

Port Campbell Headland, Port Campbell, Victoria

Ecological Significance, Threats and Recommendations to manage ecological values, particularly the Southern Brown Bandicoot



Report for The Port Campbell
Community Group Inc.

December 2012



BeaconEcological

ACKNOWLEDGEMENTS

Beacon Ecological would like to acknowledge the following people for their contribution to the project:

- **Marion Manifold** (Port Campbell Community Group Inc.) for project and site information.
- **Hellmut Toelken** (Honorary Research Associate, Adelaide State Herbarium) for identifying a Port Campbell Guinea-flower *Hibbertia truncata* specimen.
- **Justine Smith** (PhD student, The University of Melbourne) for advice on the impacts of fire on Southern Brown bandicoot habitat.
- **The Department of Sustainability and Environment** for providing data from the Flora Information System (FIS) and Atlas of Victorian Wildlife (AVW).



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Report Version: FINAL V3 17 December 2012

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DISCLAIMER

The authors advise that the information presented in this report, including any management advice, has been prepared with all due diligence and care, and based on the best available knowledge and research.

However the authors take no responsibility for any loss, injury or financial damage resulting from the reliance and/or application of advice provided in the report.



Table of Contents

ACKNOWLEDGEMENTS	2
1 INTRODUCTION	5
1.1 Study Area	5
2 METHODOLOGY.....	6
2.1 Database Review	6
2.2 Mapping and Other Literature.....	6
2.3 Field Assessment.....	7
2.4 Limitations	8
3 ECOLOGICAL VALUES	9
3.1 Native Vegetation	9
3.2 Ecological Vegetation Classes	9
3.3 Significant Flora	13
3.4 Significant Ecological Communities	17
3.5 NaturePrint.....	17
3.6 Vegetation Quality Assessment	18
3.7 Fauna	19
3.8 Fauna habitat values	19
3.9 Significant fauna.....	19
4 ECOLOGICAL SIGNIFICANCE.....	25
5 MANAGEMENT RECOMMENDATIONS.....	26
5.1 Native vegetation.....	26
5.2 Significant Flora	27
5.3 Pest Plants	28
5.4 Pest Animals.....	29
5.5 Domestic Dogs.....	31
5.6 Public Access	31
5.7 Significant Fauna species and habitat (Southern Brown Bandicoot)	32
5.8 Corangamite Shire Council, Parks Victoria and the Department of Sustainability and Environment.....	35
5.9 Signage	35
FIGURES.....	36
Figure 1. Study Area Location	37
Figure 2. Ecological Vegetation Classes identified within the study area	38
Figure 3. Significant flora species previously recorded within a 10 kilometre radius of the study area	39
Figure 4. Significant fauna species previously recorded within a 10 kilometre radius of the study area	40

REFERENCES	41
APPENDICES	44
Appendix 1. Vegetation Condition and Habitat Quality.....	45
Appendix 2. Ecological Significance	46
Appendix 3. Flora recorded within the study area during the field assessment	48
Appendix 4. Fauna recorded within the study area during the field assessment and previous assessments	51
Appendix 5. Significant flora recorded within a ten kilometre radius of the study area	54
Appendix 6. Significant fauna recorded within a ten kilometre radius of the study area.....	56

1 INTRODUCTION

Beacon Ecological was engaged by the Port Campbell Community Group Inc. to undertake an ecological assessment and provide management recommendations for the Port Campbell Headland. The Port Campbell Community Group Inc. works to educate, foster appreciation, and improve, protect and conserve the Port Campbell headland's natural, cultural, social, and scientific values and the Port's long heritage as a working port and access to the Twelve Apostles Marine National Park and Arches Marine Sanctuary and Heritage Shipwrecks. The Group's activities aim to educate, protect, enhance and sustain the coastal and marine environment.

This document details ecological values within the study area and management actions to assist the Port Campbell Community Group Inc. to protect and enhance the ecological values within the Port Campbell Headland.

1.1 Study Area

The Port Campbell headland is located on the southern outskirts of the Port Campbell Township (VicRoads 2007, Ref 516C3). Port Campbell is located approximately 190 kilometres southwest of Melbourne (Figure 1). The study area is approximately 4.7 hectares in size and bounded by the ocean to the south, Hennessy Street and Cairns Street to the northeast. Residential dwellings, the Southern Ocean Motor Inn and a car park is present to the northwest of the study area. Vegetation within the headland is contiguous with the Parks Victoria managed Port Campbell National Park to the east.

The study area is generally flat with an undulating sandy area in the west. The southern boundary of the study area features steep cliffs to the ocean with sea caverns and karst tunnels. The study area is dominated by relatively intact native vegetation from three Ecological Vegetation Classes (EVCs). Introduced species cover is generally low.

Within the study area is a small war memorial (See cover photo) and the Great Ocean Road runs through the southern portion terminating in a car park. A network of walking tracks exists between the two car parks and out to a lookout at the headland. Fencing is present around the car park areas.

The majority of the study area is owned and managed by the Corangamite Shire Council with areas fringing the cliffs owned by the Victorian Department of Sustainability and Environment and managed by Parks Victoria.

The headland is zoned Public Conservation and Resource Zone (PCRZ) with a small section zoned Public Park and Recreation Zone (PPRZ) at the end of Hennessey Street under the Corangamite Shire Planning Scheme. No overlays pertaining to ecological values cover the study area (DSE 2012a). The study area is identified as an area of Aboriginal Cultural Sensitivity and is located within the Warrnambool Plain Bioregion and within the boundary of the Corangamite Catchment Management Authority (DSE 2012b).

2 METHODOLOGY

2.1 Database Review

The following Department of Sustainability and Environment (DSE) and Department of Sustainability, Environment, Water, Population and Communities (SEWPAC) databases were reviewed to obtain background information on the survey area:

- **Flora Information System** (FIS) for information on national and state significant flora species previously recorded within a ten-kilometre radius of the survey area (DSE 2012c).
- **Atlas of Victorian Wildlife** (AVW) for information on national and state significant fauna species previously recorded within a ten-kilometre radius of the survey area (DSE 2012d).
- **Protected Matters Search Tool** for information regarding matters of national environmental significance (listed flora and fauna species, ecological communities, Ramsar wetlands) within a ten-kilometre radius of the survey area (SEWPAC 2012a).
- **Biodiversity Interactive Mapping Tool** for pre-1750 (pre - European settlement) and 2005 (extant) native vegetation modeling and significant flora and fauna species previously recorded within a ten-kilometre radius of the survey area (DSE 2012b).
- **Planning Schemes Online** for information regarding planning provision overlays and zones pertaining to native vegetation and ecological values within the survey area (DSE 2012a).

2.2 Mapping and Other Literature

Relevant literature, such as DSE Bioregional Ecological Vegetation Class (EVC) Benchmarks, the *Biodiversity Assessment Component of the West Comprehensive Regional Assessment* (CVRFA 2000) and national/state/local policies and legislation were also reviewed as part of the investigation (DSE 2012e, DSE 2007, DSE 2009d). Aerial photography provided by Google Maps (2011) was used to develop a figure of the study area and during the field assessment (Figure 2). Further, researchers at the University of Melbourne and Deakin University were contacted to obtain information arising from recent studies on the Southern Brown Bandicoots ecology.

Other reviewed relevant literature includes:

- Legg, M. 2012 *Southern Brown Bandicoot, Biodiversity and Habitat Report Port Campbell Headland for Port Campbell Community Group Inc. & Port Campbell Boardriders Assoc.* Unpublished report by Mal's Environmental and Ecological Services for the Port Campbell Community Group Inc.
- Eddy, L. 2012. *Native Vegetation Assessment and Offset Management Plan. Port Campbell Walking Trail Realignment.* Unpublished report by Plume Consulting for the Corangamite Shire Council.

- Manifold, M. 2012. *Observations on the Southern Brown Bandicoot at Port Campbell, Victoria, using Fauna Survey Cameras.*
- Legg, M. 2011. *Flora and Fauna Expert Witness Statement by Malcolm Legg in relation to the proposed development at 1 Hennessy Street, Port Campbell.* Unpublished report for the Port Campbell Community Group Inc.
- Port Campbell Community Group 2008. *National Trust Listing Submission to the Victorian Environmental Assessment Council.*
- Barlow, T.J. 2003. *Proposed Car Park Extension, Beacon Point Port Campbell. Assessment of Habitat-Hectare Vales and Net Gain Requirements.* Unpublished report by Ecology Australia for the Corangamite Shire Council.
- Toelken, H. 1998. *Notes on Hibbertia (Dilleniaceae). 2. The H. aspera – Empetrifolia complex.* Journal of Adelaide Botanical Gardens 18(2): 107-160 (1998)

2.3 Field Assessment

Flora Survey

A field survey was undertaken on 10 October 2012 by a qualified botanist. The entire study area was traversed on foot. The general condition of any vegetation present was assessed with any locations of vegetation communities documented. All observed vascular flora species were recorded excepting planted species unless seen to be spreading naturally. Vegetation condition was assessed based on a number of criteria as outlined in Appendix 1. Potential threats and management actions were considered during the field assessment.

Fauna Survey

A field assessment was undertaken on 10th October 2012 by a qualified zoologist. The assessment included a daytime survey and habitat assessment. Weather conditions during the assessment were approximately 18 degrees Celsius with southwesterly winds and periods of light rain. The study area was visually assessed and traversed on foot. Fauna survey techniques employed included active searching for birds, mammals, frogs and reptiles and signs of their presence such as scats, diggings and nests.

The habitat assessment consisted of recording habitat features of the study area, such as vegetation, presence of waterbodies and hollow trees. Overstorey, understorey and groundcover vegetation type and structure were recorded. General quality of the habitats was assessed based on a number of criteria outline in Appendix 1.

2.4 Limitations

Limitations to the current investigation include:

Field surveys provide an indication of what is present at the time of survey (i.e. a 'snapshot') and as such may not include species that may be dormant or absent due to seasonal or climatic conditions. While the flora survey was undertaken during spring, considered the optimal time to undertake flora surveys, some species may be dormant or not displaying diagnostic characteristics at the time of survey. Additional species may be recorded within the study area during assessments undertaken at alternative times of the year or during a prolonged time in the field.

The accuracy and level of detail presented in this report is by and large determined by the availability of information gathered from records of past fauna and flora surveys. Some flora and fauna data may not be readily available or may not be site specific. Therefore, many of the species identified by database information as occurring in the ten kilometre search area may not occur within the survey area due to site environmental conditions including the disturbance history, management practices and species habitat preferences.

As a result of the length and timing of the field survey (i.e. of a short duration and during winter) some migratory, transitory, uncommon or hibernating fauna species that utilise the study area may not have been detected during the field assessment. It is therefore possible that additional fauna species may have been detected within the study area and surrounds over a longer period of time and during a different time of year.

EPBC Act listed migratory and marine species and Invertebrates other than those listed in the 10 km AVW search were not considered in the assessment.

Detailed night-time frog surveys, nocturnal bird surveys or mammal trapping were not undertaken during the current assessment as this was beyond the scope of the study. A number of vertebrate fauna species are likely to occupy habitats within the study area and surrounds, which may not have been recorded during the current survey.

Threatened fauna species, due to their cryptic behaviour and generally low population numbers, may have been missed during the current assessment. Potential for their occurrence was determined from the habitat assessment and from discussions with Marion Manifold, Port Campbell Community Group Inc., who has been using remote cameras to record Southern Brown Bandicoots in the area.

However, the survey effort and review of existing relevant information including collected photos and data from the study area is considered sufficient to provide an indication and assessment of the ecological values within the survey area.

3 ECOLOGICAL VALUES

3.1 Native Vegetation

During the field assessment 92 flora species were recorded within the study area during the wandering transect (Appendix 3). Of these, 56 are native species and 36 are considered exotic.

Vegetation within the study area is generally of good condition. See Appendix 1 for condition descriptions.

3.2 Ecological Vegetation Classes

Department of Sustainability and Environment pre-1750 and 2005 vegetation modeling indicates Coastal Tussock Grassland (EVC 163) vegetation likely to be present fringing the coastal cliffs and Damp Heath Scrub (EVC 165) in the triangle area bounded by Hennessy Street and Cairns Street (DSE 2012b).

Barlow (2003) and Legg (2012) identify a mix of Coastal Headland Scrub and Coastal Tussock Grassland vegetation at the western end of the study area and Coastal Tussock Grassland in the east. Eddy (2012) identifies small sections of Coastal Dune Scrub (EVC 160) within the proposed walking track realignment in the west of the study area,

The current field assessment identified vegetation with affinities to Coastal Tussock Grassland (EVC 163), Coastal Headland Scrub (EVC 161) and Damp Heath Scrub (EVC 165) within the study area (Figure 2). Given the similarities in some of the species represented between these EVCs vegetation types, ecotones between them are likely to be encountered. The identified EVCs were selected for the following reasons:

Vegetation that is *dominated by Coastal Tussock-grass Poa poiformis* (DSE 2012e) with emergent shrubs is considered to be allied most closely to Coastal tussock Grassland. This vegetation type was identified fringing the cliffs in the eastern part of the study area and between the car parks in the west (Figure 2).

Coastal Headland Scrub was selected for *shrub dominated vegetation growing on shallow sands in association with rock sections of headland* (DSE 2012e). This vegetation type was noted in the western portion of the study area (Figure 2).

Damp Heath Scrub was selected for vegetation dominated by *shrub species on flat to gently sloping terrain* (DSE 2012e). Within the study area, vegetation mapped as Damp Heath Scrub is quite low (approximately one metre and forms an eco-tone with Coastal Tussock Grassland). However Damp Heath Scrub was selected, as native shrubs are clearly the dominant vegetation structure. This vegetation type was noted in the triangle area bounded by Hennessy Street and Cairns Street (Figure 2).

Descriptions of these vegetation types within the study area are described below.

Coastal Tussock Grassland (EVC 163)

Bioregional Conservation Status: Vulnerable

Coastal Tussock Grassland occurs on cliff-top plateaus affected by sea spray. The soils are poorly structured with sands over bedrock that can only support shallow-rooted plants. Water availability at depth is often good due to the proximity of bedrock. Harsh site quality encourages stunted and poorly-formed plants (CVRFA 2000).

Within the study area Coastal Tussock Grassland is located on the southern edge of the study area beside the extension of the Great Ocean Road and between the two car parks in the west (Figure2).

