x				
AVES	*Taeniopygia guttata*	Zebra Finch		x				

Class	*Species Name*	Vernacular Name	Naturemap (2015)	ALA (2015)	CLG (2014)	Cowan (2011)	SW Environmental (2014)	SW Environmental (2015)
AVES	*Thalasseus bergii*	Crested Tern		x				
AVES	*Thinornis rubricollis*	Hooded Plover			x			
AVES	*Threskiornis molucca*	Australian White Ibis	x					
AVES	*Threskiornis spinicollis*	Straw-necked Ibis	x					
AVES	*Todiramphus (Todiramphus) sanctus*	Sacred Kingfisher	x	x			x	
AVES	*Tribonyx ventralis*	Black-tailed Native-hen		x				
AVES	*Tringa (Heteroscelus) brevipes*	Grey-tailed Tattler			x			
AVES	*Tringa nebularia*	Common Greenshank	x					
AVES	*Tyto (Tyto) javanica*	Eastern Barn Owl		x				
AVES	*Vanellus miles*	Masked Lapwing	x					
AVES	*Vanellus tricolor*	Banded Lapwing	x					
AVES	*Zosterops lateralis*	Silvereye	x	x	x		x	
MAMMALIA	*Cercartetus concinnus*	Western Pygmy-possum			x			
MAMMALIA	*Chalinolobus gouldii*	Gould's Wattled Bat	x	x				
MAMMALIA	*Dasyurus geoffroii*	Chuditch	x					
MAMMALIA	*Felix catus*	Cat *						x tracks
MAMMALIA	*Isoodon obesulus fusciventer*	Southern brown bandicoot			x			x diggings?
MAMMALIA	*Macropus eugenii*	Tammar Wallaby	x	x				
MAMMALIA	*Macropus fuliginosus*	Western Grey Kangaroo			x	x	x	x
MAMMALIA	*Macropus irma*	Western Brush Wallaby						
MAMMALIA	*Mus musculus*	House Mouse *	x	x	x	x		
MAMMALIA	*Oryctolagus cuniculus*	Rabbit *			x		x	x scat diggings
MAMMALIA	*Petrogale lateralis subsp. hacketti*	Recherche Black-footed Rock-wallaby	x					
MAMMALIA	*Pseudomys albocinereus*	Ash-grey Mouse			x			
MAMMALIA	*Rattus fuscipes*	Bush Rat	x	x	x	x		
MAMMALIA	*Sminthopsis crassicaudat*	Fat-tailed Dunnart						
MAMMALIA	*Sminthopsis griseoventer*	Gray-bellied Dunnart			x	x		
MAMMALIA	*Tachyglossus aculeatus*	Short-beaked Echidna				x		x scat
MAMMALIA	*Tarsipes rostratus*	Honey Possum			x	x		
MAMMALIA	*Vulpes vulpes*	Fox *			x		x	x tracks
REPTILIA	*Acritoscincus trilineatum*	Southwestern Cool Skink			x	x		x

Class	*Species Name*	Vernacular Name	Naturemap (2015)	ALA (2015)	CLG (2014)	Cowan (2011)	SW Environmental (2014)	SW Environmental (2015)
REPTILIA	*Aprasia striolata*	Lined Worm-lizard			x			
REPTILIA	*Caretta caretta*	Loggerhead Turtle			x			
REPTILIA	*Christinus marmoratus*	Marbled Gecko	x	x	x	x		
REPTILIA	*Cryptoblepharus virgatus clarus*	Fence skink			x		x	
REPTILIA	*Ctenophorus chapmani*	Southern Heath Dragon	x	x				
REPTILIA	*Ctenophorus ornatus*	Ornate Crevice-dragon			x	x	x	
REPTILIA	*Ctenotus catenifer*	Chain-striped South-west Ctenotus	x	x	x	x		
REPTILIA	*Ctenotus gemmula*	Jewelled Sandplain Ctenotus			x	x		
REPTILIA	*Ctenotus labillardieri*	Common South-west Ctenotus	x	x	x	x		
REPTILIA	*Ctenotus schomburgkii*	Barred wedgesnout ctenotus	x					
REPTILIA	*Delma australis*	Marble-faced Delma	x	x	x	x		
REPTILIA	*Delma fraseri*	Fraser's Legless Lizard	x					
REPTILIA	*Echiopsis curta*	Bardick			x			
REPTILIA	*Egernia kingii*	King's Skink			x	x		
REPTILIA	*Egernia multiscutata bos*	Heath Skink			x		x	
REPTILIA	*Egernia napoleonis*	South-western Crevice-skink	x		x			
REPTILIA	*Elapognathus coronatus*	Western Crowned Snake			x	x		
REPTILIA	*Heleioporus psammophilus*	Sand Frog			x			
REPTILIA	*Hemiergis peronii peronii*	Four-toed Earless Skink			x	x		
REPTILIA	*Lerista distinguenda*	South-western Orange-tailed Slider	x	x	x	x		
REPTILIA	*Lerista microtis intermedia*	South-western slider			x	x		
REPTILIA	*Menetia greyii*	Common Dwarf Skink			x			
REPTILIA	*Morelia spilota imbricata*	South-western Carpet Python			x			
REPTILIA	*Morethia obscura*	Shrubland Morethia Skink			x	x		
REPTILIA	*Notechis scutatus*	Tiger Snake			x			
REPTILIA	*Pelamis platura*	Yellow-bellied Sea Snake			x			
REPTILIA	*Pogona minor*	Dwarf Bearded Dragon	x	x	x			
REPTILIA	*Pseudonaja affinis*	Dugite	x	x				
REPTILIA	*Pygopus lepidopodus*	Common Scaly-foot			x	x		
REPTILIA	*Ramphotyphlops australis*	Southern Blind Snake		x	x			

Class	*Species Name*	Vernacular Name	Naturemap (2015)	ALA (2015)	CLG (2014)	Cowan (2011)	SW Environmental (2014)	SW Environmental (2015)
REPTILIA	*Rankinia adelaidensis chapmani*	Western Heath Dragon			x		x	
REPTILIA	*Rhinoplocephalus bicolor*	Square-nosed Snake	x	x	x			
REPTILIA	*Strophurus spinigerus*	South-west Spiny-tailed Gecko		x				
REPTILIA	*Strophurus spinigerus inornatus*	Soft Spiny-tailed Gecko	x		x			
REPTILIA	*Tiliqua occipitalis*	Western Blue-tongue			x			
REPTILIA	*Tiliqua rugosa rugosa*	Shingleback	x	x	x	x	x	
REPTILIA	*Underwoodisaurus milii*	Barking gecko			x	x		
REPTILIA	*Varanus rosenbergi*	Heath Monitor			x	x	x	

Appendix C Database Searches

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.

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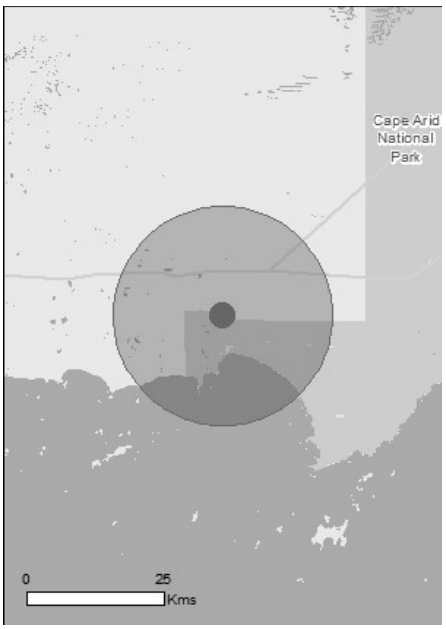

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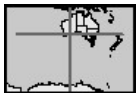

Summary

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 Area:	None
Listed Threatened Ecological Communities:	1
Listed Threatened Species:	36
Listed Migratory Species:	37

Other Matters Protected by the EPBC Act

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

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

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

Commonwealth Land:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	61
Whales and Other Cetaceans:	12
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Commonwealth Reserves Marine:	None

Extra Information

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

State and Territory Reserves:	3
Regional Forest Agreements:	None
Invasive Species:	9
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Listed Threatened Ecological Communities [Resource Information]

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

Name	Status	Type of Presence
Proteaceae Dominated Kwongkan Shrublands of the Southeast Coastal Floristic Province of Western Australia	Endangered	Community likely to occur within area

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat known to occur within area
Calyptorhynchus latirostris Carnaby's Black-Cockatoo, Short-billed Black-Cockatoo [59523]	Endangered	Species or species habitat likely to occur within area
Cereopsis novaehollandiae grisea Cape Barren Goose (south-western), Recherche Cape Barren Goose [25978]	Vulnerable	Breeding known to occur within area
Diomedea epomophora epomophora Southern Royal Albatross [25996]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea epomophora sanfordi Northern Royal Albatross [82331]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans antipodensis Antipodean Albatross [82269]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans exulans Tristan Albatross [82337]	Endangered	Species or species habitat may occur within area
Diomedea exulans (sensu lato) Wandering Albatross [1073]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Halobaena caerulea Blue Petrel [1059]	Vulnerable	Species or species habitat may occur within area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat likely to occur within area
Macronectes giganteus Southern Giant-Petrel [1060]	Endangered	Species or species habitat may occur within

Name	Status	Type of Presence
		area
Macronectes halli Northern Giant-Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Pezoporus flaviventris Western Ground Parrot, Kyloring [84650]	Critically Endangered	Species or species habitat known to occur within area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Species or species habitat may occur within area
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Foraging, feeding or related behaviour may occur within area
Thalassarche cauta cauta Shy Albatross, Tasmanian Shy Albatross [82345]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche cauta steadi White-capped Albatross [82344]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris impavida Campbell Albatross [82449]	Vulnerable	Species or species habitat may occur within area
Mammals		
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat may occur within area
Dasyurus geoffroii Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat known to occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Breeding known to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat likely to occur within area
Neophoca cinerea Australian Sea-lion [22]	Vulnerable	Breeding known to occur within area
Parantechinus apicalis Dibbler [313]	Endangered	Species or species habitat likely to occur within area
Plants		
Anigozanthos bicolor subsp. minor Little Kangaroo Paw, Two-coloured Kangaroo Paw, Small Two-colour Kangaroo Paw [21241]	Endangered	Species or species habitat likely to occur within area
Centrolepis caespitosa [6393]	Endangered	Species or species habitat may occur within area
Eremophila denticulata subsp. trisulcata Cumquat Eremophila [64570]	Endangered	Species or species habitat likely to occur within area