Within the study area Coastal Tussock Grassland is dominated by a ground layer of Coast Tussock-grass *Poa poiformis* with emergent wind pruned Coast Beard-heath *Leucopogon parviflorus*, Coast Daisy-Bush *Olearia axillaris* and Coast Everlasting *Ozothamnus turbinatus* (Plate 1). Other smaller shrubs present include Manuka *Leptospermum scoparium*, Sea Box *Alyxia buxifolia*, Common Correa *Correa reflexa* and the state significant Oval-leaf Logania *Logania ovata* (Listed on the DSE Victorian Rare and Threatened Advisory list as rare, (DSE 2007). Additional herbs and graminoids present include Bidgee-widgee *Acaena novae-zelandiae*, Shiny Swamp-mat *Selliera radicans*, Coast Saw-sedge *Gahnia trifida*, Nodding Club-sedge *Isolepis cernua*, Black-anther Flax-lily *Dianella admixta*, Australian Salt-grass *Distichlis distichophylla* and Coast Sword-sedge *Lepidosperma gladiatum*. Weed cover is less than 5% and includes Buffalo Grass *Stenotaphrum secundatum*, Mirror Bush *Coprosma repens*, Ribwort *Plantago lanceolata* and Karo *Pittosporum crassifolium*. This area also supports small areas naturally devoid of vegetation dominated by a surface of ferruginous buckshot concretions. Woody species display adequate levels of recruitment and leaf litter is of the benchmark specification.



Plate 1. Coastal Tussock Grassland vegetation within the study area

Coastal Headland Scrub (EVC 161)

Bioregional Conservation Status: Vulnerable

Coastal Headland Shrubland occurs in exposed situations on the limestone plains of coastal cliffs at Port Campbell and arkose sandstone cliffs at Cape Otway. The vegetation is often wind and salt-pruned due to exposure to prevailing south-west winds and salt spray (CVRFA 2000).

Coastal Headland Scrub is located in sandy areas at the western end of the study area in locations where there is some shelter from the prevailing south west winds to allow shrub growth (Figure 2).

Within the study area Coastal Headland Scrub is dominated by a shrub overstorey of Coastal Beard-heath, Coast Everlasting, Sea-box and Common Boobialla *Myoporum insulare*. The understorey supports a range of smaller shrubs including Seaberry Saltbush *Rhagodia candolleana* subsp. *candolleana*, Cushion Bush *Leucophyta brownii* and the state significant Port Campbell Guinea-flower *Hibbertia truncata* (Listed on the DSE Victorian Rare and Threatened Advisory list as rare). Other native graminoids and herbs include Small-fruit Fan-flower *Scaevola albida*, Honey-pots *Acrotriche serrulata*, Dune Groundsel *Senecio spathulatus* s.l., Coast Tussock-grass, Spear Grass *Austrostipa* spp., Black-anther Flax-lily, Australian Salt-grass and Coast Sword-sedge. Weed cover is less than 5% comprising Buffalo Grass, Mirror Bush and Soursob *Oxalis pes-caprae*.



Plate 2. Coastal Headland Scrub within the study area

Damp Heath Scrub (EVC 165)

Bioregional Conservation Status: Vulnerable

Damp Heath Scrub occurs on flat to gently sloping terrain, on or near coastal sites near Port Campbell and in a number of widely distributed locations including Cooriemungle and Jancourt Forest/Hanson Plain public land blocks (CVRFA 2000). This vegetation type is generally a shrubland to three metres tall with occasional emergent eucalypts. Generally high rainfall and lack of drainage combine to retain high levels of moisture throughout the year (DSE 2012e).

Within the study area Damp Heath Scrub is dominated by a mix of low growing native shrub species approximately one metre high including Coastal Beard-heath, Coast Everlasting, Common Boobialla, Manuka, Sea-box and Rough Guinea-flower *Hibbertia aspera*. Other native ground cover species include Bidgee-widgee, Coast Tussock-grass, Ivy-leaf Violet *Viola hederacea*, Black-anther Flax-lily, Common Bog-sedge *Schoenus apogon*, Australian Salt-grass, Nodding Club-sedge, Weeping Grass and Honey-pots. Weed cover is less than 5% cover with a variety of introduced species present including Mirror bush, Karo, Ribwort, Coast Banksia *Banksia integrifolia* and Common Centaury-weed *Centaureum erythraea*. Other introduced species are present along the Cairns Road edge include Great Brome *Bromus diandrus*, *Gazania* *Gazania linearis*, Cocksfoot *Dactylis glomerata*, Milkwort *Polygala myrtifolia* and Agapanthus *Agapanthus praecox*. Recruitment is adequate for all native woody species.



Plate 3. Damp Heath Scrub within the study area

3.3 Significant Flora

No nationally significant flora species were recorded within the study area during the field assessment. Two state significant flora species, Oval-leaf Logania and Port Campbell Guinea-flower, both listed as rare (DSE 2009d), were recorded within the study area during the current survey.

Appendix 4 presents flora species of conservation significance previously recorded within a ten kilometre radius of the survey area by the FIS, the Protected Matters Search Tool and the Biodiversity Interactive Map (DSE 2012b, SEWPAC 2012a, DSE 2012c).

National

Five flora species of national significance have previously been recorded within a ten-kilometre radius of the study area by the FIS (DSE 2012b) (Appendix 3). Three additional species, listed under the *Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)* are predicted to occur, or have habitat predicted to occur within a ten kilometre radius of the survey area (SEWPAC 2011), (Appendix 4).

Given habitat requirements and locations of previous records there is potential habitat within the study area for the Metallic Sun-orchid *Thelymitra epipactoides*. While the field survey was undertaken during the flowering time for this species, this species does not flower every year and a transect assessment was not undertaken meaning that the species may have been missed or absent at the time of survey

Metallic Sun-orchid *Thelymitra epipactoides*

EPBC Act: Endangered

FFG Act: Listed

DSE VROT: Endangered

This species grows in a strong, upright manner between 6 and 60 centimetres high. The single leaf is long and fleshy, lance-shaped at the end but tube-like at the base. Flower spikes comprise between 5 and 20 flowers. Flower colour is a peculiar iridescent greyish-green with pinkish tints, sometimes brown with a metallic lustre. Flowers September to December opening freely on sunny, hot days (Walsh and Entwisle 1994).

The Metallic Sun-orchid grows primarily in mesic coastal heathlands, grasslands and woodlands, but also found in drier inland heathlands, open forests and woodlands. Substrates may be moist or dry sandy loams or loamy sands. Critical habitat has not been determined but likely to require open conditions, which may be created by soil disturbance or fire, for recruitment (DSE 2003).

Numerous records of this species are identified within one kilometre to the east of the study area and has potential to occur within the study area (Figure 3).

State



Two flora species of state significance, Oval-leaf Logania and Port Campbell Guinea-flower, both listed as rare (DSE 2009d), were recorded within the study area during the field assessment.

Twenty-eight additional flora species of state significance have previously been recorded within a ten kilometre radius of the survey area (DSE 2012c) (Appendix 4). Given the extent of the survey effort and presence of high quality coastal grassland, shrub and heathland the study area provides potential habitat for five species within the study area. Descriptions of these and their habitat requirements are provided below.

Oval-leaf Logania *Logania ovata*

EPBC Act: Not listed

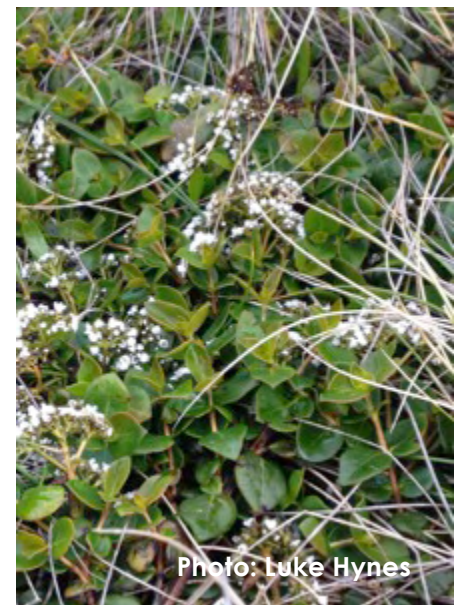
FFG Act: Not listed

DSE VROT: Rare

An erect shrub (0.5 to 2 metres high) with glabrous to minutely papillose branches. Leaves are sub sessile with petiole less than 0.8 millimetres long, lamina somewhat thickened, broadly ovate to ovate. Inflorescence a terminal panicle usually foliose, many flowered, unisexual (Walsh and Entwisle 1999).

This species is generally confined to southwestern coasts near Portland, Port Fairy and near Peterborough where occasionally found on sandy soils. Flowers August to November (Walsh and Entwisle 1999). Thirty eight records of this species have been identified by the FIS within a ten kilometre radius of the study area (DSE 2012c).

Within the study area numerous specimens of this species were noted near the cliff edge within Coastal Tussock Grassland vegetation.



Port Campbell Guinea-flower *Hibbertia truncata*

EPBC Act: Not listed

FFG Act: Not listed

DSE VROT: Rare

Shrublets with decumbent to prostrate branches up 0.4 metres high, more or less densely branched, pubescent to tomentose. Vestiture on branches and calyx persisting, with few larger multiangulate radial stellate hairs. Flowers abruptly constricted into peduncle (buds broadly ellipsoid before opening), often terminal on short shoots and usually subtended by 2 or 3 subwhorled leaves. Flowers September to November (Toelken 1998).

FIS records indicate that 39 previous records of this species are within ten kilometres of the study area. One specimen of this species taken from Coastal Headland Scrub at the western end of the study area was sent to



Photo: Toelken (1998)

Hellmut Toelken, Honorary Research Associate at the Adelaide State Herbarium for species confirmation. There are likely more occurrences of this species within the study area.

Scented Spider Orchid *Caladenia fragrantissima*

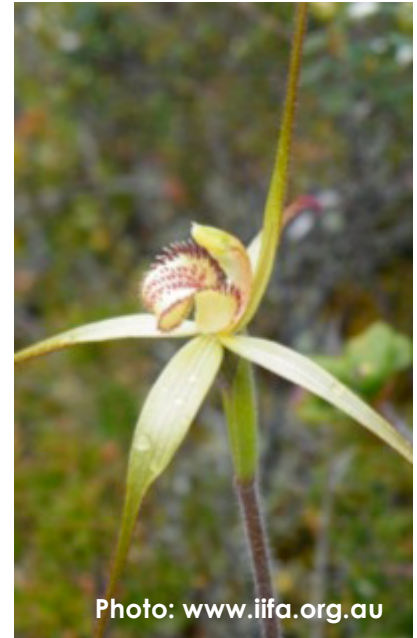
EPBC Act: Not listed

FFG Act: Listed

DSE VROT: Endangered

A flowering plant 15 to 27 centimetres tall with a 6 to 25 centimetre long leaf. Flowers usually solitary, sometimes 2 or 3 per plant. Perianth segments are green with blackish granular tips. Sepals are flattened at base, abruptly tapered to a long tail densely covered with glands and glandular hairs. The labellum is curved forward with the apex recurved and lateral lobes erect. The lamina is ovate, obscurely 3 lobed (Walsh and Entwisle 1994).

This species is generally known only from far south west Victoria between Nelson and Portland and in southern Gippsland. It grows in coastal and near coastal heath or heathy woodland flowering between October and November. There is one previous record of this species approximately 300 metres west of the study area on the opposite headland (Figure 3). Given the presence of intact coastal heath (Damp Heath Scrub) the study area supports potential habitat for this species.



Coast Stork's-bill *Pelargonium littorale*

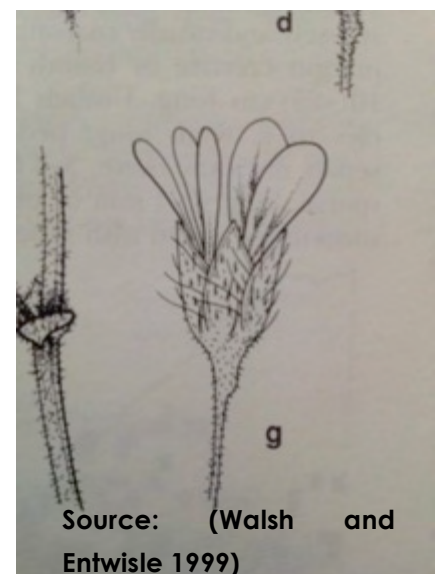
EPBC Act: Not listed

FFG Act: Not listed

DSE VROT: Poorly known

Erect to ascending perennial to approximately 40 centimetres high. Stems, peduncles and pedicels pilosa with long and short glandular hairs and shortly stalked or sessile glands. Taproot is fleshy or fibrous. Leaves are opposite, lamina ovate-cordate to 6 centimetres long and wide. Entire or shallowly lobed and usually coarsely hairy to glabrescent. Umbels 2 to 7 flowered, flowering October to April (Walsh and Entwisle 1999).

Scattered but rather uncommon, usually near coastal on sandy soils. (Walsh and Entwisle 1999). FIS records indicate two previous records within a 10 kilometre radius (DSE 2012c). One record is approximately four kilometres to the west in Damp Heath Scrub (DSE 2012b).



Lax Twig-sedge *Baumea laxa*

EPBC Act: Not listed

FFG Act: Not listed

DSE VROT: Rare

Slender tufted perennial with short rhizome. Culms rigid, subterete to biconvex, nodeless, striate, glabrous, smooth, 20 to 55 centimetres high, 1 to 2 millimetres in diameter. Inflorescence oblong in outline, loose with distant drooping branches to 20 centimetres long. Spikelets few, 3 to 5 flowered, glumes red brown, smooth or minutely glabrous, margins with scattered cilia. Flowers during spring (Walsh and Entwisle 1994)

Rare, confined to a few sites in the southwest (Portland – Nelson Area, Port Campbell National Park) and the northern part of Wilsons Prom. Occurs in wet sandy areas in heathlands and heathy swamps (Walsh and Entwisle 1994). The FIS identifies five previous records within a ten kilometre radius. One record is approximately 1.5 kilometres east of the study area (DSE 2012c). Given the presence of intact coastal heath (Damp Heath Scrub) the study area supports potential habitat for this species.



Source: (Walsh and Entwisle 1994)

Southern Xanthosia *Xanthosia tasmanica*

EPBC Act: Not listed

FFG Act: Not listed

DSE VROT: Rare

A weak or ascending herb, 15 to 20 centimetres high, covered by sparse spreading hairs. Leaves are alternate, 4 to 15 millimetres long and 15 to 30 millimetres wide, usually glabrescent, ternately dissected to 5 segmented. Inflorescence simple or compound, leaf opposed, sessile or shortly pedunculata. Petals to 1.5 millimetres long white. Flowers during spring and summer (Walsh and Entwisle 1994).