Name	Status	Type of Presence
Lambertia echinata subsp. echinata		
Prickly Honeysuckle [56729]	Endangered	Species or species habitat likely to occur within area
Ricinocarpos trichophorus		
Barrens Wedding Bush [19931]	Endangered	Species or species habitat likely to occur within area
Reptiles		
Caretta caretta		
Loggerhead Turtle [1763]	Endangered	Breeding likely to occur within area
Chelonia mydas		
Green Turtle [1765]	Vulnerable	Breeding likely to occur within area
Dermochelys coriacea		
Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Breeding likely to occur within area
Sharks		
Carcharodon carcharias		
Great White Shark [64470]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Rhincodon typus		
Whale Shark [66680]	Vulnerable	Species or species habitat may 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
Diomedea antipodensis		
Antipodean Albatross [64458]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Diomedea dabbenena		
Tristan Albatross [66471]	Endangered*	Species or species habitat may occur within area
Diomedea epomophora (sensu stricto)		
Southern Royal Albatross [1072]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans (sensu lato)		
Wandering Albatross [1073]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi		
Northern Royal Albatross [64456]	Endangered*	Foraging, feeding or related behaviour likely to occur within area
Macronectes giganteus		
Southern Giant-Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli		
Northern Giant-Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Onychoprion anaethetus		
Bridled Tern [82845]		Foraging, feeding or related behaviour likely to occur within area
Puffinus carneipes		
Flesh-footed Shearwater, Fleshy-footed Shearwater [1043]		Breeding known to occur within area

Name	Threatened	Type of Presence
Puffinus tenuirostris Short-tailed Shearwater [1029]		Breeding known to occur within area
Sterna caspia Caspian Tern [59467]		Foraging, feeding or related behaviour known to occur within area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Foraging, feeding or related behaviour may occur within area
Thalassarche cauta (sensu stricto) Shy Albatross, Tasmanian Shy Albatross [64697]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Thalassarche impavida Campbell Albatross [64459]	Vulnerable*	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Migratory Marine Species		
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat may occur within area
Caperea marginata Pygmy Right Whale [39]		Species or species habitat may occur within area
Carcharodon carcharias Great White Shark [64470]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding likely to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding likely to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Breeding likely to occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Breeding known to occur within area
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat may occur within area
Lamna nasus Porbeagle, Mackerel Shark [83288]		Species or species habitat likely to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat likely to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Rhincodon typus		
Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area
Migratory Terrestrial Species		
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 may occur within area
Gallinago megala		
Swinhoe's Snipe [864]		Roosting likely to occur within area
Gallinago stenura		
Pin-tailed Snipe [841]		Roosting likely to occur within area
Numenius minutus		
Little Curlew, Little Whimbrel [848]		Roosting likely to occur within area
Pandion cristatus		
Eastern Osprey [82411]		Species or species habitat likely to occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species [Resource Information]

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

Name	Threatened	Type of Presence
Birds		
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba		
Great Egret, White Egret [59541]		Species or species habitat known to occur within area
Ardea ibis		
Cattle Egret [59542]		Species or species habitat may occur within area
Catharacta skua		
Great Skua [59472]		Species or species habitat may occur within area
Cereopsis novaehollandiae grisea		
Cape Barren Goose (south-western), Recherche Cape Barren Goose [25978]	Vulnerable	Breeding known to occur within area
Diomedea antipodensis		
Antipodean Albatross [64458]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Diomedea dabbenena		
Tristan Albatross [66471]	Endangered*	Species or species habitat may occur within area
Diomedea epomophora (sensu stricto)		
Southern Royal Albatross [1072]	Vulnerable*	Foraging, feeding or related behaviour likely

Name	Threatened	Type of Presence
		to occur within area
Diomedea exulans (sensu lato) Wandering Albatross [1073]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered*	Foraging, feeding or related behaviour likely to occur within area
Gallinago megala Swinhoe's Snipe [864]		Roosting likely to occur within area
Gallinago stenura Pin-tailed Snipe [841]		Roosting likely to occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Halobaena caerulea Blue Petrel [1059]	Vulnerable	Species or species habitat may occur within area
Larus pacificus Pacific Gull [811]		Foraging, feeding or related behaviour known to occur within area
Macronectes giganteus Southern Giant-Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant-Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Numenius minutus Little Curlew, Little Whimbrel [848]		Roosting likely to occur within area
Pandion haliaetus Osprey [952]		Species or species habitat likely to occur within area
Phalacrocorax fuscescens Black-faced Cormorant [59660]		Foraging, feeding or related behaviour likely to occur within area
Pterodroma macroptera Great-winged Petrel [1035]		Breeding likely to occur within area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Species or species habitat may occur within area
Puffinus assimilis Little Shearwater [59363]		Foraging, feeding or related behaviour known to occur within area
Puffinus carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [1043]		Breeding known to occur within area
Puffinus tenuirostris Short-tailed Shearwater [1029]		Breeding known to occur within area
Recurvirostra novaehollandiae Red-necked Avocet [871]		Roosting known to occur within area
Sterna anaethetus Bridled Tern [814]		Foraging, feeding or related behaviour likely