Occurs mainly in coastal areas in heath on sand (Walsh and Entwisle 1994). One previous record occurs approximately 1.5 kilometres west of the study area (DSE 2012c). Given the presence of intact coastal heath (Damp Heath Scrub) the study area supports potential habitat for this species.



Source:
www.yarraranges.vic.gov.au

Swamp Diuris *Diuris palustris*

EPBC Act: Not listed

FFG Act: Listed

DSE VROT: Rare

Flowering Plant slender 6 – 22 centimetres tall. Leaves 8 to 15, narrow, subterete, 6 – 13 centimetres long. Flowers erect, 1 to 4, yellow, blotched with dark brown, darker on outer surface, faintly spice scented. Flowers between August and October (Walsh and Entwisle 1994).

This species is scattered throughout western Victoria in a range of habitats. Six records have been previously identified through the FIS with one record less than 500 metres east of the study area.



Photo: Ian Edwards

3.4 Significant Ecological Communities

A review of information and databases maintained by DSE and SEWPAC identified the following ecological communities as occurring within the study area or within a ten kilometre radius of the study area.

Ramsar Wetlands (Listed under the EPBC Act)

The Protected Matters Search Tool identified the survey area is not within the catchment of any Ramsar Wetlands of International Significance.

Ecological Communities (Listed under the EPBC Act)

The Protected Matters Search Tool did not identify any threatened ecological communities within the study area or within a ten kilometre radius of the study area.

Ecological Communities (Listed under the Flora and Fauna Guarantee Act 1988 (FFG Act))

Vegetation and habitat present within the study area is not considered to form part of any threatened flora and fauna communities listed under the FFG Act.

3.5 NaturePrint

NaturePrint mapping identifies areas that contribute most to protecting the full range of biodiversity values, and identifies the relative contribution of all areas to protecting the full range of biodiversity values. The analysis behind the mapping incorporates the best information available through DSE databases on the species distribution for all Victorian plants and animals combined with habitat connectivity and recoverability layers. It explicitly considers rare and threatened species site records (DSE 2012b).

NaturePrint mapping indicates that the study area provides a high contribution to natural values (DSE 2012b).

3.6 Vegetation Quality Assessment

A Vegetation Quality Assessment (habitat hectare assessment) was undertaken within the study area to determine the conservation significance. Three Habitat Zones (HZ) from three vegetation types were identified within the study area during the VQA as described in Section 3.2. The habitat hectare scores are detailed below in Table 1. No scattered trees or Large Old Trees were identified within the study area (Figure 2).

Table 1. Vegetation Quality Assessment results

Habitat Zone			CTG1	CHS1	DHS1
EVC Name			Coastal Tussock Grassland	Coastal Headland Scrub	Damp Heathy Scrub
EVC Number			163	161	165
Bioregion Conservation Status			Vulnerable		
Bioregion			Warrnambool Plain Bioregion		
Max Score					
Site Condition	Large Trees	10	N/A	N/A	N/A
	Canopy Cover	5	N/A	N/A	N/A
	Understorey	25	15	20	20
	Lack of Weeds	15	13	13	11
	Recruitment	10	10	10	10
	Organic Litter	5	5	5	5
	Logs	5	N/A	N/A	N/A
Landscape Context [^]		25	16	16	16
Habitat Score		100	74.48	81.28	78.56
Habitat Score/100			0.75	0.81	0.79
Conservation Significance	Conservation Status X HS		Very High	Very High	Very High
	Threatened Species Rating*		Very High	Very High	Very High
	Other site Attribute Rating		N/A	N/A	N/A
	Overall Conservation Significance		Very High	Very High	Very High

Notes:

N/A = Not applicable,

HZ = Habitat Zone, # Rounded to two decimal points (DSE 2006),

[^] Value taken from Biodiversity Interactive Map (DSE 2012c),

* See section 3.4 and 3.9 for threatened species rating determinations.

3.7 Fauna

The Atlas of Victorian wildlife (DSE 2012d) has records of 206 species of bird, 35 species of mammal, seven species of frog, 13 species of reptile, 13 species of fish and two species of invertebrate within a 10 km radius of the study area (Appendix 6). During the field assessment, 23 fauna species were recorded including 19 bird species (16 native and three introduced species) and four mammal species (two native and two introduced species). All except one mammal, the Short-beaked Echidna, were detected indirectly through scats and diggings. Previous surveys have recorded many more fauna species from the site including 59 and 68 native species in October 2011 and September 2012 respectively (Legg 2011, 2012).

3.8 Fauna habitat values

The main habitat type throughout the study area is coastal heathy scrub and tussock grassland (See Section 3.2 for vegetation descriptions). According to the DSE Biodiversity Interactive mapping and aerial photography, these habitat types continue to the east and west of the study area and join with the Port Campbell National Park. Connectivity exists and is good towards east along the coast. Connectivity to habitats towards west is fragmented by roads and housing. Fauna habitat in the study area is dissected east-west by a bitumen road. Vehicle and walking tracks also traverse the habitat.

Overall the habitat is considered to be of high quality to native vertebrate fauna due to the presence of intact vegetation and habitat links to the Port Campbell National Park.

3.9 Significant fauna

Appendix 6 lists fauna species of conservation significance that have been previously recorded within a 10 km radius of the study area by the AVW (DSE 2012d). This table also lists nationally threatened species, which may occur or for which potential habitat may occur in the study area, as predicted by the Protected Matters Search Tool (SEWPAC 2012a). EPBC Act listed migratory and marine species are not included in this table.

National

One nationally significant fauna species was recorded within the study area during the field assessment – the Southern Brown Bandicoot. This species was judged to be present from the characteristic conical diggings that were found throughout the study area (Triggs 1996). The Southern Brown Bandicoot is known to inhabit the area due to evidence from remote cameras employed at the site between January 2010 and May 2012 (Manifold 2012) and has also been recorded in other recent surveys (Legg 2011, 2012).

An additional eight fauna species of national significance, listed under the EPBC Act have previously been recorded within a 10 km radius of the study area (DSE 2012d): Orange-bellied Parrot, Southern Right Whale, Black-browed Albatross, Growling Grass Frog, Humpback Whale, Long-nosed Potoroo, Fairy Prion and Shy Albatross. The Protected Matters Tool identified a further 28 species that may occur or for which habitat may occur in the study area. These species are listed below:

- **Mammals:** Southern Bent-wing Bat, Blue Whale, Smoky Mouse, Southern Brown Bandicoot, Southern Right Whale, Spot-tailed Quoll, Grey-headed Flying-fox, Humpback Whale, Long-nosed Potoroo;
- **Birds:** Orange-bellied Parrot, Amsterdam Albatross, Australasian Bittern, Grey-headed Albatross, Northern Royal Albatross, Swift Parrot, Tristan Albatross, Australian Painted Snipe, Black-browed Albatross, Blue Petrel, Buller's Albatross, Campbell Albatross, Gibson's Albatross, Northern Giant-Petrel, Southern Giant-Petrel, Fairy Tern, Salvin's Albatross, Shy Albatross, Southern Royal Albatross, Soft-plumaged Petrel, Wandering Albatross, Fairy Prion, Malleefowl;
- **Frogs:** Growling grass Frog
- **Reptiles:** Loggerhead Turtle, Leathery Turtle
- **Fish:** Australian Grayling, Dwarf Galaxias, Great White Shark

The majority of the above species are oceanic and very unlikely to occur in the study area. The oceanic bird species (albatrosses, giant-petrels and petrels) may occasionally be blown on-shore by strong winds, but are not likely to occur in the study area regularly. The study area contains no or very limited habitat for the majority of the EPBC Act listed species identified as occurring or potentially occurring there.

Species for which habitat exists within the study area include:

Malleefowl *Leipoa ocellata*

EPBC Act: Vulnerable

FFG Act: Listed

DSE VROT: Endangered

The Malleefowl inhabits woodlands and shrublands in arid and semi-arid regions of Australia (Benshemesh 2007, Higgins and Davies 1993). It has also been found to occur in coastal areas in south western Australia in heath and mallee-heath vegetation (Higgins and Davies 1993). In Victoria, Malleefowl occurs in mallee scrub vegetation in the north-western part of the state and has not been recorded from coastal habitats (Emison et al. 1987). It is very unlikely to occur in the study area.

Long-nosed Potoroo *Potorous tridactylus tridactylus*

EPBC Act: Vulnerable

FFG Act: Listed

DSE VROT: Endangered

The Long-nosed Potoroo has been recorded once within the 10 km AVW search area, in Peterborough in 1979. This species inhabits wet forest and scrub habitats with dense understorey in Victoria (Menkhorst 1995). There are two known regions of occurrence for this species near the study site: the south-western region and Otways (SEWPAC 2012b). Port Campbell and the study site is situated in between these regions. The known habitats in the south-western and Otways regions include eucalypt forests and woodlands. In the Otways, the shrub layer consisted of *Acacia verticillata* and *Banksia marginata*

(SEWPAC 2012b). In other regions within the state, including the Grampians, Western Port and Wilsons Prom the species has been mostly found in heath-woodland habitats. The study area contains some shrub layer species that are characteristics of some of the habitats the Long-nosed Potoroo is found in across Victoria, however, eucalypt overstorey is missing. It is unlikely that the Long-nosed Potoroo would regularly occur in the study area, although it may rarely visit.

Smoky Mouse *Pseudomys fumeus*

EPBC Act: Endangered

FFG Act: Listed

DSE VROT: Endangered

The Smoky Mouse is a small native mouse, which has a patchy distribution in Victoria (Menkhorst and Broome 2006, Menkhorst 1995). Smoky Mouse occurs in a range of vegetation communities including coastal heath and heathy woodlands and open forests (Menkhorst 1995, 2003). Floristic understorey diversity appears to be important, with plant species in the families Epacridaceae, Fabaceae and Mimosaceae being present at sites where Smoky Mouse occurs (Menkhorst and Broome 2006). Populations of this species in the state are fragmented and the nearest records to the study area are from the Otway Ranges (Menkhorst and Broome 2006). The Otway Ranges population is thought to have become recently extinct with no individuals recorded there since 1985 (Menkhorst and Broome 2006). Although potentially suitable habitat for the Smoky Mouse does exist in the study area, it is considered unlikely to occur there on the basis of its current distribution in Victoria, distance from the Otway Ranges records and the likely decline and extinction of the nearest population there.

Spot-tailed Quoll *Dasyurus maculatus*

EPBC Act: Endangered

FFG Act: Listed

DSE VROT: Endangered

Although the Spot-tailed Quoll inhabits forest and woodlands, they may utilise other habitats including heathlands while undertaking long distance movements (Backhouse 2003). The nearest known areas where the Spot-tailed Quoll occurs include Otway Ranges to the east and Mount Eccles to the west of the study area (Backhouse 2003). This species is unlikely to regularly occur in the study area, but may rarely utilise it while moving between suitable habitats.

Southern Brown Bandicoot *Dasyurus maculatus*

EPBC Act: Endangered

FFG Act: Invalid or ineligible

DSE VROT: Near Threatened

The Southern Brown Bandicoot is known to occur and breed in the study area. Numerous individuals have been recorded by Marion Manifold in the last two years using remote cameras (Marion Manifold pers. comm.), (Plate 4). Additionally, the AVW has 14 records from the 10 km search area (see Figure 4). This species occurs in isolated populations along coastal areas in Victoria as well as the Grampians and

Dandenong Ranges (Menkhorst 1995). The Southern Brown Bandicoot populations in Victoria have declined and suffered from range contractions due to agricultural and urban development (Menkhorst 1995). Loss of suitable habitat due to vegetation clearance and predation by the introduced Red Fox and cats are thought to be main reasons for declines.

Southern Brown Bandicoots inhabit heath, shrubland, heathy forest, woodland and sedgeland (SEWPAC 2012b, Menkhorst 1995). Structure and dense ground cover is thought to be more important than floristics of vegetation in their habitat (SEWPAC 2012b). Suitable habitat has been defined to contain understorey vegetation in the 0.2-1 meter range with 50-80% average foliage density (SEWPAC 2012b) and may consist of native or exotic vegetation within their distributional range. Mosaics of different successional stages of vegetation have been recommended to be incorporated into Southern Brown Bandicoot habitat management (SEWPAC 2012b).

Southern Brown Bandicoots nest and shelter in dense vegetation using leaves and grass as nesting material (SEWPAC 2012b). Logs may also provide nesting and sheltering habitat. There is some evidence that Southern Brown Bandicoots may utilise burrows made by other species (SEWPAC 2012b). The species is omnivorous and its diet consists of invertebrates, hypogaeal fungi, seeds and plants (Menkhorst 1995).



Plate 4. Southern Brown bandicoot captured by remote sensor camera by Marion Manifold on 21/2/2011

State

One species of state significance, the Rufous Bristlebird, was recorded during the field assessment. Three other species of state significance have been recorded in previous surveys: Pied Cormorant, Pacific Gull, White-bellied Sea Eagle and Swamp Antechinus (Legg 2011, 2012).

In addition, thirty one fauna species of state significance listed by DSE or the National Action Plans as rare or threatened, have previously been recorded within a 10 km radius of the study area (DSE 2012d). Most of these are species that rely on wetland habitat, which is absent in the study area. The study area provides habitat for the following species:

- **Birds:** Ground Parrot, Chestnut-rumped Heathwren
- **Mammals:** Swamp Antechinus, White-footed Dunnart
- **Frogs:** Southern Toadlet
- **Reptiles:** Swamp Skink

Ground Parrot *Pezoporus wallicus wallicus*

EPBC Act: Not listed

FFG Act: Listed

DSE VROT: Endangered

The Ground Parrot inhabits heathlands and dense sedgelands along the Victorian coast. Known populations exist in East Gippsland, Wilsons Promontory the Otway Ranges and near Nelson. There is one record of this species in the 10 km AVW search area from 1927. This species used to be more wider spread in Victoria, but urban and agricultural development have resulted in loss of habitat and reduction or elimination of populations around the coast. Although some suitable habitat in the study area exists, this species is unlikely to occur there due to low reporting rate in the wider region.