Name	Threatened	Type of Presence
		to occur within area
Sterna caspia Caspian Tern [59467]		Foraging, feeding or related behaviour known to occur within area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Foraging, feeding or related behaviour may occur within area
Thalassarche cauta (sensu stricto) Shy Albatross, Tasmanian Shy Albatross [64697]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Thalassarche impavida Campbell Albatross [64459]	Vulnerable*	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Thinornis rubricollis Hooded Plover [59510]		Breeding known to occur within area
Fish		
Acentronura australe Southern Pygmy Pipehorse [66185]		Species or species habitat may occur within area
Campichthys galei Gale's Pipefish [66191]		Species or species habitat may occur within area
Heraldia nocturna Upside-down Pipefish, Eastern Upside-down Pipefish, Eastern Upside-down Pipefish [66227]		Species or species habitat may occur within area
Hippocampus breviceps Short-head Seahorse, Short-snouted Seahorse [66235]		Species or species habitat may occur within area
Histiogamphelus cristatus Rhino Pipefish, Macleay's Crested Pipefish, Ring-back Pipefish [66243]		Species or species habitat may occur within area
Leptoichthys fistularius Brushtail Pipefish [66248]		Species or species habitat may occur within area
Lissocampus caudalis Australian Smooth Pipefish, Smooth Pipefish [66249]		Species or species habitat may occur within area
Lissocampus runa Javelin Pipefish [66251]		Species or species habitat may occur within area
Maroubra perserrata Sawtooth Pipefish [66252]		Species or species habitat may occur within area
Nannocampus subosseus Bonyhead Pipefish, Bony-headed Pipefish [66264]		Species or species habitat may occur within area
Notiocampus ruber Red Pipefish [66265]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Phycodurus eques Leafy Seadragon [66267]		Species or species habitat may occur within area
Phyllopteryx taeniolatus Common Seadragon, Weedy Seadragon [66268]		Species or species habitat may occur within area
Pugnaso curtirostris Pugnose Pipefish, Pug-nosed Pipefish [66269]		Species or species habitat may occur within area
Solegnathus lettiensis Gunther's Pipehorse, Indonesian Pipefish [66273]		Species or species habitat may occur within area
Stigmatopora argus Spotted Pipefish, Gulf Pipefish [66276]		Species or species habitat may occur within area
Stigmatopora nigra Widebody Pipefish, Wide-bodied Pipefish, Black Pipefish [66277]		Species or species habitat may occur within area
Urocampus carinirostris Hairy Pipefish [66282]		Species or species habitat may occur within area
Vanacampus margaritifer Mother-of-pearl Pipefish [66283]		Species or species habitat may occur within area
Vanacampus phillipi Port Phillip Pipefish [66284]		Species or species habitat may occur within area
Vanacampus poecilolaemus Longsnout Pipefish, Australian Long-snout Pipefish, Long-snouted Pipefish [66285]		Species or species habitat may occur within area
Mammals		
Arctocephalus forsteri Long-nosed Fur-seal, New Zealand Fur-seal [20]		Species or species habitat may occur within area
Neophoca cinerea Australian Sea-lion [22]	Vulnerable	Breeding known to occur within area
Reptiles		
Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding likely to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding likely to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Breeding likely to occur within area

Whales and other Cetaceans [Resource Information]

Name	Status	Type of Presence
Mammals		
Balaenoptera acutorostrata Minke Whale [33]		Species or species habitat may occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species

Name	Status	Type of Presence
		habitat may occur within area
Caperea marginata Pygmy Right Whale [39]		Species or species habitat may occur within area
Delphinus delphis Common Dophin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Breeding known to occur within area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat likely to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area

Extra Information

State and Territory Reserves [Resource Information]

Name	State
Bebenorin	WA
Cape Arid	WA
Recherche Archipelago	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		
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Mammals		
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Felis catus		
Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Feral deer		
Feral deer species in Australia [85733]		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
Vulpes vulpes		
Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Asparagus asparagoides		
Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Lycium ferocissimum		
African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area

Caveat

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

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

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

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

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.

Coordinates

-33.80494 123.01131

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.

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NatureMap
Mapping Western Australia's biodiversity

NatureMap Species Report

Created By Guest user on 07/08/2015

Kingdom	Animalia
Current Names Only	Yes
Core Datasets Only	Yes
Method	'By Circle'
Centre	123°01' 38" E,33°48' 27" S
Buffer	20km
Group By	Conservation Status

Conservation Status	Species	Records
Non-conservation taxon	224	1365
Other specially protected fauna	2	6
Priority 4	2	9
Priority 5	1	1
Protected under international agreement	13	57
Rare or likely to become extinct	10	38
TOTAL	**252**	**1476**

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
Rare or likely to become extinct					
1.	24790	*Calidris tenuirostris (Great Knot)*		T	
2.	24734	*Calyptorhynchus latirostris (Carnaby's Cockatoo (short-billed black-cockatoo), Carnaby's Cockatoo)*		T	
3.	24320	*Cereopsis novaehollandiae subsp. grisea (Recherche Cape Barren Goose, Cape Barren Goose)*		T	
4.	24092	*Dasyurus geoffroii (Chuditch, Western Quoll)*		T	
5.	24043	*Eubalaena australis (Southern Right Whale)*		T	
6.	24473	*Falco hypoleucos (Grey Falcon)*		T	
7.	24143	*Petrogale lateralis subsp. hacketti (Recherche Black-footed Rock-wallaby)*		T	
8.	41348	*Pezoporus flaviventris (Western Ground Parrot)*		T	
9.	25719	*Pezoporus wallicus (Ground Parrot)*		T	
10.	34136	*Thalassarche chrysostoma (Grey-headed Albatross)*		T	
Protected under international agreement					
11.	41323	*Actitis hypoleucos (Common Sandpiper)*		IA	
12.	25554	*Apus pacificus (Fork-tailed Swift)*		IA	
13.	41324	*Ardea modesta (Eastern Great Egret)*		IA	
14.	25736	*Arenaria interpres (Ruddy Turnstone)*		IA	
15.	24779	*Calidris acuminata (Sharp-tailed Sandpiper)*		IA	
16.	24780	*Calidris alba (Sanderling)*		IA	
17.	24788	*Calidris ruficollis (Red-necked Stint)*		IA	
18.	24293	*Haliaeetus leucogaster (White-bellied Sea-Eagle)*		IA	
19.	30932	*Limosa lapponica (Bar-tailed Godwit)*		IA	
20.	24382	*Pluvialis fulva (Pacific Golden Plover)*		IA	
21.	24383	*Pluvialis squatarola (Grey Plover)*		IA	
22.	24717	*Puffinus tenuirostris (Short-tailed Shearwater)*		IA	
23.	24808	*Tringa nebularia (Common Greenshank)*		IA	
Other specially protected fauna					
24.	25624	*Falco peregrinus (Peregrine Falcon)*		S	
25.	24210	*Neophoca cinerea (Australian Sea Lion)*		S	
Priority 4					
26.	24376	*Charadrius rubricollis (Hooded Plover)*		P4	
27.	24328	*Oxyura australis (Blue-billed Duck)*		P4	
Priority 5					
28.	24131	*Macropus eugenii subsp. derbianus (Tammar Wallaby (WA subsp))*		P5	
Non-conservation taxon					
29.	24260	*Acanthiza apicalis (Broad-tailed Thornbill, Inland Thornbill)*			
30.	24261	*Acanthiza chrysorrhoa (Yellow-rumped Thornbill)*			
31.	24560	*Acanthorhynchus superciliosus (Western Spinebill)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
32.	25536	*Accipiter fasciatus (Brown Goshawk)*			
33.		*Aedes (Och.) ENM's sp nr stricklandi (SAP)*			
34.		*Agraptocorixa hirtifrons*			
35.		*Alona cf. crassicauda (SAP)*			
36.		*Alonella cf. clathratula*			
37.	24310	*Anas castanea (Chestnut Teal)*			
38.	24312	*Anas gracilis (Grey Teal)*			
39.	24315	*Anas rhynchotis (Australasian Shoveler)*			
40.	24316	*Anas superciliosa (Pacific Black Duck)*			
41.	24561	*Anthochaera carunculata (Red Wattlebird)*			
42.	24562	*Anthochaera lunulata (Western Little Wattlebird)*			
43.	24285	*Aquila audax (Wedge-tailed Eagle)*			
44.		*Araneus cyphoxis*			
45.		*Araneus senicaudatus*			
46.	24341	*Ardea pacifica (White-necked Heron)*			
47.	24610	*Ardeotis australis (Australian Bustard)*			
48.	25566	*Artamus cinereus (Black-faced Woodswallow)*			
49.	24353	*Artamus cyanopterus (Dusky Woodswallow)*			
50.		*Artemia sp.*			
51.		*Artoriopsis expolita*			
52.		*Austrochiltonia subtenuis*			
53.		*Austrolestes annulosus*			
54.		*Austrosuccinea sp.*			
55.		*Austrosynthemis sp.*			
56.		*Batrachomatus nannup (formerly Allomatus genus)*			
57.		*Berosus discolor*			
58.	24319	*Biziura lobata (Musk Duck)*			
59.		*Boeckella triarticulata*			
60.		*Brachionus cf. plicatilis (SAP)*			
61.		*Brachionus plicatilis s.l.*			
62.		*Brachionus quadridentatus quadridentatus*			
63.	25598	*Cacomantis flabelliformis (Fan-tailed Cuckoo)*			
64.	42307	*Cacomantis pallidus (Pallid Cuckoo)*			
65.	24269	*Calamanthus campestris (Rufous Fieldwren)*			
66.		*Calamoecia attenuata*			
67.		*Calamoecia sp. 342 (ampulla variant)*			
68.		*Calamoecia sp. 342 (ampulla variant) (CB)*			
69.		*Candonocypris novaezelandiae*			
70.		*Capitella sp.*			
71.		*Carabidae sp.*			
72.		*Cercophonius sulcatus*			
73.	25551	*Cereopsis novaehollandiae (Cape Barren Goose)*			
74.	24186	*Chalinolobus gouldii (Gould's Wattled Bat)*			
75.	24377	*Charadrius ruficapillus (Red-capped Plover)*			