Chestnut-rumped Heathwren *Calamanthus pyrrhopygius*

EPBC Act: Not listed

FFG Act: Listed

DSE VROT: Vulnerable

There is some potential habitat for the Chestnut-rumped Heathwren, which is known to inhabit wet heath and scrub vegetation (Atlas of Vic birds). It is considered likely that this species may occur in the study area on occasion.

Swamp Antechinus *Antechinus minimus maritimus*

EPBC Act: Not listed

FFG Act: Listed

DSE VROT: Near Threatened

Swamp Antechinus is known to occur and breed in the study area. This species inhabits wet heath, grassland or sedgeland with dense vegetation. In heathy habitats, open ground vegetation with dense low cover to two metres is preferred (Menkhorst 1995).

White-footed Dunnart *Sminthopsis leucopus*

EPBC Act: Not listed

FFG Act: Listed

DSE VROT: Near Threatened

The White-footed Dunnart occurs in a variety of habitat types across its range in Victoria, including coastal tussock grassland, sedgeland and wet heath with a dense understorey or mid-storey (Menkhorst 1995). Given the proximity of a number of recent records, it is considered likely that this species would occur in the study area.

Southern Toadlet *Pseudophryne semimarmorata*

EPBC Act: Not listed

FFG Act: Not listed

DSE VROT: Vulnerable

Swamp Skink *Egernia coventryi*

EPBC Act: Not listed

FFG Act: Listed

DSE VROT: Vulnerable

The Southern Toadlet and the Swamp Skink have been recorded in some habitat types, which occur within the study area. Southern Toadlet inhabits a range of habitats in Victoria including heath vegetation (Robinson 1993). It utilises leaf litter and other ground cover as shelter and requires presence of water for breeding. Swamp Skink is associated with swamps, watercourses, wet heaths and sedgelands (Robertson 2007). Although the study area lacks wetland habitat these two species may occur there during wetter parts of the year.

Regional

No species of regional significance were recorded during the field assessment. Fifteen fauna species of regional significance listed by DSE as threatened have previously been recorded with a 10 km radius of the study area. Most of these are species that rely on wetland habitat, which is absent in the study area (Appendix 6). There is some suitable habitat for the following species, in particular during wetter parts of the year:

- **Birds:** Brown Quail, Latham's Snipe
- **Reptiles:** Glossy Grass Skink.

4 ECOLOGICAL SIGNIFICANCE

The study area supports intact native vegetation of Very High conservation significance and is considered to be of **national** significance. See Appendix 2 for the criteria for defining site significance.

The study area is considered to be of national significance as it supports:

- Coastal Headland Scrub (a *vulnerable* EVC for the Warrnambool Plain Bioregion) vegetation of Very High conservation significance;
- Coastal Tussock Grassland (a *vulnerable* EVC for the Warrnambool Plain Bioregion) vegetation of Very High conservation significance;
- Damp Heath Scrub (a *vulnerable* EVC for the Warrnambool Plain Bioregion) vegetation of Very High conservation significance;
- Known populations of two state significant flora species, Oval-leaf Logania and Port Campbell Guinea-flower, both listed as *rare* on the DSE Advisory List for Rare and Threatened Flora;
- Potential habitat for one flora species of national significance, Metallic Sun-orchid *Thelymitra epipactoides*, listed as *endangered* under the *EPBC Act*;
- Potential habitat for 7 state significant flora species;
- Known population of the nationally endangered Southern Brown Bandicoot, listed as *endangered* under the *EPBC Act*;
- Known populations of two state significant fauna species, Rufous Bristle Bird and Swamp Antechinus, both listed as *near threatened* on the DSE Advisory list for threatened vertebrate fauna;
- Potential habitat for four fauna species of national significance listed under the *EPBC Act*;
- Potential habitat for five fauna species of state significance; and,
- DSE NaturePrint mapping indicating a high contribution to natural values;

5 MANAGEMENT RECOMMENDATIONS

The following recommendations detail actions to manage ecological values and the future use of the Port Campbell Headland. Each section details values or threats to values within the study area and potential mitigation measures to ensure values are protected and enhanced. Priority for each management action is also provided. **High Priority** actions should be implemented as soon as possible. **Medium Priority** actions should be implemented in the short term (two to four years) and **Low Priority** actions should be implemented after High and Medium Priority actions have been completed or considered.

5.1 Native vegetation

Revegetation: As the vegetation within the study area is relatively intact, supplementary planting of locally indigenous species is generally not required except in small locations as has been implemented where tracks have been closed or realigned. Any proposed revegetation site should undergo adequate preparation, including introduced species controlled with herbicide several times, prior to any planting. Mulch should also be used in the planting area to suppress introduced species germination and spread.

Flora Surveys: Field surveys provide an indication of what is present at the time of survey (i.e. a 'snapshot') and as such may not include species that may be dormant or absent due to seasonal or climatic conditions. While the flora survey was undertaken during spring, considered the optimal time to undertake flora surveys, some species may be dormant or not displaying diagnostic characteristics at the time of surveys. Additional surveys with greater survey effort at alternative times of the year may locate additional species.

Fire and disturbance: Fire is an important process in many Australian vegetation communities. The EVC benchmark for Damp Heath Scrub indicates that this vegetation type requires episodic disturbance or a fire event every thirty years. Disturbance events are important to facilitate successional process and maintain diversity. Some significant species may also require fire to assist germination and open up space for new plants. However, given the known population of Southern Brown Bandicoot within the reserve any potential planned burns may have significant impacts on this species and as a precautionary approach, are not recommended. See Section 5.7 for details.

Vegetation Monitoring: Developing base level information to monitor health of native vegetation and impacts of management actions is an important part of evaluation success. Monitoring of native vegetation within the study area could be done using photopoint and quadrat data.

Permanent photopoints should be established using two stakes approximately 5 metres apart. The photograph is taken from one stake with the tip of the second stake marked and placed in the centre of the photo frame. This ensures that photopoints are repeated accurately. Photopoints should be placed in locations of proposed management works such as weed control and revegetation but also in locations where native vegetation is intact to monitor for any adverse affects.

Permanently marked quadrats recording species and cover within defined areas (e.g.: three metres by three metres) offers an easy way to have quantitative data and assess any change over time. This may be important in area

Management Actions

1. Any revegetation of closed or realigned tracks must use locally indigenous species. **High Priority**
2. Investigate potential of a local naturalist club to undertake additional flora surveys at varying times of the year. **Low Priority**
3. Implement monitoring protocols for native vegetation monitoring. **Medium Priority**

5.2 Significant Flora

Two state significant flora species, Oval-leaf Logania and Port Campbell Guinea-flower, both listed as rare (DSE 2009d), were recorded within the study area.

Analysis of previous significant flora records from a ten kilometre radius of the study area, the Protected Matters Search Tool and Biodiversity Interactive Map indicate that there is potential habitat for one nationally significant flora species, Metallic Sun-orchid and an additional five state significant species.

The populations of Oval-leaf Logania and Port Campbell Guinea-flower within the study area should be mapped using GIS equipment and monitored annually for any new threats such as insect attack, fungus infestations or impacts from introduced species. If natural recruitment becomes absent, seed collection and germination undertaken offsite and planting may be necessary to maintain populations.

Systematic, targeted surveys for potential species should be carried out during flowering times, ideally with observers walking transects two to five metres apart. Table 2 provides details of significant species flowering times. See section 3.3 for photos and descriptions of significant species

Table 2.Significant species and flowering times.

Scientific Name	Common Name	Listing	Flowering Period
<i>Thelymitra epipactoides</i>	Metallic Sun-orchid	EPBC Act: Endangered FFG Act: listed VROT: Endangered	September to December on hot days
<i>Logania ovata</i>	Oval-leaf Logania	VROT: Rare	August to November
<i>Hibbertia truncata</i>	Port Campbell Guinea-flower	VROT: Rare	September to November
<i>Caladenia fragrantissima</i>	Scented Spider Orchid	FFG Act: Listed VROT: Endangered	October to November
<i>Pelargonium littorale</i>	Coast Stork's-bill	VROT: Poorly known	October to April
<i>Baumea laxa</i>	Lax Twig-sedge	VROT: Rare	September to November
<i>Xanthosia tasmanica</i>	Southern Xanthosia	VROT: Rare	September to January

Management Actions

1. Map recorded significant species, Oval-leaf Logania and Port Campbell Guinea-flower, using GIS equipment or aerial photography. **Medium Priority**
2. Monitor Oval-leaf Logania and Port Campbell Guinea-flower annually for decline in health. **High Priority**
3. Encourage, monitor and protect recruits/juvenile Oval-leaf Logania and Port Campbell Guinea-flower if required. **Medium Priority**
4. If natural recruitment is absent, collect seed and germinate offsite for supplementary planting. **Medium Priority**
5. Implement targeted surveys for additional significant species with potential habitat. **Medium Priority**

5.3 Pest Plants

Pest plants are a major threat to the ecological values within the study area. Any pest plant control must be undertaken by persons with appropriate native vegetation identification skills and an understanding of the ecological values of the study area. With all pest plant management, follow up control is vital. Pest plants detailed in Table 3 should be controlled (Figure 3). Further, controlling the source of pest plants is important to ensure that reinfestation does not continue to reoccur. Virtually all of the notable weeds in Table 3 are found in residential gardens on the adjacent Cairn Street and Hennessy Street. Local residents should be made aware of the threat of these species and programs to offer their removal and replacement with native plants investigated.

Pest plant populations should also be monitored. Notable pest plants should be mapped using GPS technology or aerial photos to ensure that control is effective.

Table 3. Notable Pest Plants, distribution and potential control methods within the study area

Species	Distribution	Potential Control Methods
Norfolk Pine <i>Araucaria heterophylla</i>	Scattered trees at western end	• Larger trees should be ring barked and the stripped area immediately painted with herbicide or cut and the base painted with neat herbicide immediately. • Seedlings can be sprayed with herbicide or hand pulled.
Coast Banksia <i>Banksia integrifolia</i>	Scattered saplings and seedlings across the study area	• Saplings should be cut and the base painted with neat herbicide immediately. • Seedlings can be sprayed with herbicide or hand pulled.
Mirror Bush <i>Coprosma repens</i>	Scattered saplings and seedlings across the study area	
Coast Tea-tree <i>Leptospermum laevigatum</i>	Scattered saplings and seedlings across the study area	
Milkwort <i>Polygala</i>	Scattered saplings and	

Species	Distribution	Potential Control Methods
<i>myrtifolia</i>	seedlings across the study area, particularly the eastern end of Cairns Road	
Karo <i>Pittosporum undulatum</i>	Scattered saplings and seedlings in the western end of the study area.	
African Box-thorn <i>Lycium ferocissimum</i>	Only one plant noted which was removed.	• This plant should be monitored for and hand pulled when seen.
Great Brome <i>Bromus diandrus</i>	Scattered infestations long the Cairns Road roadside	• Handpull individual plants or use herbicide on infestations taking care to avoid off target damage.
Buffalo Grass <i>Stenotaphrum secundatum</i>	Small to medium sized patches present in all vegetation types, particularly near the clifftops within Coastal Tussock Grassland vegetation	

Management Actions

1. Map notable weed infestations to assist with monitoring and evaluation. **Medium Priority**
2. Create annual works plans and implement control of treat notable pest plants within the study area with a view for long-term control and eradication. **High Priority**
3. Increase awareness of adjacent residents with regard to pest plants and the threat they pose. Investigate funding for a program to offer replacement plantings using locally indigenous species. **High Priority**
4. Monitor pest plant control effectiveness and modify as required. **Medium Priority**

5.4 Pest Animals

Pest animals recorded within the study area include cats, foxes and rabbits (Legg 2011, 2012). These species should be monitored and action taken if required.

Foxes: 'Predation by the European Red Fox' is a listed key threatening process under the EPBC Act and a threat abatement plan has been prepared for it (DEWHA 2008a). 'Predation of native wildlife by the introduced Red Fox *Vulpes vulpes*' is listed as a potentially threatening process under Section 10 of the FFG Act. Foxes cause serious environmental damage through predation on native fauna including mammals, reptiles and amphibians. It is important that this pest animal is adequately controlled and control actions should be implemented in a coordinated manner on a landscape scale to achieve meaningful results.

Potential fox control methods include:

- Den destruction; Den destruction is not as profitable as it is for rabbits, because foxes can quickly make new dens.

- Fumigation: Used at breeding time, humane fumigation of dens with carbon monoxide cartridges may be used in semi-urban areas to kill cubs.
- Baiting: A baiting program using baits twice a year, with bait replacement until the take is reduced, is an effective and environmentally conscious form of fox control in most rural areas.
- Fencing: Fox-proof fencing is effective for small areas only. Fox proof fencing is costly and requires regular maintenance.
- Shooting: Shooting foxes is helpful, but it is likely to only remove a small proportion of foxes. Only those foxes that are easily seen are shot. Spotlighting can underestimate the fox population.
- Trapping: trapping using soft-jaw traps has been shown to have some success. This method can work quite well if movement patterns and habitat use of foxes are known.

All methods must comply with relevant agricultural chemical, animal welfare and firearms legislation and be undertaken by appropriately qualified operators.

Rabbits: 'Competition and land degradation by rabbits' is a listed key threatening process under the EPBC Act and a threat abatement plan has been prepared for it (DEWHA 2008b). 'Reduction in biomass and biodiversity of native vegetation through grazing by the Rabbit *Oryctolagus cuniculus*' is listed as a potentially threatening process under Section 10 of the FFG Act. Rabbits can reduce available habitat for native species by overgrazing on native vegetation, compete for food and shelter and cause soil erosion (DEWHA 2008b).

The most effective rabbit control measures have been those that integrate more than one method (DEWHA 2008c). Rabbit control methods include:

- Use of fumigants in burrows.
- Fencing.
- Use of toxins.
- Shooting.
- Mechanical destruction of warrens.
- Trapping.

All rabbit control measures should follow methods that are generally recommended and be undertaken humanely by qualified personnel (see DEWHA 2008b, 2008c).

Consideration in the study area should be given to controlling rabbits but retaining burrows and warrens, which may provide shelter and nesting habitat for the Southern Brown Bandicoots. This species has been found to utilise rabbit warrens for breeding (Manifold 2012).

Cats: 'Predation by feral cats' is a listed key threatening process under the EPBC Act and a threat abatement plan has been prepared for it (DEWHA 2008d). 'Predation of native wildlife by the cat, *Felis catus*' is listed as a potentially threatening process in accordance with Section 10 of the *Flora and Fauna*

Guarantee Act 1988 (DSE 2012f). Cats are a serious risk to a range of native mammals, birds, reptiles and frogs. They are often difficult to control and methods include:

- Trapping.
- Shooting.
- Enclosures.