76.	24321	*Chenonetta jubata (Australian Wood Duck, Wood Duck)*			
77.	24980	*Christinus marmoratus (Marbled Gecko)*			
78.	24288	*Circus approximans (Swamp Harrier)*			
79.	24289	*Circus assimilis (Spotted Harrier)*			
80.	24774	*Cladorhynchus leucocephalus (Banded Stilt)*			
81.		*Coenagrionidae sp. 3 (Ausrivas)*			
82.	25675	*Colluricincla harmonica (Grey Shrike-thrush)*			
83.		*Conochilus coenobasis*			
84.	25568	*Coracina novaehollandiae (Black-faced Cuckoo-shrike)*			
85.	25592	*Corvus coronoides (Australian Raven)*			
86.	24671	*Coturnix pectoralis (Stubble Quail)*			
87.	24673	*Coturnix ypsilophora subsp. australis (Brown Quail)*			
88.		*Coxiella sp.*			
89.	25595	*Cracticus tibicen (Australian Magpie)*			
90.	25596	*Cracticus torquatus (Grey Butcherbird)*			
91.	25398	*Crinia georgiana (Quacking Frog)*			
92.	42385	*Ctenophorus chapmani (Eastern Heath Dragon)*			
93.	25031	*Ctenotus catenifer*			
94.	25049	*Ctenotus labillardieri*			
95.	25074	*Ctenotus schomburgkii*			
96.		*Culicoides sp.*			
97.		*Curculionidae sp.*			
98.		*Cyclosa trilobata*			
99.	24322	*Cygnus atratus (Black Swan)*			
100.		*Daphnia n. sp. d (Ewerts) (SAP)*			Y
101.		*Daphnia queenslandensis*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
102.		*Daphnia sp. nov. d (Ewerts)*			Y
103.		*Dasyhelea sp.*			
104.	24995	*Delma australis*			
105.	25766	*Delma fraseri (Fraser's Legless Lizard)*			
106.		*Dero digitata*			
107.		*Diacypris spinosa*			
108.		*Dicrotendipes pseudoconjunctus*			
109.		*Difflugia cf. lithophila (SAP)*			
110.		*Dolichopodidae sp. A (SAP)*			
111.		*Dolichopodidae sp. B (SAP)*			
112.	24470	*Dromaius novaehollandiae (Emu)*			
113.		*Ecnomina E group sp. 5*			
114.		*Ecnomus pansus/turgidus*			
115.	25100	*Egernia napoleonis*			
116.		*Enchytraeidae sp.*			
117.		*Enochrus eyrensis*			
118.		*Ephydridae sp. 3 (SAP)*			
119.		*Ephydridae sp. 6 (SAP)*			
120.	24567	*Epthianura albifrons (White-fronted Chat)*			
121.	24368	*Eurostopodus argus (Spotted Nightjar)*			
122.		*Exosphaeroma sp.*			
123.	25621	*Falco berigora (Brown Falcon)*			
124.	25622	*Falco cenchroides (Australian Kestrel)*			
125.	25623	*Falco longipennis (Australian Hobby)*			
126.		*Forcypomyia sp. 6*			
127.		*Forcypomyia sp. 6 (PSW)*			
128.	25727	*Fulica atra (Eurasian Coot)*			
129.		*Gladioferens imparipens*			
130.	24735	*Glossopsitta porphyrocephala (Purple-crowned Lorikeet)*			
131.	24443	*Grallina cyanoleuca (Magpie-lark)*			
132.		*Habronestes bradleyi*			
133.	25627	*Haematopus fuliginosus (Sooty Oystercatcher)*			
134.	24487	*Haematopus longirostris (Pied Oystercatcher)*			
135.		*Halicyclops sp. 1 (nr ambiguus)*			
136.		*Halicyclops sp. 1 (nr ambiguus) (SAP)*			
137.		*Haloniscus searlei*			
138.		*Hemicordulia tau*			
139.		*Hemigomphus armiger*			
140.	25734	*Himantopus himantopus (Black-winged Stilt)*			
141.	24491	*Hirundo neoxena (Welcome Swallow)*			
142.		*Hygrobia wattsi*			
143.		*Hyphydrus elegans*			
144.		*Ilyocryptus smirnovi*			
145.		*Keratella australis*			
146.		*Kiefferulus intertinctus*			
147.		*Lancetes sp.*			
148.	25638	*Larus pacificus (Pacific Gull)*			
149.	24512	*Larus pacificus subsp. georgii (Pacific Gull)*			
150.		*Lecane hamata*			
151.	25131	*Lerista distinguenda*			
152.	24573	*Lichenostomus cratitius (Purple-gaped Honeyeater)*			
153.	25661	*Lichmera indistincta (Brown Honeyeater)*			
154.		*Limnocythere sp. 732 (n. sp.)*			Y
155.		*Limnocythere sp. 732 (n. sp.) (SAP)*			Y
156.	25383	*Litoria cyclorhyncha (Spotted-thighed Frog)*			
157.		*Macrodiplax cora*			
158.	24326	*Malacorhynchus membranaceus (Pink-eared Duck)*			
159.	24551	*Malurus pulcherrimus (Blue-breasted Fairy-wren)*			
160.	24583	*Manorina flavigula (Yellow-throated Miner)*			
161.	25663	*Melithreptus brevirostris (Brown-headed Honeyeater)*			
162.		*Mesochra baylyi*			
163.		*Mesocyclops brooksi*			
164.		*Mesostigmata sp.*			
165.		*Microcyclops varicans*			
166.		*Microsporus sp.*			
167.		*Monohelea sp. 1*			
168.		*Monohelea sp. 1 (SAP)*			
169.		*Monohelea sp. 3*			
170.		*Monohelea sp. 3 (SAP)*			
171.	24223	*Mus musculus (House Mouse)*	Y		

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
172.		*Muscidae sp. A (SAP)*			
173.	25610	*Myiagra inquieta (Restless Flycatcher)*			
174.		*Mytilocypris mytiloides*			
175.		*Mytilocypris tasmanica chapmani*			
176.		*Naididae (ex Tubificidae)*			
177.		*Necterosoma penicillatus*			
178.		*Nematoda sp.*			
179.	24739	*Neophema petrophila (Rock Parrot)*			
180.		*Newnhamia sp. 295 (south-west, SAP)*			
181.	25748	*Ninox novaeseelandiae (Boobook Owl)*			
182.		*Notalina spira*			
183.		*Notholca salina*			
184.		*Notoperata sp. AV4 (SFM)*			
185.	24407	*Ocyphaps lophotes (Crested Pigeon)*			
186.		*Onychocamptus bengalensis*			
187.		*Opisthopora sp.*			
188.	24618	*Oreoica gutturalis (Crested Bellbird)*			
189.		*Oribatida sp.*			
190.		*Orthocladiinae SO3 sp. A (SAP)*			
191.	25679	*Pachycephala pectoralis (Golden Whistler)*			
192.	25680	*Pachycephala rufiventris (Rufous Whistler)*			
193.		*Parachironomus sp. 1 (VSCL35)*			
194.		*Parachironomus sp. 1 (VSCL35) (SAP)*			
195.		*Paracyclops chiltoni*			
196.		*Paralimnocythere sp. 262 (south-west)*			
197.	25681	*Pardalotus punctatus (Spotted Pardalote)*			
198.	24626	*Pardalotus punctatus subsp. xanthopyge (Yellow-rumped Pardalote)*			
199.	25682	*Pardalotus striatus (Striated Pardalote)*			
200.	24648	*Pelecanus conspicillatus (Australian Pelican)*			
201.	25697	*Phalacrocorax carbo (Great Cormorant)*			
202.	24665	*Phalacrocorax fuscescens (Black-faced Cormorant)*			
203.	24667	*Phalacrocorax sulcirostris (Little Black Cormorant)*			
204.	25699	*Phalacrocorax varius (Pied Cormorant)*			
205.	24409	*Phaps chalcoptera (Common Bronzewing)*			
206.	25587	*Phaps elegans (Brush Bronzewing)*			
207.		*Philosciidae sp.*			
208.	24596	*Phylidonyris novaehollandiae (New Holland Honeyeater)*			
209.		*Phyrganoporus candidus*			
210.		*Pleuroxus cf. foveatus (SAP)*			
211.	25703	*Podargus strigoides (Tawny Frogmouth)*			
212.	25704	*Podiceps cristatus (Great Crested Grebe)*			
213.	24907	*Pogona minor subsp. minor (Dwarf Bearded Dragon)*			
214.	24681	*Poliocephalus poliocephalus (Hoary-headed Grebe)*			
215.		*Polypedilum nr. convexum (SAP)*			
216.		*Polypedilum nubifer*			
217.	24769	*Porzana fluminea (Australian Spotted Crake)*			
218.		*Procladius paludicola*			
219.	25259	*Pseudonaja affinis subsp. affinis (Dugite)*			
220.	24243	*Rattus fuscipes (Western Bush Rat)*			
221.	24776	*Recurvirostra novaehollandiae (Red-necked Avocet)*			
222.	30818	*Rhinoplocephalus bicolor (Square-nosed Snake)*			
223.	25614	*Rhipidura leucophrys (Willie Wagtail)*			
224.		*Rhombognathus marginalis*			
225.		*Rotaria sp.*			
226.		*S03 S03 sp. A*			
227.		*Sarscypridopsis aculeata*			
228.		*Sarscypridopsis aff. aculeata (165)*			
229.		*Sarscypridopsis aff. aculeata (165) (south-west, SAP)*			
230.		*Scaridium sp. Nov. (Pleasant View) (SAP)*			
231.		*Scatopsidae sp.*			
232.	25534	*Sericornis frontalis (White-browed Scrubwren)*			
233.	30948	*Smicrornis brevirostris (Weebill)*			
234.		*Spencerhydrus sp.*			
235.	24645	*Stagonopleura oculata (Red-eared Firetail)*			
236.	25655	*Stipiturus malachurus (Southern Emu-wren)*			
237.		*Stratiomyidae sp.*			
238.	25597	*Strepera versicolor (Grey Currawong)*			
239.	24943	*Strophurus spinigerus subsp. inornatus*			
240.		*Symphitoneuria wheeleri*			
241.		*Tabanidae sp.*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
242.	24331	*Tadorna tadornoides (Australian Shelduck, Mountain Duck)*			
243.		*Tanytarsus barbitarsis*			
244.		*Tasmanocoenis tillyardi*			
245.	24844	*Threskiornis molucca (Australian White Ibis)*			
246.	24845	*Threskiornis spinicollis (Straw-necked Ibis)*			
247.	25207	*Tiliqua rugosa subsp. rugosa*			
248.	25549	*Todiramphus sanctus (Sacred Kingfisher)*			
249.		*Trombidioidea sp.*			
250.	25577	*Vanellus miles (Masked Lapwing)*			
251.	24386	*Vanellus tricolor (Banded Lapwing)*			
252.	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