Management Actions

1. Monitor study area for evidence of foxes, rabbits and domestic and feral cats, and take appropriate action accordingly. A multi-species feral pest control approach is recommended to prevent from any single one of these species becoming dominant post control. **High Priority**
2. Ensure that any pest animal control is implemented on a landscape scale providing a cross tenure approach. **Medium Priority**

5.5 Domestic Dogs

Domestic dogs may cause injury and death if allowed to roam freely and attack native animals. In some cases the scent left by domestic dogs in bush land areas may discourage some native animals from going about their natural activities. It is important to make users of the study area aware of the potential impacts that uncontrolled domestic dogs may have on local fauna.

Management Actions

1. Erect signage to indicate that dogs should be under effective control at all times. Given the number of threatened fauna species residing and breeding in the study area, it is recommended that this should include having dogs on the leash while in the area. **Medium Priority**

5.6 Public Access

The current walking track connects the fisherman's car park in the west of the study area to the car park at the end of the old Great Ocean Road and down to a lookout (Figure 2). These access tracks seem to be adequate to visit the site and provide a thoroughfare around the headland. It is important that these tracks are maintained so that human access into areas of native vegetation is not encouraged.

Management Actions

1. Maintain existing tracks to provide a safe walking environment and ensure people do not enter areas of native vegetation. **Low Priority**
2. Assess potential threat to significant fauna if habitat is to be removed as part of any track works. **Medium Priority**

5.7 Significant Fauna species and habitat (Southern Brown Bandicoot)

The study area has high quality habitat for a number of native vertebrate species and is known to support nationally and state significant species including the Southern Brown Bandicoot, Rufous Bristlebird and Swamp Antechinus. All these three species have been confirmed to also breed there. Other state and regionally significant species may also occur on occasion. These are all listed below:

- **National significance:** Southern Brown Bandicoot
- **State significance:** Rufous Bristlebird, Swamp Antechinus, White-footed Dunnart, Southern Toadlet, Swamp Skink
- **Regional significance:** Brown Quail, Latham's Snipe, Glossy Grass Skink.

Given the known occurrence of the Southern Brown Bandicoot, Rufous Bristlebird and Swamp Antechinus, it is important to protect and manage the habitat in the study area. The species of most concern for management Southern Brown Bandicoot, which is listed under the EPBC Act and is considered endangered nationally.

The Southern Brown Bandicoot population in the study area has been impacted on recently due to loss of habitat from urban development in a residentially zoned area adjoining the public reserve. Extensive documentation with remote cameras indicated that this area was important for breeding individuals and provided an area where the adults and young were recorded foraging (Manifold 2012). Removal of vegetation and breeding sites in the study area is likely to have an impact on the species.

The main threatening processes for the Southern Brown Bandicoot include (SEWPAC 2012b):

- Habitat loss or modification.
- Habitat fragmentation.
- Inappropriate fire regimes and extensive wildfires.
- Introduced predators.
- Isolation of populations.

Due to the fragmented nature of Southern Brown Bandicoot habitat, the species often occurs in low densities in small and isolated patches. Additional threats in such areas include degradation by introduced weeds, grazing and trampling by stock, altered fire regimes, clearance of understorey vegetation and the construction of tracks and roads (SEWPAC 2012b).

The effect of fire on Southern Brown Bandicoot populations is incompletely understood. There are also contradictory findings on the age of heath that the species prefers after disturbance. Some studies have found that Southern Brown Bandicoots prefer early successional regenerating heath of 4-8 years, whereas other studies have found them to prefer older heath of 14-18 years old (DEC 2006, Menkhorst 1995 and references therein). Menkhorst and Seebeck (1990) suggested managing Southern Brown

Bandicoot habitat with controlled fires that would result in mosaic of different successional stages of vegetation (SEWPAC 2012b).

More recent studies indicate that the risks and benefits of fire on the species are still largely unknown and although fire may be important in creating or managing suitable habitat, the effects of the scale, intensity and timing of fire require further research (Nicholls and Coates 2011, DEC 2006). Majority of the published sources suggest that vegetation structure is more important than the floristic composition or post-fire successional stage of vegetation. Fires may negatively affect the density of ground cover, which is agreed to be important for nesting and protection from predators (SEWPAC 2012b, DEC 2006, Menkhorst 1995). Recovery of numbers may be slow and the longer-term population effects are uncertain (Smith et al. 2012, DEC 2006). Long-term loss or reduction in ground cover may also cause localised extinctions of Southern Brown Bandicoots (DEC 2006).

A number of regional recovery plans for the Southern Brown Bandicoot have been developed in Victoria, including the Southern Brown Bandicoot Strategic Management Plan for the former Koo Wee Rup Swamp Area (Ecology Australia 2003), Regional Recovery Plan for the Southern Brown Bandicoot (*Isodon obesulus obesulus*) in the Mornington Peninsula and Western Port Biosphere Reserve, Victoria, Australia (Nicholls and Coates 2011) and the Sub-regional Species Strategy for the Southern Brown Bandicoot (DSE 2011).

A national recovery plan for the Southern Brown Bandicoot is currently in draft form, and outlines the recovery objectives below:

- Ensure that existing bandicoot populations and their habitat are protected and managed
- Identify threats and threat abatement management practices to assist the recovery of the Southern Brown Bandicoot
- Determine the distribution, abundance and population structure of the Southern Brown Bandicoot
- Identify the key attributes of existing or potential habitat that are important for the Southern Brown Bandicoot
- Evaluate population responses of the Southern Brown Bandicoot to recovery actions, and adapt actions as required
- Build a network of government and non-government organisations and individuals to facilitate recovery of the Southern Brown Bandicoot
- Manage and review recovery plan implementation
- Promote public awareness of and involvement in the Southern Brown Bandicoot recovery program
- Assess the requirement for captive populations.

The management actions for the study area are considered within the context of relevant draft national recovery plan objectives below.

Management Actions

Ensure that existing bandicoot populations and their habitat are protected and managed

1. The existing bandicoot population and their habitat in the study area should be protected from current and potential future threats outlined in this section. **High priority**

Identify threats and threat abatement management practices to assist the recovery of the Southern Brown Bandicoot

2. Threat abatement should incorporate ensuring that there is no further habitat loss, modification or fragmentation. This should include protection and management of the vegetation, control of feral pest fauna species, preventing further fragmentation from development or track and road works, careful management of any fire regimes and maintaining habitat links with the Port Campbell National Park to the east. If weedy vegetation is removed, this should be done in stages across the site as the Southern Brown Bandicoot may use such vegetation for cover. **High priority**

Determine the distribution, abundance and population structure of the Southern Brown Bandicoot

Identify the key attributes of existing or potential habitat that are important for the Southern Brown Bandicoot

Evaluate population responses of the Southern Brown Bandicoot to recovery actions, and adapt actions as required

3. Continue monitoring the study area with remote cameras to determine long-term effects of loss of habitat due to recent residential development. This should include recording numbers, individuals and breeding events if possible. **High priority**
4. Consider determining the distribution, abundance and population structure in the entire headland by increasing monitoring effort with cameras across the site. This should be done in a systematic way and incorporate detailed assessment of vegetation, nesting and other important habitat attributes for the species. Such monitoring would aid in determining the importance of the rest of the headland habitat to this species in the study area. **Medium priority**
5. Consider a wider bioregional study on the Southern Brown Bandicoot to establish its status and the importance of the study area population in the region. **Medium priority**

Build a network of government and non-government organisations and individuals to facilitate recovery of the Southern Brown Bandicoot

Manage and review recovery plan implementation

Promote public awareness of and involvement in the Southern Brown Bandicoot recovery program

6. Consider liaising with local Department of Sustainability and Environment and Parks Victoria officers, researchers at Victorian universities, Catchment Management Authorities, councils and non-government environmental groups to discuss the potential for developing a recovery program and a recovery plan for the south-western population of Southern Brown Bandicoots.

Medium priority

5.8 Corangamite Shire Council, Parks Victoria and the Department of Sustainability and Environment

Corangamite Shire Council are the owners and managers of the majority of the study area with Parks Victoria the manager of the coastal fringe and adjacent native vegetation within the Port Campbell National Park. Strengthening partnerships between Port Campbell Community Group Inc., Corangamite Shire Council and Parks Victoria will ensure management actions can be integrated leading to more efficient use of resources. Regular communication and partnering of management actions such as pest plant and animal control will result in better overall management of the study area and surrounds.

Management Actions

1. Ensure that high levels of communication are maintained between Port Campbell Community Group Inc., Corangamite Shire Council, Parks Victoria and the Department of Sustainability and Environment. **High Priority**

5.9 Signage

Currently no signage pertaining to ecological values exists within the study area (informative or educational). Signage can assist with educating the community about environmental and historical assets within the study area. It can also assist with other social uses within the study area such as informing dog owners to keep their pet under effective control.

Management Actions

1. Develop interpretive signage (informative and/or educational) across the study area to communicate issues such as ecological assets, historical assets, management actions, permitted and non permitted uses of the study area. **Medium Priority**

FIGURES



Figure 1. Study Area Location

Figure 1: Study area location



Study area



0 250 500m

Figure 2: Ecological values within the study area

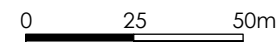
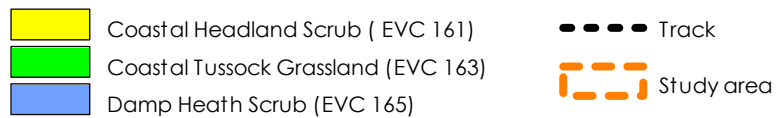
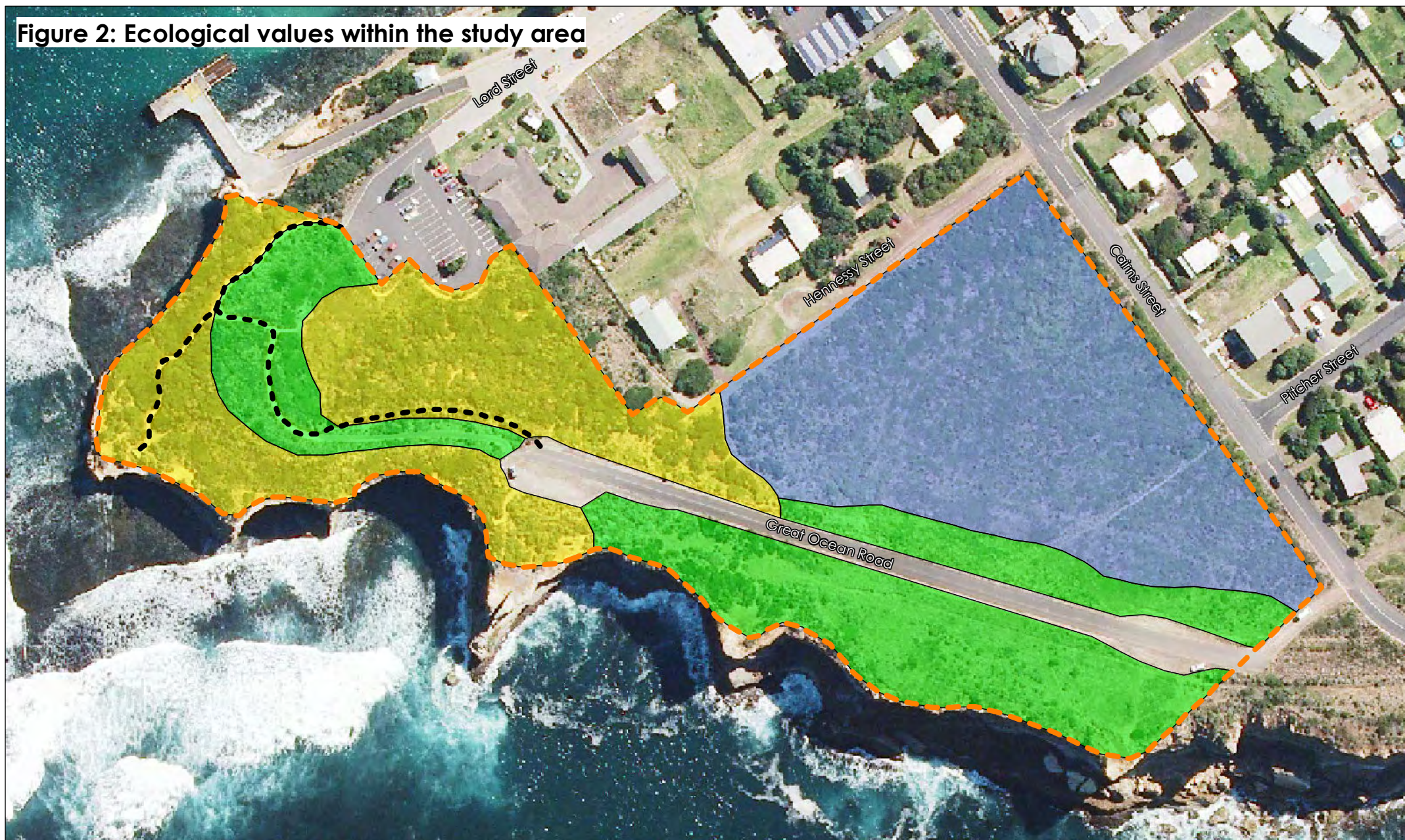
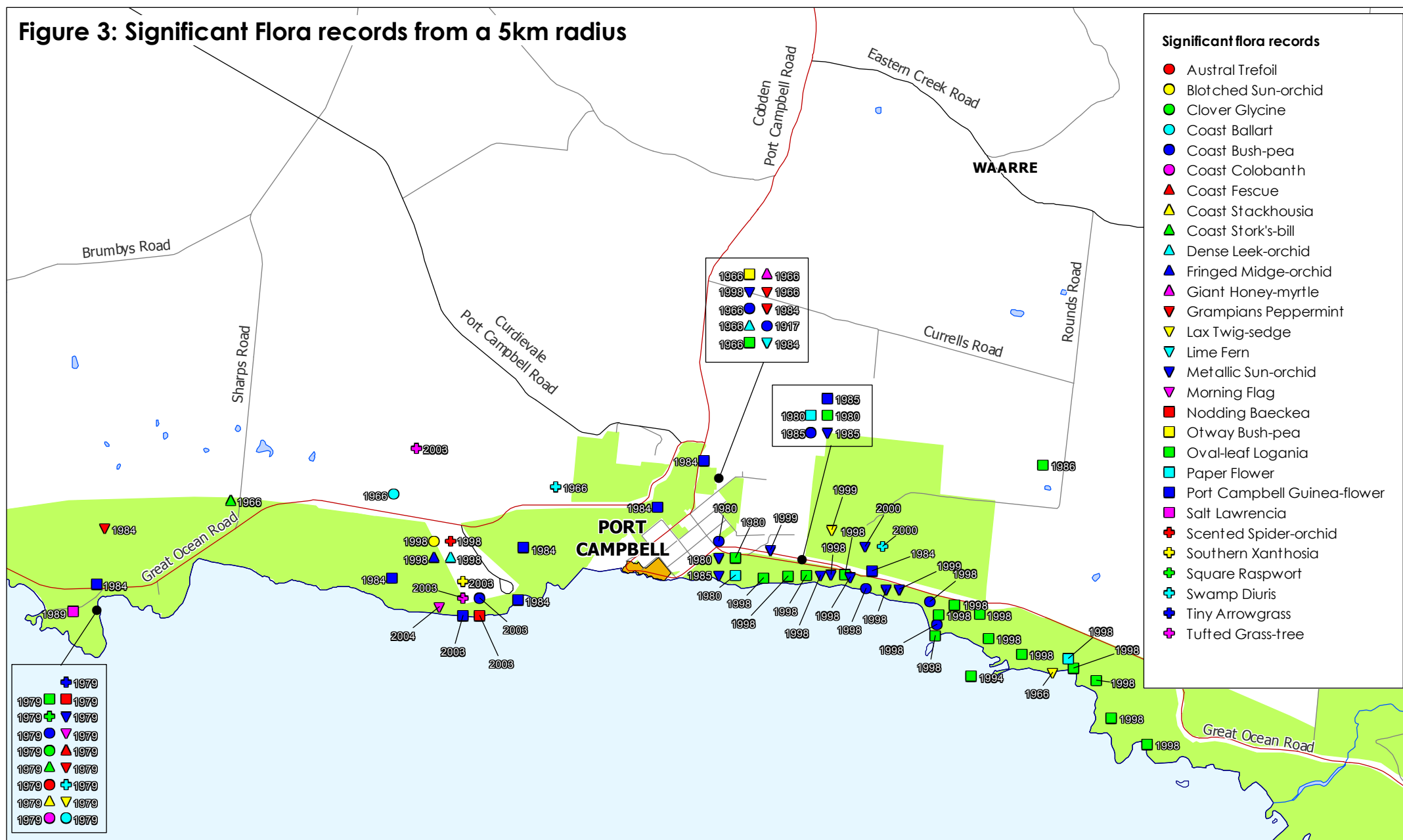


Figure 3: Significant Flora records from a 5km radius



Study area



0 500 1000m

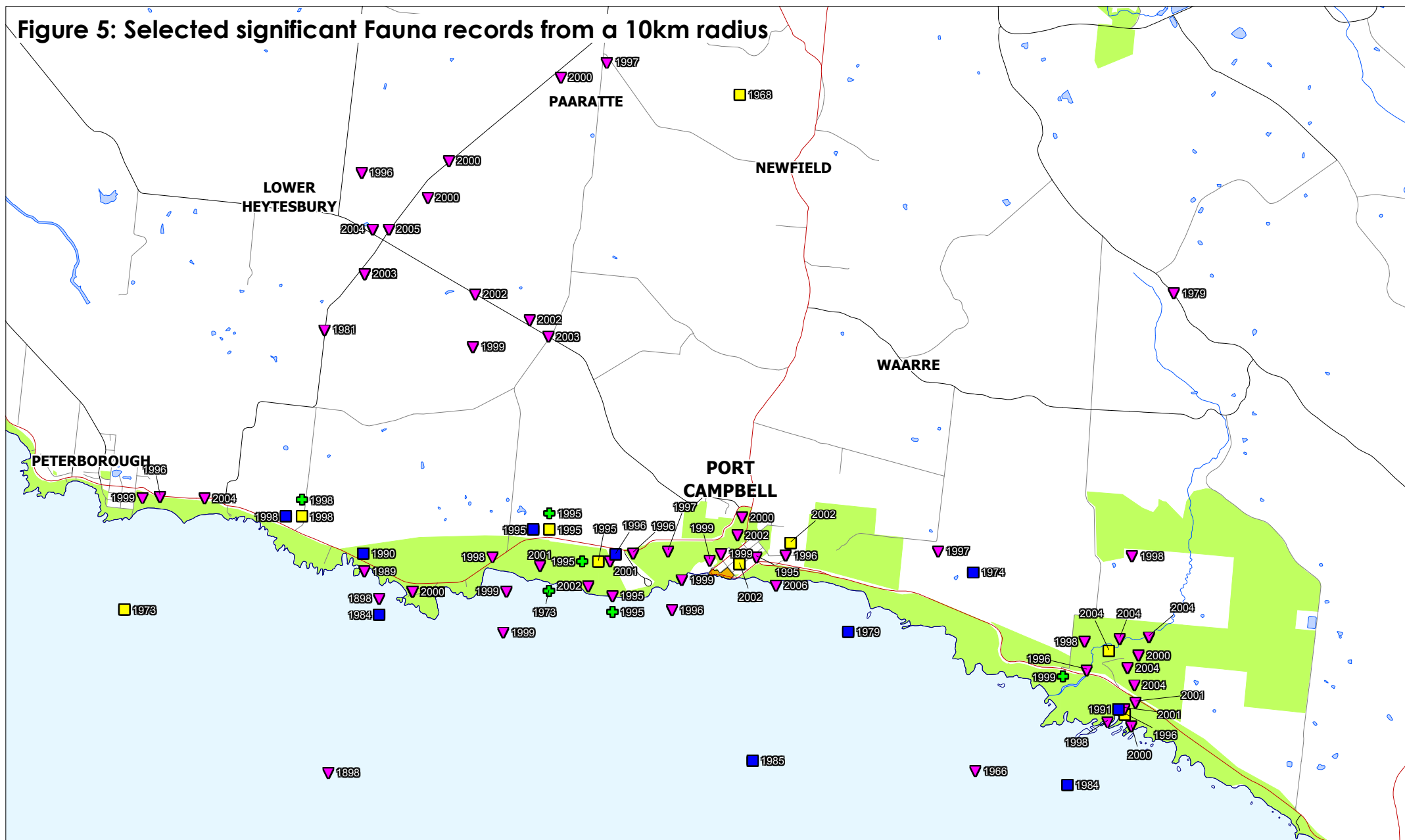
Figure 4: Significant Fauna records from a 5km radius

Significant fauna records

- Azure Kingfisher
- Black Falcon
- Black-browed Albatross
- Black-faced Cormorant
- Chestnut-rumped Heathwren
- Dingo
- Eastern Great Egret
- Glossy Grass Skink
- Grey Goshawk
- Growing Grass Frog
- Hairy Burrowing Crayfish
- Hooded Plover
- Humpback Whale
- Intermediate Egret
- Orange-bellied Parrot
- Pied Cormorant
- Rufous Bristlebird (Otways subsp.)
- Shy Albatross
- Southern Brown Bandicoot
- Southern Right Whale
- Southern Toadlet
- Swamp Antechinus
- Swamp Skink
- Whimbrel
- White-bellied Sea-Eagle
- White-footed Dunnart



Figure 5: Selected significant Fauna records from a 10km radius



Selected significant fauna records

- ▼ Rufous Bristlebird (Otways subsp.)
- Southern Brown Bandicoot
- Swamp Antechinus
- ⊕ White-footed Dunnart

■ Study area



0 1 2km

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APPENDICES



Appendix 1. Vegetation Condition and Habitat Quality

Vegetation Condition

Good Condition

Vegetation of good condition is likely to support a diverse range of native floristic and structural components. Cover of introduced species is likely to be low and relevant ecosystem processes likely to be intact.

Moderate Condition

Vegetation of moderate condition is likely to support some range of floristic and structural components with greater than 25% cover of introduced species. Some ecosystem processes may be present or disrupted in some way.

Poor Condition

Vegetation of poor condition is likely to be dominated by introduced species with a low presence of native floristic and structural components. Relevant ecosystem processes are likely to be absent.

Habitat Quality

High Quality

Habitat of high quality is likely to be dominated by native flora species and supports relevant native structural with few introduced flora species present. Habitat features present include ground debris such as litter, rocks, logs and intact ground cover as well as hollow bearing trees if relevant. The habitat supports, or is likely to support significant fauna species and habitat links to other remnant ecosystems are intact.

Moderate Quality

Habitat of moderate quality supports some native floristic and structural component, however introduced species may be prevalent in some areas. Some habitat elements such as ground debris and hollow bearing trees may be present. The area supports potential habitat for significant species and some form of habitat links with remnant ecosystems may be present.

Low Quality

Habitat of low quality is likely to be dominated by introduced flora species and support few native floristic and structural components. Habitat elements such as ground debris and tree bearing hollows are likely to be absent. The area is unlikely to support or there is no suitable habitat for any significant fauna species and habitat links to other remnant ecosystems are likely to be absent.

Appendix 2. Ecological Significance

Criteria used for defining site significance are listed below and are based on the *Standard Criteria for sites of Biological Significance in Victoria* (Amos 2004). Criteria for definitions of ecological significance are also provided.

Nationally Significant

Sites are of national significance if they support:

- Known habitat for nationally significant taxa listed as Critically Endangered or an important site for a taxon listed as Vulnerable or Conservation Dependent.
- Areas with unusually high native species richness, vegetation, habitat types or communities that are exceptional when compared to sites nationally.
- Corridors or habitat components that are important at a national scale. i.e. forms a link with nationally significant vegetation such as a National Park, and/or Ramsar Wetlands.
- Breeding sites, nesting or nursery or other sites where individuals aggregate for a defined part of their life cycle which comprises $\geq 1\%$ of national breeding population of species.
- Areas regularly used by migratory taxon which is nationally threatened or $\geq 1\%$ of world or national, population of taxon.
- Known or potential feeding sites of a nationally significant nomadic/migratory/mobile taxon within the known range of a taxon which is known to be reliant on defined dispersed feeding sites and where the taxon is nationally Critically Endangered, Endangered or Vulnerable.

Species of national significance are flora or fauna listed as Extinct, Extinct in the Wild, Critically Endangered, Endangered, Vulnerable or Rare under the Environment Protection and Biodiversity Conservation (EPBC) Act 1999 or under the relevant National Action Plan.

Ecological Communities of national significance are those listed as Critically Endangered, Endangered or Vulnerable under the *Environment Protection and Biodiversity Conservation Act 1999*.

State Significant

Sites are of state significance if they support:

- Known habitat of a nationally significant taxon listed as Vulnerable, or Conservation Dependent.
- Areas that support, or regularly support individuals of a taxon or a community listed under the Flora and Fauna Guarantee Act 1988 or the DSE Advisory List of Rare or Threatened plants in Victoria (DSE 2005)
- Sites that contain vegetation which would have a vegetation significance rating of 'Very High' or 'High' if assessed using the DSE Vegetation Quality Assessment Manual (DSE 2004).
- Areas with unusually high native species richness, vegetation, habitat types or communities that are exceptional when compared to sites on a statewide basis.
- Corridors or habitat components that are important at a state scale. i.e. forms a link with state significant vegetation such as State Parks and/or Flora and Fauna Study areas.
- Known or potential feeding sites of a nomadic/migratory/mobile taxon within the known range of a taxon which is known to be reliant on defined dispersed feeding sites and where the taxon is state Endangered or Vulnerable or Data Deficient.

- Breeding sites, nesting or nursery or other sites where individuals aggregate for a defined part of their life cycle which comprises $\geq 1\%$ of state breeding population of species.
- Areas regularly used by migratory taxon, which is threatened in Victoria, or $\geq 1\%$ of State population of taxon.

Species of state significance in Victoria are flora or fauna listed as Extinct, Extinct in the Wild, Critically Endangered, Endangered, Vulnerable or Conservation Dependent in the Advisory List of Rare or Threatened Plants (DSE 2005), the Advisory List of Threatened Vertebrate Fauna in Victoria (DSE 2008), or the Advisory List of Threatened Invertebrate Fauna in Victoria (DSE 2009b); species listed as Near Threatened, Conservation Dependent or Least Concern under the relevant National Action Plan; and/or species listed under the Victorian FFG Act).

Ecological Communities of state significance in Victoria are those listed as threatened under the Flora and Fauna Guarantee Act 1988

Regionally Significant

Sites are of regional significance if they support:

- Sites that contain vegetation which would have a vegetation significance rating of 'Medium' if assessed under the DSE Vegetation Quality Assessment Manual (DSE 2004).
- Sites with unusually high native species richness, vegetation, habitat types or communities that are exceptional when compared to sites regionally.
- Corridors or habitat components that are important at a regional scale.
- Breeding sites, nesting or nursery or other sites where individuals aggregate for a defined part of their life cycle which comprises $\geq 5\%$ of bioregional breeding population of species.
- Sites regularly used by migratory taxon, which is declining in the bioregion, or $\geq 5\%$ of bioregional population of taxon.
- Known or potential feeding sites of a nomadic/migratory/mobile taxon within the known range of a taxon which is known to be reliant on defined dispersed feeding sites and where the taxon is regionally significant.

Species of regional significance in the Warrnambool Plain Bioregion are flora or fauna species considered rare by the author, flora listed in any relevant regional Native Vegetation Plan, Victorian Environmental Assessment Council Reports, or fauna or listed as Near Threatened or Data Deficient in the Advisory List of Threatened Vertebrate Fauna in Victoria (DSE 2008) or the Advisory List of Threatened Invertebrate Fauna in Victoria (DSE 2009b).

Appendix 3. Flora recorded within the study area during the field assessment

Listing:

DSE	Department of Sustainability and Environment rare or threatened species (DSE 2005)	EPBC	EPBC Act nationally significant flora species
BOLD	Regionally Significant species (DSE 2012a)	FFG - T	Threatened under the FFG Act (DSE 2009b)
DPI	Department of Primary Industries regionally controlled or regulated weed (DPI 2008)	FFG - n	Nominated for listing under the FFG Act (DSE 2009b)
#	Native, non-indigenous species, located outside of pre-1750 distribution (DSE 2012a)	WONS	Weed of National significance (WONS 2011)

Scientific Name	Common Name
NATIVE SPECIES	
<i>Acacia longifolia</i> subsp. <i>sophorae</i>	Coast Wattle
<i>Acacia myrtifolia</i>	Myrtle Wattle
<i>Acacia verticillata</i>	Prickly Moses
<i>Acaena novae-zelandiae</i>	Bidgee-widgee
<i>Acrotriche affinis</i>	Ridged Ground-berry
<i>Acrotriche serrulata</i>	Honey-pots
<i>Actites megalocarpus</i>	Dune Thistle
<i>Allocasuarina paludosa</i>	Scrub Sheoak
<i>Allocasuarina verticillata</i>	Drooping Sheoak
<i>Alyxia buxifolia</i>	Sea Box
<i>Apium prostratum</i> subsp. <i>prostratum</i>	Sea Celery
<i>Asperula scoparia</i> subsp. <i>scoparia</i>	Prickly Woodruff
<i>Astroloma humifusum</i>	Cranberry Heath
<i>Austrostipa</i> spp.	Spear Grass
<i>Banksia marginata</i>	Silver Banksia
<i>Baumea juncea</i>	Bare Twig-sedge
<i>Carex breviculmis</i>	Common Grass-sedge
<i>Carpobrotus rossii</i>	Karkalla
<i>Cassytha pubescens</i> s.s.	Downy Dodder-laurel
<i>Correa reflexa</i>	Common Correa
<i>Crassula sieberiana</i> s.l.	Sieber Crassula
<i>Dianella admixta</i>	Black-anther Flax-lily
<i>Dichondra repens</i>	Kidney-weed
<i>Distichlis distichophylla</i>	Australian Salt-grass
<i>Ficinia nodosa</i>	Knobby Club-sedge
<i>Gahnia trifida</i>	Coast Saw-sedge
<i>Gonocarpus tetragynus</i>	Common Raspwort
<i>Hibbertia aspera</i> s.l.	Rough Guinea-flower
DSE <i>Hibbertia truncata</i>	Port Campbell Guinea-flower
<i>Isolepis cernua</i>	Nodding Club-sedge



Scientific Name	Common Name
<i>Lepidosperma gladiatum</i>	Coast Sword-sedge
<i>Lepidosperma gunnii</i>	Slender Sword-sedge
<i>Lepidosperma laterale</i>	Variable Sword-sedge
<i>Leptospermum scoparium</i>	Manuka
<i>Leucopogon parviflorus</i>	Coast Beard-heath
<i>Leucophyta brownii</i>	Cushion Bush
DSE <i>Logania ovata</i>	Oval-leaf Logania
<i>Microlaena stipoides</i> var. <i>stipoides</i>	Weeping Grass
<i>Myoporum insulare</i>	Common Boobialla
<i>Olearia axillaris</i>	Coast Daisy-Bush
<i>Oxalis corniculata</i> s.l.	Yellow Wood-sorrel
<i>Ozothamnus turbinatus</i>	Coast Everlasting
<i>Pimelea glauca</i>	Smooth Rice-flower
<i>Poa morrisii</i>	Soft Tussock-grass
<i>Poa poiformis</i>	Coast Tussock-grass
<i>Rhagodia candolleana</i> subsp. <i>candolleana</i>	Seaberry Saltbush
<i>Samolus repens</i>	Creeping Brookweed
<i>Sarcocornia</i> spp.	Glasswort
<i>Scaevola albida</i>	Small-fruit Fan-flower
<i>Schoenus apogon</i>	Common Bog-sedge
<i>Selliera radicans</i>	Shiny Swamp-mat
<i>Senecio pinnatifolius</i>	Variable Groundsel
<i>Senecio spathulatus</i> s.l.	Dune Groundsel
<i>Tetragonia implexicoma</i>	Bower Spinach
<i>Threlkeldia diffusa</i>	Coast Bonefruit
<i>Viola hederacea</i> sensu Willis (1972)	Ivy-leaf Violet
INTRODUCED SPECIES	
<i>Agapanthus praecox</i> subsp. <i>orientalis</i>	Agapanthus
<i>Ammophila arenaria</i>	Marram Grass
<i>Anagallis arvensis</i>	Pimpernel
<i>Araucaria heterophylla</i>	Norfolk Pine
<i>Arctotheca calendula</i>	Cape Weed
<i>Atriplex prostrata</i>	Hastate Orache
# <i>Banksia integrifolia</i>	Coast Banksia
<i>Bellis perennis</i>	English Daisy
<i>Brassica</i> spp.	Turnip
<i>Bromus diandrus</i>	Great Brome
<i>Centaurium erythraea</i>	Common Centaury
DPI <i>Cirsium vulgare</i>	Spear Thistle
<i>Coprosma repens</i>	Mirror Bush
<i>Dactylis glomerata</i>	Cocksfoot
<i>Freesia</i> spp.	Freesia
<i>Galium murale</i>	Small Goosegrass
<i>Helminthotheca echioides</i>	Ox-tongue
<i>Holcus lanatus</i>	Yorkshire Fog



Scientific Name	Common Name
<i>Hordeum spp.</i>	Barley-grass
<i>Hypochoeris radicata</i>	Flatweed
# <i>Leptospermum laevigatum</i>	Coast Tea-tree
DPI <i>Lycium ferocissimum</i>	African Box-thorn
<i>Medicago polymorpha</i>	Burr Medic
<i>Modiola caroliniana</i>	Red-flower Mallow
<i>Oxalis pes-caprae</i>	Soursob
<i>Pennisetum clandestinum</i>	Kikuyu
Pigweed	<i>Portulaca oleracea</i>
<i>Pittosporum undulatum</i>	Karo
<i>Plantago coronopus</i>	Buck's-horn Plantain
<i>Plantago lanceolata</i>	Ribwort
<i>Polygala myrtifolia</i>	Milkwort
<i>Romulea rosea</i>	Onion Grass
<i>Sagina apetala</i>	Common Pearlwort
<i>Sonchus asper</i> s.l.	Rough Sow-thistle
<i>Sonchus oleraceus</i>	Common Sow-thistle
<i>Stellaria media</i>	Chickweed
<i>Stenotaphrum secundatum</i>	Buffalo Grass

Appendix 4. Fauna recorded within the study area during the field assessment and previous assessments

COMMON NAME	SCIENTIFIC NAME	FFG	VIC ADV	EPBC	Current survey	Previous surveys [#]
BIRDS						
Australian Magpie	<i>Gymnorhina tibicen</i>				X	X
Australian Raven	<i>Corvus coronoides</i>					X
Black-faced Cuckoo-shrike	<i>Coracina novaehollandiae</i>					X
Black-shouldered Kite	<i>Elanus axillaris</i>					X
Brown Goshawk	<i>Accipiter fasciatus</i>					X
Brown Songlark	<i>Cincloramphus cruralis</i>					
Brown Thornbill	<i>Acanthiza pusilla</i>					X
Buff-banded Rail	<i>Gallirallus philippensis</i>					X
*Common Blackbird	<i>Turdus merula</i>				X	X
Common Bronzewing	<i>Phaps chalcoptera</i>					X
*Common Myna	<i>Acridotheres tristis</i>					X
Common Sandpiper	<i>Actitis hypoleucos</i>		VU			
*Common Starling	<i>Sturnus vulgaris</i>				X	X
Crescent Honeyeater	<i>Phylidonyris pyrrhoptera</i>					X
Crested Tern	<i>Thalaseus bergii</i>					X
Crimson Rosella	<i>Platycercus elegans</i>					X
Eastern Great Egret	<i>Ardea modesta</i>	L	VU			
Eastern Rosella	<i>Platycercus eximius</i>					X
Eastern Spinebill	<i>Acanthorhynchus tenuirostris</i>					X
Eastern Yellow Robin	<i>Eopsaltria australis</i>					X
Fan-tailed Cuckoo	<i>Cacomantis flabelliformis</i>					X
Galah	<i>Eolophus roseicapilla</i>					X
Golden Whistler	<i>Pachycephala pectoralis</i>					X
Grey Butcherbird	<i>Cracticus torquatus</i>					X
Grey Fantail	<i>Rhipidura albiscarpa</i>					X
Grey Shrike-thrush	<i>Colluricincla harmonica</i>					X
Horsfield's Bronze-Cuckoo	<i>Chrysococcyx basalis</i>					X
*House Sparrow	<i>Passer domesticus</i>				X	X
Laughing Kookaburra	<i>Dacelo novaeguineae</i>					X
Little Pied Cormorant	<i>Microcarbo melanoleucos</i>					X
Little Raven	<i>Corvus mellori</i>					X
Little Wattlebird	<i>Anthochaera chrysoptera</i>				X	X
Long-billed Corella	<i>Cacatua tenuirostris</i>					X
Magpie-lark	<i>Grallina cyanoleuca</i>					X
Masked Lapwing	<i>Vanellus miles</i>					X
Musk Lorikeet	<i>Glossopsitta concinna</i>				X	
Nankeen Kestrel	<i>Falco cenchroides</i>				X	X

COMMON NAME	SCIENTIFIC NAME	FFG	VIC ADV	EPBC	Current survey	Previous surveys#
New Holland Honeyeater	<i>Phylidonyris novaehollandiae</i>				X	X
Pacific Gull	<i>Larus pacificus pacificus</i>		NT			X
Peregrine Falcon	<i>Falco peregrinus</i>					X
Pied Cormorant	<i>Phalacrocorax varius</i>					X
Rainbow Lorikeet	<i>Trichoglossus haematodus</i>					X
Red Wattlebird	<i>Anthochaera carunculata</i>					X
Richard's Pipit	<i>Anthus novaeseelandiae</i>					X
Rufous Bristlebird (Otways subsp.)	<i>Dasyornis broadbenti caryochrus</i>	L	NT		X	X
Silver Gull	<i>Chroicocephalus novaehollandiae</i>				X	X
Silvereye	<i>Zosterops lateralis</i>				X	X
Singing Honeyeater	<i>Lichenostomus virescens</i>				X	X
Southern Emu-wren	<i>Stipiturus malachurus</i>					X
Spotted Pardalote	<i>Pardalotus punctatus</i>				X	
*Spotted Turtle-dove	<i>Streptopelia chinensis</i>					X
Straw-necked Ibis	<i>Threskiornis spinicollis</i>				X	
Sulphur-crested Cockatoo	<i>Cacatua galerita</i>					X
Superb Fairy-wren	<i>Malurus cyaneus</i>				X	X
Swamp Harrier	<i>Circus approximans</i>					X
Wedge-tailed Eagle	<i>Aquila audax</i>				X	X
Welcome Swallow	<i>Hirundo neoxena</i>				X	X
Whistling Kite	<i>Haliastur sphenurus</i>					X
White-bellied Sea-Eagle	<i>Haliaeetus leucogaster</i>	L	VU			X
White-browed Scrubwren	<i>Sericornis frontalis</i>				X	X
White-faced Heron	<i>Egretta novaehollandiae</i>					X
Willie Wagtail	<i>Rhipidura leucophrys</i>					X
Yellow-tailed Black-Cockatoo	<i>Calyptrorhynchus funereus</i>					X
MAMMALS						
Black Wallaby	<i>Wallabia bicolor</i>					X
*Black Rat	<i>Rattus rattus</i>					X
Bush Rat	<i>Rattus fuscipes</i>					X
*Cat	<i>Felis catus</i>					X
Common Brushtail Possum	<i>Trichosurus vulpecula</i>					X
Common Ringtail Possum	<i>Pseudocheirus peregrinus</i>					X
*European Rabbit	<i>Oryctolagus cuniculus</i>				X	
Gould's Wattled Bat	<i>Chalinolobus gouldii</i>					X
*House Mouse	<i>Mus musculus</i>					X
Large Forest Bat	<i>Vespadelus darlingtoni</i>					X
*Red Fox	<i>Vulpes vulpes</i>					X
Red-necked Wallaby	<i>Macropus rufogriseus</i>				X	



COMMON NAME	SCIENTIFIC NAME	FFG	VIC ADV	EPBC	Current survey	Previous surveys#
Short-beaked Echidna	<i>Tachyglossus aculeatus</i>				X	X
Southern Brown Bandicoot	<i>Isodon obesulus obesulus</i>	L	NT	EN		X
Swamp Antechinus	<i>Antechinus minimus maritimus</i>	L	NT			X
Swamp Rat	<i>Rattus lutreolus</i>					X
REPTILES						
Common Blue-tongued Lizard	<i>Tiliqua scincoides</i>					X
Eastern Three-lined Skink	<i>Bassiana duperreyi</i>					X
Garden Skink	<i>Lampropholis guichenoti</i>					X
Swamp Skink	<i>Egernia coventryi</i>	L	VU			
Tiger Snake	<i>Notechis scutatus</i>					X
Weasel Skink	<i>Saproscincus mustelinus</i>					X
White-lipped Snake	<i>Drysdalia coronoides</i>					X

#Legg 2011, Legg 2012, Marion Manifold (2012)

Appendix 5. Significant flora recorded within a ten kilometre radius of the study area

STATUS:

EPBC Act

X	Extinct
CR	Critically Endangered
EN	Endangered
VU	Vulnerable
#	Habitat predicted to occur within 5 km radius (SEWPAC 2011)

FFG Act

L	Listed as threatened under FFG Act
Nom.	Nominated for listing

DSE

x	Extinct
e	Endangered
v	Vulnerable
r	Rare
k	Poorly Known

LIKELIHOOD: Recorded, Potential Habitat, Unlikely, No Habitat.

SOURCES:

Flora Information System (DSE 2012a), Biodiversity Interactive Map (DSE 2012a), Protected Matters Search Tool (SEWPAC 2011), Threatened List: Flora and Fauna Guarantee List (DSE 2009b), Advisory list of rare or threatened plants in Victoria (DSE 2005).

Scientific Name	Common Name	Number of records	EPBC Act	DSE	FFG Act	Likelihood of Occurrence
NATIONAL SIGNIFICANCE						
<i>Thelymitra epipactoides</i>	Metallic Sun-orchid	26	EN	e	L	Potential habitat
<i>Prasophyllum spicatum</i>	Dense Leek-orchid	2	VU	e		Unlikely
<i>Glycine latrobeana</i>	Clover Glycine	3	VU	v	L	Unlikely
<i>Haloragis exalata</i> subsp. <i>exalata</i> var. <i>exalata</i>	Square Raspwort	3	VU	v	-	No habitat
<i>Pterostylis tenuissima</i>	Swamp Greenhood	1	VU	v		No habitat
# <i>Prasophyllum frenchii</i>	Maroon Leek-orchid	-	EN	e	L	No habitat
# <i>Pterostylis cucullata</i>	Leafy Greenhood	-	Vu	e	L	No habitat
STATE SIGNIFICANCE						
<i>Caladenia fragrantissima</i>	Scented Spider-orchid	1	-	e	L	Potential habitat
<i>Lachnagrostis scabrasubsp. curviseta</i>	Rough Blown-grass	1	-	e	-	No habitat
<i>Pneumatopteris pennigera</i>	Lime Fern	2	-	e	-	No habitat
<i>Caesia parviflora</i> var. <i>minor</i>	Pale Grass-lily	1	-	k	-	No habitat
<i>Corunastylis ciliata</i>	Fringed Midge-orchid	1	-	k	-	No habitat
<i>Lotus australis</i> var. <i>australis</i>	Austral Trefoil	1	-	k	-	Unlikely
<i>Pelargonium littorale</i>	Coast Stork's-bill	2	-	k	-	Potential

Scientific Name	Common Name	Number of records	EPBC Act	DSE	FFG Act	Likelihood of Occurrence
						habitat
<i>Stackhousia spathulata</i>	Coast Stackhousia	1	-	k	-	No habitat
<i>Acacia howittii</i>	Sticky Wattle	1	-	r	-	Unlikely
<i>Austrofestuca littoralis</i>	Coast Fescue	7	-	r	-	Unlikely
<i>Baumea laxa</i>	Lax Twig-sedge	5	-	r	-	Potential habitat
<i>Cardamine papillata</i>	Forest Bitter-cress	1	-	r	-	No habitat
<i>Colobanthus apetalus</i>	Coast Colobanth	1	-	r	-	Unlikely
<i>Eucalyptus ovata</i> var. <i>grandiflora</i>	West-coast Swamp-gum	3	-	r	-	No habitat
<i>Eucalyptus willisii</i> subsp. <i>falciformis</i>	Grampians Peppermint	11	-	r	-	No habitat
<i>Euryomyrtus ramosissima</i> subsp. <i>prostrata</i>	Nodding Baeckea	6	-	r	-	Unlikely
<i>Exocarpos syrticola</i>	Coast Ballart	4	-	r	-	No habitat
<i>Hibbertia truncata</i>	Port Campbell Guinea-flower	39	-	r	-	Present
<i>Lawrenzia spicata</i>	Salt Lawrenzia	3	-	r	-	No habitat
<i>Logania ovata</i>	Oval-leaf Logania	38	-	r	-	Present
<i>Orthrosanthus multiflorus</i>	Morning Flag	3	-	r	-	No habitat
<i>Pultenaea canaliculata</i>	Coast Bush-pea	16	-	r	-	Unlikely
<i>Pultenaea prolifera</i>	Otway Bush-pea	4	-	r	-	No habitat
<i>Thomasia petalocalyx</i>	Paper Flower	7	-	r	-	Unlikely
<i>Triglochin minutissima</i>	Tiny Arrowgrass	1	-	r	-	No habitat
<i>Xanthorrhoea caespitosa</i>	Tufted Grass-tree	4	-	r	-	Unlikely
<i>Xanthosia tasmanica</i>	Southern Xanthosia	1	-	r	-	Potential habitat
<i>Diuris palustris</i>	Swamp Diuris	6	-	v	L	Potential habitat
<i>Thelymitra benthamiana</i>	Blotched Sun-orchid	1	-	v		No habitat

Appendix 6. Significant fauna recorded within a ten kilometre radius of the study area

STATUS:

EX	Extinct	NT	Near Threatened
RX	Regionally Extinct	LR (NT)	Lower Risk Near Threatened
CR	Critically Endangered	LR (LC)	Lower Risk (Least Concern)
EN	Endangered	L	Listed as threatened under FFG Act
VU	Vulnerable	I	Invalid or ineligible for listing under the FFG Act
RA	Rare	DD	Data Deficient (poorly known)
CD	Conservation Dependent	Mig/Mar	Migratory or Marine species
*	Species recorded by the Biodiversity Interactive Map (DSE 2012)		
^	Species or species' habitat predicted to occur within the study site by the Victorian Butterfly Database (Museum Victoria)		
Habitat	Species or species' habitat predicted to occur within the study site by the Protected Matters Search Tool (SEWPAC 2011b)		

LIKELIHOOD: Recorded, Potential Habitat, Unlikely, No Habitat.

SOURCES:

Atlas of Victorian Wildlife (DSE 2012b), Protected Matters Search Tool (SEWPAC 2012b), Biodiversity Interactive Map (DSE 2012d), Threatened List: Flora and Fauna Guarantee List (DSE 2009c), Advisory List of Threatened Vertebrate Fauna in Victoria (DSE 2007) and Advisory List of Threatened Invertebrate Fauna in Victoria (DSE 2009d)

Common Name	Scientific Name	#of Records	Last Record	EPBC Act	DSE	FFG Act	Likelihood
NATIONALLY SIGNIFICANT							
Orange-bellied Parrot	<i>Neophema chrysogaster</i>	4	2008	CR	CR	L	Rare flyover
Southern Bent-wing Bat#	<i>Miniopterus schreibersii bassanii</i>	-	-	CR	EN	L	Unlikely
Amsterdam Albatross#	<i>Diomedea exulans amsterdamensis</i>	-	-	EN	-	-	No habitat
Australasian Bittern#	<i>Botaurus poiciloptilus</i>	-	-	EN	EN	L	No habitat
Blue Whale#	<i>Balaenoptera musculus</i>	-	-	EN	CR	L	No habitat
Grey-headed Albatross#	<i>Thalassarche chrysostoma</i>	-	-	EN	VU	L	No habitat
Loggerhead Turtle#	<i>Caretta caretta</i>	-	-	EN	-	-	No habitat
Northern Royal Albatross#	<i>Diomedea epomophora sanfordi</i>	-	-	EN	VU	L (in part)	No habitat
Smoky Mouse#	<i>Pseudomys fumeus</i>	-	-	EN	EN	L	Unlikely
Southern Brown Bandicoot	<i>Isodon obesulus obesulus</i>	14	2002	EN	NT	I	Resident
Southern Giant-Petrel#	<i>Macronectes giganteus</i>	-	-	EN	VU	L	No habitat
Southern Right Whale	<i>Eubalaena australis</i>	53	2005	EN	CR	L	No habitat
Spot-tailed Quoll#	<i>Dasyurus maculatus</i>	-	-	EN	EN	L	Unlikely
Swift Parrot#	<i>Lathamus discolor</i>	-	-	EN	EN	L	No habitat
Tristan Albatross#	<i>Diomedea exulans exulans</i>	-	-	EN	-	-	No habitat
Australian Grayling#	<i>Prototroctes maraena</i>	-	-	VU	VU	L	No habitat
Australian Painted	<i>Rostratula australis</i>	-	-	VU	CR	L	No habitat



Snipe#							
Black-browed Albatross	<i>Thalassarche melanophris melanophris</i>	5	2000	VU	VU	-	No habitat
Blue Petrel#	<i>Halobaena caerulea</i>	-	-	VU	-	-	No habitat
Buller's Albatross#	<i>Thalassarche bulleri</i>	-	-	VU	-	-	No habitat
Campbell Albatross#	<i>Thalassarche melanophris impavida</i>	-	-	VU	-	-	No habitat
Dwarf Galaxias#	<i>Galaxiella pusilla</i>	-	-	VU	VU	L	No habitat
Fairy Tern#	<i>Sternula nereis nereis</i>	-	-	VU	EN	L	No habitat
Gibson's Albatross#	<i>Diomedea exulans gibsoni</i>	-	-	VU	-	-	No habitat
Great White Shark#	<i>Carcharodon carcharias</i>	-	-	VU	VU	L	No habitat
Grey-headed Flying-fox#	<i>Pteropus poliocephalus</i>	-	-	VU	VU	L	Rare flyover
Growling Grass Frog	<i>Litoria raniformis</i>	2	2002	VU	EN	L	No habitat
Humpback Whale	<i>Megaptera novaeangliae</i>	4	1997	VU	VU	L	No habitat
Leathery Turtle#	<i>Dermochelys coriacea</i>	-	-	VU	CR	L	No habitat
Long-nosed Potoroo	<i>Potorous tridactylus tridactylus</i>	1	1979	VU	EN	L	Rare Visitor
Malleefowl#	<i>Leipoa ocellata</i>	-	-	VU	EN	L	Unlikely
Northern Giant-Petrel#	<i>Macronectes halli</i>	-	-	VU	-	-	No habitat
Salvin's Albatross#	<i>Thalassarche cauta salvini</i>	-	-	VU	-	-	No habitat
Fairy Prion	<i>Pachyptila turtur</i>	1	1967	VU	VU		No habitat
Shy Albatross	<i>Thalassarche cauta</i>	2	2006	VU	VU	L	No habitat
Soft-plumaged Petrel#	<i>Pterodroma mollis</i>	-	-	VU	-	-	No habitat
Southern Royal Albatross#	<i>Diomedea epomophora epomophora</i>	-	-	VU	VU	L (in part)	No habitat
Wandering Albatross#	<i>Diomedea exulans</i>	-	-	VU	EN	L	No habitat
STATE SIGNIFICANT							
Grey-tailed Tattler	<i>Heteroscelus brevipes</i>	1	2000	-	CR	L	No habitat
Intermediate Egret	<i>Ardea intermedia</i>	3	2006	-	CR	L	No habitat
Australasian Bittern	<i>Botaurus poiciloptilus</i>	2	1998	-	EB	L	No habitat
Blue-billed Duck	<i>Oxyura australis</i>	1	1977	-	EN	L	No habitat
Fairy Tern	<i>Sternula nereis nereis</i>	1	1992	-	EN	L	No habitat
Great Knot	<i>Calidris tenuirostris</i>	1	1999	-	EN	L	No habitat
Ground Parrot	<i>Pezoporus wallicus wallicus</i>	1	1927	-	EN	L	Unlikely
Little Egret	<i>Egretta garzetta nigripes</i>	5	2008	-	EN	L	No habitat
Caspian Tern	<i>Hydroprogne caspia</i>	5	2000	-	NT	L	Rare flyover
Rufous Bristlebird (Otways subsp.)	<i>Dasyornis broadbenti caryochrus</i>	154	2006	-	NT	L	Resident
Swamp Antechinus	<i>Antechinus minimus maritimus</i>	13	1996	-	NT	L	Resident
White-footed	<i>Sminthopsis leucopus</i>	6	1998	-	NT	L	Likely



Dunnart							
Brolga	<i>Grus rubicunda</i>	1	1977	-	VU	L	No habitat
Chestnut-rumped Heathwren	<i>Calamanthus pyrrhopygius</i>	1	1995	-	VU	L	Likely
Eastern Great Egret	<i>Ardea modesta</i>	14	2000	-	VU	L	No habitat
Grey Goshawk	<i>Accipiter novaehollandiae novaehollandiae</i>	58	2007	-	VU	L	Flyover
Hooded Plover	<i>Thinornis rubricollis rubricollis</i>	22	2007	-	VU	L	No habitat
Lewin's Rail	<i>Lewinia pectoralis pectoralis</i>	1	2000	-	VU	L	No habitat
Little Tern	<i>Sternula albifrons sinensis</i>	1	2001	-	VU	L	No habitat
Swamp Skink	<i>Egernia coventryi</i>	9	2003	-	VU	L	Rare visitor
White-bellied Sea-Eagle	<i>Haliaeetus leucogaster</i>	8	2008	-	VU	L	Rare flyover
Dingo	<i>Canis lupus dingo</i>	1	1866	-	VU	L	Unlikely
Australasian Shoveler	<i>Anas rhynchos</i>	1	1999	-	VU	-	No habitat
Black Falcon	<i>Falco subniger</i>	1	2006	-	VU	-	Rare flyover
Common Sandpiper	<i>Actitis hypoleucos</i>	2	1979	-	VU	-	No habitat
Greater Sand Plover	<i>Charadrius leschenaultii</i>	1	1979	-	VU	-	No habitat
Hairy Burrowing Crayfish	<i>Engaeus sericatus</i>	3	1982	-	VU	-	No habitat
Hardhead	<i>Aythya australis</i>	1	1980	-	VU	-	No habitat
Royal Spoonbill	<i>Platalea regia</i>	7	2005	-	VU	-	No habitat
Southern Toadlet	<i>Pseudophryne semimarmorata</i>	43	2002	-	VU	-	Rare visitor
Whimbrel	<i>Numenius phaeopus</i>	1	1995	-	VU	-	No habitat
REGIONALLY SIGNIFICANT							
Azure Kingfisher	<i>Alcedo azurea</i>	1	1985	-	NT	-	No habitat
Black-faced Cormorant	<i>Phalacrocorax fuscescens</i>	15	2006	-	NT	-	No habitat
Brown Quail	<i>Coturnix ypsilophora australis</i>	1	1898	-	NT	-	Likely
Common Diving-Petrel	<i>Pelecanoides urinatrix</i>	2	1973	-	NT	-	No habitat
Eastern Curlew	<i>Numenius madagascariensis</i>	1	1967	-	NT	-	No habitat
Glossy Grass Skink	<i>Pseudemoia rawlinsoni</i>	1	1969	-	NT	-	Rare visitor
Glossy Ibis	<i>Plegadis falcinellus</i>	2	1999	-	NT	-	No habitat
Grey Plover	<i>Pluvialis squatarola</i>	1	2007	-	NT	-	No habitat
Latham's Snipe	<i>Gallinago hardwickii</i>	5	2002	-	NT	-	Rare visitor
Nankeen Night Heron	<i>Nycticorax caledonicus hillii</i>	2	2003	-	NT	-	No habitat
Pacific Golden Plover	<i>Pluvialis fulva</i>	2	2007	-	NT	-	No habitat
Pacific Gull	<i>Larus pacificus pacificus</i>	4	2000	-	NT	-	Flyover
Pied Cormorant	<i>Phalacrocorax varius</i>	5	2000	-	NT	-	No habitat
Spotted Harrier	<i>Circus assimilis</i>	4	2004	-	NT	-	Rare flyover



Whiskered Tern	<i>Chlidonias hybridus javanicus</i>	3	2000	-	NT	-	No habitat
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