Phytophthora dieback hygiene category assessment criteria

Phytophthora dieback hygiene category assessment criteria

DPaW (2015) guidelines identify six potential disease hygiene categories based on presence/absence of the disease, or the unknown disease status of an area. An area can have an unknown disease status if the vegetation at the site is not susceptible to the disease or it cannot be assessed because of disturbance, eg fire. As a result, even if the pathogen is present, there may be no interpretable signs.

Only areas with suitable remnant native vegetation can be assessed. Areas that have been cleared or significantly altered are excluded from survey. In some cases small excluded areas may be afforded a hygiene category if they are small enough to be influenced by adjacent surveyed vegetation or situated such that topographical influences can be used to determine disease presence or absence.

The six possible disease categories are listed and described below:

1. **Infested –** Areas a registered interpreter determines to have plant disease symptoms consistent with the presence of *Phytophthora cinnamomi*.
2. **Uninfested –** Areas determined by a registered interpreter to be free of plant disease symptoms that indicate the presence of *P. cinnamomi*.
3. **Uninterpretable –** Natural, undisturbed areas where susceptible plants are absent, or are too few to make a determination of the presence or absence of *P. cinnamomi*.
4. **Temporarily uninterpretable –** Areas where disease presence or absence cannot be determined due to a level and type of site disturbance that will recover within the short to medium term, eg fire, rehabilitation.
5. **Not yet resolved –** *Phytophthora* occurrence diagnosis cannot be made because of inconsistent or incomplete evidence (including sample results). The category is only to be used in low interpretability zones (400mm to 600mm rainfall range).
6. **Disease risk roads (DRR) –** Interpreters will use the DRR category to show the disease status is unknown because of suspected or apparent recent use under unknown hygiene conditions.

Following the determination of disease categories, protectable areas are identified to determine areas that are likely to remain free from the disease with the application of appropriate disease hygiene as required.

Protectable areas are defined in the *Manual for Detecting and Mapping Phytophthora dieback disease (Draft)*, (DPaW, Jan 2015) as areas that:

- Have greater than 600mm of annual rainfall or are water gaining sites in the 400mm - 600mm rainfall zone;
- Are determined to be free from *Phytophthora cinnamomi* by a DPaW registered disease interpreter;
- Are positioned in the landscape and are of sufficient size that they will not be engulfed by *Phytophthora* via autonomous spread. Such an area is defined as being greater than 4ha with a minimum axis of 100m, and not down slope of an infested area;
- Have controllable human vectors; and
- Include high conservation and/or socio economic values.

Appendix E

VHS Certificate of Analysis – *Phytophthora* dieback samples

Department of Parks and Wildlife

Vegetation Health Service – Phytophthora sample information

FORM FEM046

CONTACT DETAILS of sender
Name Jeremy Spencer
Fax No. _____ Phone No. 0400 113 093
DPW Office or Company Name GS Bio Logic

Job Type (Please indicate)
Private

VHA use only
Date received 20/8/2015
Date faxed 2.9.15

GDA(1) GDA 94

SEND TO: Vegetation Health Service, Ecosystem Health Branch – Dept. Parks & Wildlife, 17 Dick Perry Ave, KENSINGTON 6151
Phone: (08) 9334 0317
Fax: (08) 9334 0114

VHS Identification Number (VHS USE ONLY)	Sample Date	*Sample label (Give location, eg. Forest Block or Shire, etc. and sample number)*	Plant species sampled	Site Impact (2)	Zone 50 or 51	Map Reference (3)	Land Tenure (4)	RESULT s/s root (5)	RESULT bait (5)
VHS33217	12-8-15	Merivale Rd 1	X. platyphylla	H	51	E 501528 N 6259228	R		CIN
VHS33218	12-8-15	Merivale Rd 2	X. platyphylla	H	51	E 501431 N 6259345	R		SUB?
						E _ _ _ _ _ _ N _ _ _ _ _ _ _			
						E _ _ _ _ _ _ N _ _ _ _ _ _ _			
						E _ _ _ _ _ _ N _ _ _ _ _ _ _			
						E _ _ _ _ _ _ N _ _ _ _ _ _ _			

NOTES:
1. Please tick this box if your map references are supplied in the **GDA 94** standard. If not, please specify the datum used.
2. Site impact - Low, Moderate, or High (as in the Dieback Interpreter's Manual).
3. An MGA map reference with prefixes **must** be supplied for all samples.
4. Land tenure - State Forest (SF), National Park (NP), Reserve (R), Westrail (W), Private (P), Gravel Pit (GP), or other. (Other - describe in comments below).
5. Result codes used – CIN = *Phytophthora cinnamomi*, MUL = *P. multivora*, CRY = *P. cryptogea*, PI = *P. inundata*, ARE = *P. arenaria*, ELO = *P. elongata*, THE = *P. thermophila*, PM = *P. megasperma*, PN = *P. nicotianae*, CON = *P. constricta*, NEG = negative, SUB = subcultured for further tests

Please Note: a). NEG results cannot be used to represent a total absence of *Phytophthora* in the sampled area. b). Information from your samples will be incorporated into the VHS database and map products, which may be made available to the public and third parties to be used for research and other purposes.

COMMENTS: