

Murtnagurt Lagoon, Barwon Heads, Flora and Fauna Assessment

Project: 08-45

Prepared for:

Save Barwon Heads Alliance



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Summary

Ecology Australia was commissioned by the Save Barwon Heads Alliance to undertake an overview flora and fauna assessment of Murtnagurt Lagoon and surrounding land as part of a proposal for a development on 51 ha of land adjoining the Lagoon. The proposed development at 1920 Barwon Heads Road (Macafee's Land), comprising 24 ha of residential development and 27 ha of open space, would include an expansion of the western boundary of Barwon Heads township to the northeast side of Murtnagurt Lagoon and a planning scheme amendment with a rezoning of land from Rural to Residential.

Barwon Heads is located on the Bellarine Peninsula and in the Otway Plain Bioregion. The study area is situated to the western side of Barwon Heads township. Macafee's Land adjoins the northeastern side of Murtnagurt Lagoon and the eastern side of the Lagoon's connecting Overflow Channel from the Barwon River Estuary. Barwon Heads Golf Course borders the eastern and southern edges of the Lagoon; Thirteenth Beach Residential Estate and Golf Course borders the western and southern edges. Coastal dunes occur to the south and back Thirteenth Beach.

This assessment addresses the values of Murtnagurt Lagoon and its Overflow Connecting Channel, land covered by the proposed rezoning at 1920 Barwon Heads Road, Thirteenth Beach Residential Estate and Golf Course and Barwon Heads Golf Course. The assessment identifies existing impacts of adjoining land uses to Murtnagurt Lagoon and the Overflow Connecting Channel, potential issues associated with the proposed town boundary expansion and rezoning and the potential legislative implications associated with existing and proposed developmental impacts on the Lagoon.

Murtnagurt Lagoon

Murtnagurt Lagoon is connected to the Barwon River Estuary and Lake Connewarre c. 2.5 km to the north via an Overflow Connecting Channel. The western two-thirds of Murtnagurt Lagoon and Overflow Channel is part of the Lake Connewarre State Game Reserve and part of the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar Wetland Site. Although the eastern section of the Lagoon is privately owned, the values are comparable across the Lagoon. This Ramsar site is important in regards to total numbers (e.g. more than 20,000 waterbirds) and/or numbers of individuals of particular species (e.g. more than 1% of populations) of migratory wading birds, seabirds and waterfowl and the size, diversity and integrity of the intertidal mudflat, seagrass and saltmarsh ecosystems.

There are no specific descriptions of the Ramsar values of Murtnagurt Lagoon. However, the Lagoon is clearly an important part of a system of significant wetlands scattered throughout the Bellarine Peninsula. These wetlands form a 'stepping stone' spatial arrangement between which mobile species (e.g. migratory wader/shorebird species, other waterbird species and terrestrial species dependent on coastal or sub-coastal wetlands) move. Other significant sites comprising part of this system include those forming part of the Ramsar site (e.g. Lake Connewarre, Reedy Lake, the Barwon River Estuary, Swan Bay, Swan Island and Mud Islands), and sites recently nominated for inclusion in an extended Ramsar boundary (e.g. Lake Victoria, Freshwater Lagoon and Sand Island).

Diverse coastal vegetation occurs at Murtnagurt Lagoon. Complex patterns result from the subtle influences of microtopography on now largely historic salinity and hydrological regimes. The vegetation fits broadly under the umbrella of a number of threatened saltmarsh and estuarine Ecological Vegetation Classes (EVCs): (1) Coastal Saltmarsh is currently an aggregate of several EVCs and Floristic Communities (status Endangered); (2) Estuarine Flats Grassland (Vulnerable); (3) Estuarine Wetland (Endangered); and (4) Saline Aquatic Meadow (Rare). The Lagoon supports one of the best remaining and largest examples of coastal dry saltmarsh in Victoria. Dry saltmarsh is critically endangered in the Port Phillip/Bellarine region due to extensive elimination.

The diversity of habitats at Murtnagurt Lagoon support or potentially support a variety of threatened and/or migratory fauna species. Mudflats support numerous international migratory shorebird species. Fourteen threatened fauna species have a moderate or higher likelihood of regular occurrence, comprising: one species listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC) (Orange-bellied Parrot); eight species listed under the Victorian *Flora and Fauna Guarantee Act 1988* (FFG) (Lewin's Rail, Hooded Plover, Great Egret, Little Egret, Fairy Tern, Caspian Tern, Swamp Skink and Yellow Sedge-skipper); and five species otherwise classified in Victoria (Pied Cormorant, Pacific Gull, Royal Spoonbill, Whiskered Tern and Glossy Grass Skink). Key species include the Orange-bellied Parrot, Hooded Plover and Little Egret.

The Orange-bellied Parrot is a winter migrant to mainland Australia from its breeding grounds in southwest Tasmania. The total population is probably less than 150 birds. During the overwintering period, the Parrot occupies coastal saltmarsh and adjoining exotic grasslands between southeastern South Australia and South Gippsland. The regular occurrence of Orange-bellied Parrots at Lake Connewarre and other sites on the Peninsula (e.g. Swan Bay), the presence of suitable foraging habitat at Murtnagurt Lagoon and records of Blue-winged Parrots (an indicator species for the occurrence of its close relative) at the Lagoon during the current field assessment suggest that the Orange-bellied Parrot has a moderate likelihood of regular occurrence. The Lagoon potentially supports an ecologically-significant proportion (greater than 1%) of the National population and 'important habitat' as defined under the EPBC Act.

The Lagoon is likely to support an ecologically significant proportion of the Victorian populations of Little Egret and Hooded Plover. Hooded Plovers breed on nearby beaches (e.g. Thirteenth Beach). Murtnagurt Lagoon is an important storm shelter/refuge, supporting up to 20 Hooded Plovers. The Victorian population of Little Egrets is possibly less than 100 birds. A colony of 6-12 pairs of Little Egrets has bred at Geelong Grammar School for the last 10-12 years. It is the only breeding colony in Victoria, following collapse of breeding at other Victorian sites. It is likely that the Egrets observed foraging at the Lagoon originate from Geelong. The Lagoon is an important site in context of the Victorian population.

Overflow Connecting Channel

The channel supports a patchwork of mostly Chaffy Saw-sedge (*Gahnia filum*) Sedgeland and Beaded Glasswort Herbland, with small occurrences of Blackseed Glasswort (*Halosarcia*

pergranulata) Shrubland, Coast Tussock (*Poa poiformis* var. *poiformis*) Grassland and exotic vegetation. All indigenous vegetation is currently within the Endangered Coastal Saltmarsh EVC.

Three key fauna species likely to occur in the Overflow Channel are the Orange-bellied Parrot and FFG-listed Swamp Skink and Yellow Sedge-skipper. The record of 70 Blue-winged Parrots in the Overflow Channel indicates that suitable habitat occurs there for Orange-bellied Parrots. Suitable habitat (saltmarsh and Chaffy Saw-sedge) occurs for the Swamp Skink and Yellow Sedge-skipper.

The Overflow Connecting Channel is the critical hydrological and functional habitat link that connects Murtnagurt Lagoon to the balance of the Ramsar site (i.e. the Barwon River Estuary/Lake Connewarre). It would appear to support backflows from the Barwon River Estuary under high tidal influence or possibly from rainfall-induced flood events. The Overflow Channel could be used by a broad range of fauna species, including the Orange-bellied Parrot and other threatened species moving between the Estuary and Lagoon (e.g. Little Egret, tern species).

Land surrounding Murtnagurt Lagoon

The original vegetation of the surrounding calcarenite dunes, including Barwon Heads Golf Course, Thirteenth Beach Residential Estate and Golf Course and Macafee land, was Coast Moonah (*Melaleuca lanceolata*) Woodland. Only small patches of Moonah Woodland remain, including a stand of Moonah on the Macafee property and scattered and highly modified Moonah on Barwon Heads Golf Course. Thirteenth Beach Residential Estate and Golf Course supports very little remnant vegetation. These habitats are used by mostly common open country/grassland fauna species and tree or shrub-dependent passerines.

Existing impacts to Murtnagurt Lagoon and the Overflow Connecting Channel

Murtnagurt Lagoon and the Overflow Connecting Channel are subject to a number of impacts which threaten the “**Ecological Character**” of the **Ramsar** site: hydrological severance; on-going perimeter development; altered drainage; and edge effects.

Murtnagurt Lagoon would have flooded under tidal influence from the Barwon River Estuary and possibly by high river floods. However, the Lagoon is effectively isolated from the River by a levee c. 2.0 km to the north and by the Barwon Heads Road unless these barriers are flooded out. The effect is a long-term reduction in salinity and less frequent and extensive flooding.

A large proportion of the immediate perimeter of both the Ramsar and privately owned sections of the Lagoon are developed (e.g. surrounded by golf courses and residential development). Further, development of the township to the west of Golf Links Road has shifted residential areas to be within 500 m of the Lagoon or 600-700 m of the Overflow Channel. In the absence of perimeter buffers, all developments overlook the Lagoon and challenge the concept of “**Wise Use**” of a **Ramsar** site.

Two anthropogenically derived vegetation types occur on or surrounding the Lagoon and are replacing threatened saltmarsh and estuarine vegetation communities. Salt Club-sedge (*Bolboschoenus caldwellii*) Sedgeland is invading Beaded Glasswort (*Sarcocornia quinqueflora*)

Herbfield from the fringes of a stormwater pond (c. 200 m²) in the eastern privately-owned section of the Lagoon. It is associated with the Hopgood Place residential estate stormwater outflow and is having a detrimental effect on the saltmarsh, including the very rare Grey Glasswort (*Halosarcia halocnemoides*) Shrubland. The freshwater effects reach habitat immediately adjoining the Ramsar site.

Common Reed (*Phragmites australis*) is now a dominant species on the western edge of the Ramsar site and is progressively replacing Sea Rush (*Juncus kraussii*) Rushland and Australian Salt-grass (*Distichlis distichophylla*) Grassland. The expansion of Common Reed is an obvious edge effect and is assisted by, or due to, freshwater run-off from the adjoining Thirteenth Beach Residential Estate and Golf Course.

Existing or likely increased freshwater inputs from surrounding development are placing further pressure on a saline system already devoid of its major source of salt-flooding of the Barwon River Estuary. This has important implications for the “**Ecological Character**” of the Ramsar site and the balance of the Lagoon.

Further encroachment

The existing threats would be exacerbated by rezoning and subsequent development of Macafee’s Land at 1920 Barwon Heads Road. This would be most pronounced at the Overflow Connecting Channel because of its narrow (mostly between 50-80 m wide) and linear configuration with sharp boundaries to cleared land. Whilst weed incursion is currently an obvious edge effect on the Channel, most of the habitat is in good condition and the current adjoining rural landuses probably sustain a reasonable degree of “core habitat” in relation to disturbance (i.e. rural landuses include less disturbance related threats than urban landuse). Further encroachment of residential development to be juxtaposed to the Ramsar Overflow Channel would appear to contravene the concept of “**Wise Use**”.

With a change in landuse from Rural to Residential, and associated increases in disturbance (pedestrian traffic, dogs, maintenance machinery and vehicles) and predation (by dogs and cats), the current habitat condition of the Channel and its usage by fauna could be compromised. Increased predation and disturbance could significantly impede known foraging habitat for the migratory Blue-winged Parrot and potential foraging habitat for the EPBC-listed Orange-bellied Parrot. This could also ultimately impede the habitat linkage function of the Channel between Murtnagurt Lagoon and the balance of the Ramsar site.

Climate Change

Murtnagurt Lagoon and surrounding low lying land could play a strategic role as sea levels rise and inundate coastal wetlands linked to the Barwon River Estuary. While this is complex and largely untested, such opportunities need to be thoroughly explored as the ultimate loss and modification of coastal wetlands under a 0.8 m sea level rise is a very real possibility. For arguments sake, with more frequent inundation, Murtnagurt Lagoon may become an important wetland refugia under

climate change impacts. In turn, nearby residential development, such as that proposed for the Macafee property, and the risk of residences flooding, may place severe constraints on this role.

1 Introduction

Ecology Australia Pty Ltd was commissioned by the Save Barwon Heads Alliance to undertake an overview flora and fauna assessment of Murtnagurt Lagoon and surrounding land as part of a rezoning proposal for a residential development on 51 ha of land adjoining the Lagoon. The proposed development at 1920 Barwon Heads Road would include an expansion of the western boundary of Barwon Heads township to the northeast side of Murtnagurt Lagoon. This boundary expansion would require a planning scheme amendment with a rezoning of land from Rural to Residential. A 24 ha residential development with 27 ha of open space is proposed by Macafee Investments. The proposed development is discussed under, but is not supported by, the draft Barwon Heads Structure Plan (City of Greater Geelong 2007).

The Save Barwon Heads Alliance has received funding from the City of Greater Geelong to undertake this assessment.

This flora and fauna assessment addresses the values of:

- Murtnagurt Lagoon;
- land covered by the proposed rezoning at 1920 Barwon Heads Road; and
- other land surrounding Murtnagurt Lagoon (e.g. Thirteenth Beach Residential Estate and Golf Course and Barwon Heads Golf Course).

The purpose of the assessment is to:

- document the values of Murtnagurt Lagoon and surrounding land;
- address existing impacts of adjoining land uses to Murtnagurt Lagoon,
- discuss potential issues at Murtnagurt Lagoon associated with the proposed town boundary extension and residential development; and
- discuss the potential legislative implications associated with existing and proposed developmental impacts on Murtnagurt Lagoon.

2 Study Area

The study area is situated to the western side of Barwon Heads township and c. 18 km southeast of the City of Geelong (City of Greater Geelong 2007) (Figure 1). Barwon Heads is located on the Bellarine Peninsula, in the Otway Plain Bioregion and in the Corangamite Catchment Management Area (Conn 1993; DSE 2003a, 2003b). Barwon Heads is included in the Bellarine Landscape Zone which covers 13.7% of the Otway Plain Bioregion. The majority of this Zone is low lying and consists of poorly drained duplex soils over Tertiary and Quaternary marine and non-marine sediments.

The present study area comprised the following components on the south side of Barwon Heads Road:

1. Murtnagurt Lagoon and the Lagoon's connecting Overflow Channel from Lake Connewarre and the Barwon River Estuary to the north;
2. Macafee's Land at 1920 Barwon Heads Road; and
3. other areas adjoining Murtnagurt Lagoon, including the Thirteenth Beach Residential Estate and Golf Course (and tourist resort) and Barwon Heads Golf Course.

In addition, a brief visit was also made to:

4. the confluence of the connecting Overflow Channel and the Barwon River Estuary to the north of Barwon Heads Road to evaluate hydrological issues associated with inundation of Murtnagurt Lagoon.

Macafee's Land adjoins the northeastern side of Murtnagurt Lagoon and the eastern side of the Lagoon's connecting Overflow Channel. Barwon Heads Golf Course borders the eastern and southern edges of Murtnagurt Lagoon. Thirteenth Beach Residential Estate and Golf Course borders the western and southern edges of the Lagoon. Land on the southern border of the Lagoon is shared approximately equally by the Barwon Heads Golf Course and Thirteenth Beach Residential Estate and Golf Course. Coastal dunes occur further to the south which back Thirteenth Beach (Bird 1993).

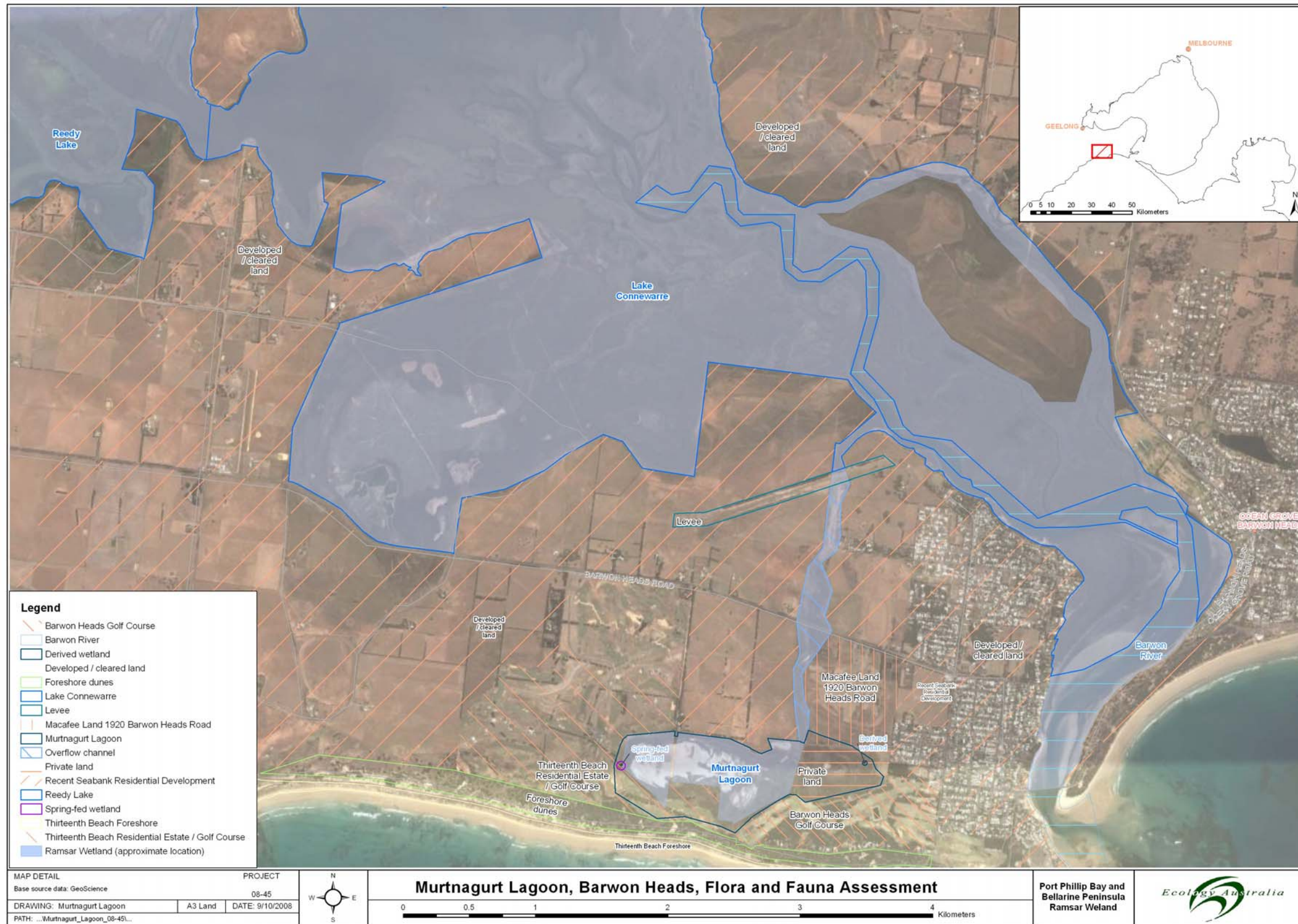
Murtnagurt Lagoon is connected to Lake Connewarre and the Barwon River Estuary and is possibly a former channel of the Barwon River (J. Yugovic, Biosis Research, pers. comm.). Murtnagurt Lagoon would have flooded under tidal influence from the Barwon River Estuary (and possibly by high river floods). However, Murtnagurt Lagoon is effectively isolated from Lake Connewarre and the River by the levee c. 2.5 km to the north and by the Barwon Heads Road unless these barriers are flooded out (Bird 1993; Biosis Research 2004).

The western two-thirds (approximately) of Murtnagurt Lagoon and the Overflow Connecting Channel from Lake Connewarre and the Barwon River Estuary is officially known as Lake Connewarre State Game Reserve and is part of the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar Wetland Site (ANCA 1996; DSE 2003b, 2003c; City of Greater

Geelong 2007; Ecology Australia 2007, 2008). Other components of the Bellarine Peninsula which are included in the Ramsar Site include Reedy Lake, the Barwon River Estuary, Swan Bay, Swan Island and Mud Islands. Lake Connewarre State Game Reserve is managed by Parks Victoria as a Natural Features Reserve – Wildlife Reserve under the *Crown Land (Reserves) Act 1978* and *Wildlife Act 1975* (DSE 2003c). The eastern third of Murtnagurt Lagoon is privately owned by Barwon Heads Golf Course.

Ramsar wetlands are internationally important wetlands listed under the International Convention on Wetlands (i.e. the Ramsar Convention), and are also matters of national environmental significance listed under the EPBC Act 1999. The Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site is important in regards to: (i) total numbers of waterbirds (e.g. regularly supports more than 20,000 waterfowl, including large numbers of migratory waders, thousands of Black Swans, ducks, ibis and cormorants), (ii) substantial numbers of waterbirds from particular groups (e.g. regularly supports tens of thousands of Straw-necked Ibis and internationally significant numbers of migratory waders); (iii) regularly supporting ecologically significant numbers of individuals in a population of one species or subspecies (e.g. regularly supporting internationally significant numbers of Curlew Sandpipers and Sharp-tailed Sandpipers, nationally significant numbers of Red-necked Stint and Marsh Sandpipers and 1% of the known Australian population of Pacific Golden Plover, Grey Plover, Mongolian Plover and Ruddy Turnstone); and (iv) the size, diversity and integrity of the intertidal mudflat, seagrass and saltmarsh ecosystems (Watkins 1993; ANCA 1996; DSE 2003b, 2003c).

Figure 1 Landscape aerial photograph of a section of the Bellarine Peninsula showing the location of the Lake Connewarre State Game Reserve Ramsar boundary encompassing Murtnagurt Lagoon and the overflow connecting channel between the Lagoon and the Barwon River Estuary. Land subject to the proposed rezoning at 1920 Barwon Heads Road is also shown.



3 Methods

Little information is available for Murtnagurt Lagoon. Methods utilised to document and evaluate the vegetation (flora) and fauna of the study area included literature and database reviews, a field inspection and consultation with local environmentalists (e.g. bird watchers).

3.1 Desktop review

Information was reviewed, including:

- flora records within 5 km of the study area (referred to as the Data Review Area – DRA) held in the Flora Information System (FIS), a state-wide database maintained by the Department of Sustainability and Environment (DSE 2005a);
- fauna records from within an area of 5 km radius of the study area held in the Victorian Fauna Display (DSE 2007a), a CD-ROM version of the Atlas of Victorian Wildlife (AVW) database curated by DSE (Appendix 1);
- wader/shorebird (avifauna) records collected from Murtnagurt Lagoon by the Australasian Wader Studies Group (AWSG) and held in Birds Australia’s Atlas database (Appendix 2);
- a search for flora and fauna species listed under the Federal *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) using the EPBC Protected Matters Search Tool database (DEWHA 2008a) for species potentially occurring (or potential habitat occurring) within a 5 km radius of the study area (Appendix 3);
- Ecological Vegetation Class mapping/modelling for the area (both extant and pre-1750) (DSE 2008a);
- previous reports and publications and vegetation community mapping from the broader area (e.g. Yugovic 1985; Biosis Research 2004, 2007; Birds Australia 2007; Ecology Australia 2001, 2007, 2008); and
- aerial photography obtained from Google Earth (2008).

3.2 Field assessment and survey

A field assessment was undertaken by a botanist and a zoologist on 31 July and 1 August 2008, to document the flora and fauna of the study area, including Murtnagurt Lagoon, the adjoining edges of Barwon Heads and Thirteenth Beach Golf Courses and the adjoining proposed Macafee development area.

The site was traversed on foot to: ground check values and record plant species, vegetation communities, fauna species and fauna habitats; identify key areas/habitats; firm the constraints associated with the proposed rezoning; and assess existing threats to the Lagoon’s biodiversity values.

Murtnagurt Lagoon and area of the proposed rezoning were assessed for their potential to support threatened flora and fauna species. For fauna, particular attention was given to potential habitat attributes of threatened fauna species, such as the presence of diverse and abundant saltmarsh vegetation (e.g. for EPBC- and FFG-listed Orange-bellied Parrot and FFG-listed and otherwise state-classified waterbirds).

In conjunction with an aerial photograph, the site inspection was undertaken to place Murtnagurt Lagoon and its Overflow Connecting Channel and the adjoining development area in context with adjoining/nearby areas of fauna habitat, especially the balance of the Ramsar site.

A site visit was undertaken to the northern end of the Overflow Connecting Channel to briefly investigate hydrological issues associated with the flows into the channel and subsequent inundation of Murtnagurt Lagoon.

3.2.1 Determination of Ecological Vegetation Classes

Remnant vegetation in the study area was assigned to Ecological Vegetation Classes (EVCs) by reference to the site data, DSE vegetation modelling (DSE 2008a) and EVC benchmarks (DSE 2008b). Vegetation mapping provided by Yugovic (1985) was checked during the field assessment to broadly assess any changes to vegetation mapped by him and Biosis Research (2004) and particularly the 1985 mapping of the Ramsar section of Murtnagurt Lagoon.

3.2.2 Incidental sightings

All fauna species detected during the habitat assessment were recorded to provide an indicator of the type and quality of fauna habitats occurring in the study area. Diurnal bird species were identified via their calls or by direct observation.

3.3 Conservation status

The conservation status of vegetation communities was determined by reference to DSE's Ecological Vegetation Class bioregional conservation status listings (DSE 2008b). The conservation status of species is determined by reference to DSE's advisory lists (DSE 2005b and 2007b), listings under the Victorian *Flora and Fauna Guarantee Act 1988* (FFG Act) and the Federal *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), and by reference to National Action Plans for vertebrates and invertebrates.

3.4 Terminology and taxonomy

Plant taxonomy and the use of common names follow the accepted authorities – Walsh and Stajsic (2007) and DSE (2004).

The scientific names, common names and systematic orders of fauna used here follow Churchill (1998), Stanger et al. (1998), Birds Australia (2003), Wilson and Swan (2003) and DSE (2007). In

general, only common names are used in the text. A complete list of common and scientific names of species occurring in the fauna DRA is provided in Appendices 3, 4 and 5.

A hash (#) is used to denote native plants that are not indigenous in the relevant vegetation types. An asterisk (*) preceding a plant name is used to signify non-indigenous taxa, which are those that would not naturally occur in the particular habitat, and an asterisk (*) preceding an animal name is used to denote feral (exotic) animals.

4 Values

There are no specific descriptions pertaining to Ramsar values for Murtnagurt Lagoon. Therefore, the Ramsar values described below apply more generally to the larger Lake Connewarre State Game Reserve which encompasses part of the Lagoon. Specific descriptions of the values of Murtnagurt Lagoon (see Section 4.3) arise from our field inspection, the study of Biosis Research (2004) and through consultation. It should be noted that some information used to document values is now dated (e.g. the Ramsar Information Sheet provided in DSE 2003c was compiled in 1999).

4.1 Ramsar values

The western two-thirds (approximately) of Murtnagurt Lagoon and the linking Overflow Channel is within Lake Connewarre State Game Reserve which forms part of the wetland which is listed as a site of international significance under the Ramsar convention (DSE 2003c). It should be noted that the ecological values also occur across the eastern privately-owned section of Murtnagurt Lagoon which is not included in the Ramsar boundary (Biosis Research 2004).

Specific values pertaining to Lake Connewarre State Game Reserve are described in Watkins (1993), ANCA (1996), DSE (2003b, 2003c), Birds Australia (2007) and Chris Tzaros (Birds Australia, pers. comm.). Criteria under which Lake Connewarre State Game Reserve qualifies as a Ramsar site include (also see Biosis Research 2004):

- It is a particularly good representative example of a natural or near natural wetland, characteristic of the appropriate biogeographical region;
- It is a particularly good representative example of a natural or near natural wetland, common to more than one biogeographical region;
- It is of special value for maintaining the genetic and ecological diversity of a region because of the quality and peculiarities of its flora and fauna;
- It regularly supports 20,000 waterfowl;
- It regularly supports substantial numbers of individuals from particular groups of waterfowl, indicative of wetland values, productivity or diversity; and
- Where data on populations are available, it regularly supports 1% of the individuals in a population of one species or subspecies of waterbirds.

Lake Connewarre State Game Reserve (also includes Reedy Lake) is an extensive estuarine and saltmarsh system drained by the Barwon River. It supports a diversity of wetland habitats and includes a large permanent freshwater lake, a deep freshwater marsh, several semi-permanent saline wetlands and an estuary. It is listed as a site of geomorphological interest.

Lake Connewarre State Game Reserve comprises the largest area of native vegetation remaining on the Bellarine Peninsula. Reedy Lake is the largest natural freshwater lake in central Victoria and

has outstanding significance due to its size, floristic richness and structural diversity. The Reserve contains the most extensive (65 ha) example of Silky Wilsonia (*Wilsonia humilis*) herblands in Victoria, and the most extensive area of Australian Salt-grass (*Distichlis distichophylla*) grassland in Victoria. Grey Glasswort (*Halosarcia halecnemoides*) and Tangled Lignum (*Muehlenbeckia cunninghamii*) reach their southernmost limits within the Reserve. The vegetation of the Reserve is very diverse with 137 native species being recorded, including 45 (85%) of the 53 Victorian saltmarsh species.

Lake Connewarre has supported up to 40% of the world population of the EPBC- and FFG-listed Orange-bellied Parrot. Lake Connewarre is one of the three most important areas in Port Phillip Bay between which the Parrots move depending on seasonal availability of food resources, including also Murtcaim Wildlife Reserve (Point Wilson) and Swan Bay. Lake Connewarre is one of the sites where parrots can still be regularly found (Birds Australia records).

Lake Connewarre has supported internationally-significant numbers of Curlew Sandpipers and Sharp-tailed Sandpipers (i.e. greater than 1% of the East Asian - Australasian Flyway) and nationally-significant numbers of the Red-necked Stint and Marsh Sandpiper (i.e. greater than 1% of the national population).

Other threatened fauna species which occur at Lake Connewarre include FFG-listed Great Egret, Fairy Tern, Blue-billed Duck and Australasian Bittern.

Lake Connewarre is also important for the spawning and nursery for river fish, such as the Tupong (*Pseudaphritis urvilli*), Climbing Galaxias (*Galaxias brevipennis*) and Common Jollytail and may be important for early development of the larvae of the EPBC- and FFG-listed Australian Grayling (*Prototroctes maraena*) (Biosis Research 2004).

4.2 Landscape context

Murtnagurt Lagoon is a backswamp fed by overflow during higher tides (and possibly by rainfall flood events) from the Barwon River Estuary. The Lagoon would only receive water when backflows are sufficient to flood over the barriers created by levee in the north and the Barwon Heads Road (Biosis Research 2004). For fish species, Murtnagurt Lagoon is effectively isolated from the Barwon River Estuary under low or moderate tidal inflows (and rainfall flood events), but under higher inflows, fish from the Estuary could occasionally move into the Lagoon (Biosis Research 2004). The Lagoon is therefore partially or loosely connected to the Barwon River Estuary and Lake Connewarre.

Murtnagurt Lagoon is part of a system of significant wetlands scattered throughout the Bellarine Peninsula. These wetlands form a complex or a 'stepping stone' spatial arrangement between which mobile species, especially migratory wader/shorebird species, other waterbird species and terrestrial species dependent on coastal or sub-coastal wetlands move to feed, perch and roost depending on resource availability. Other significant wetlands or sites comprising part of this system and scattered though a landscape of pasture and townships (e.g. Ocean Grove, Point Lonsdale and Queenscliff) include sites forming part of the Ramsar site, such as Lake Connewarre,

Reedy Lake, the Barwon River Estuary, Swan Bay, Swan Island and Mud Islands, and wetlands/sites nominated for inclusion in an extended Ramsar boundary, including Lake Victoria, Freshwater Lagoon, Lonsdale Lakes, Lakers Cutting and Sand Island (DSE 2003b, 2003c; Hewish 2003; Birds Australia 2007; Ecology Australia 2007, 2008a).

4.3 Site-specific values

4.3.1 Murtnagurt Lagoon/Lake Connewarre State Game Reserve

Murtnagurt Lagoon has high biodiversity values (Biosis Research 2004; this assessment). As discussed in Section 2.0, the western section of the Lagoon forms part of Lake Connewarre State Game Reserve, which is included in the internationally important Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar Wetland Site. Although the eastern section is owned by the Barwon Heads Golf Course, the biodiversity values are comparable across the Lagoon.

Ecological Vegetation Classes

Diverse and complex coastal vegetation occurs at Murtnagurt Lagoon (see Yugovic 1985; Biosis Research 2004; this assessment). The intricate patterns result from the subtle influences of microtopography on now largely historic salinity and hydrological regimes. The vegetation fits broadly under the umbrella of a number of threatened saltmarsh and estuarine Ecological Vegetation Classes (EVCs), including (Plates 1-5):

- Coastal Saltmarsh – currently an aggregate of several EVCs and Floristic Communities – status Endangered;
- Estuarine Flats Grassland – dominated by Coast Tussock Grass (*Poa poiformis* var. *poiformis*) – status Vulnerable;
- Estuarine Wetland – dominated by Sea Rush (*Juncus kraussii*) – status Endangered; and
- Saline Aquatic Meadow – characteristic of the main lagoon and variously Water-mat (*Lepilaena* spp.) and/or Tassel (*Ruppia* spp.) – status Rare.

Further, the widely acknowledged diversity within Coastal Saltmarsh EVC is currently under review as part of a National Heritage Trust (NHT) funded project on Victoria's saltmarsh and mangrove communities. This review will develop a new typology for saltmarsh vegetation recognising the distinct structural and floristic elements, variously dominated by:

- Shrubby Glasswort (*Sclerostegia arbuscula*);
- Beaded Glasswort (*Sarcocornia quinqueflora*);
- Blackseed Glasswort (*Halosarcia pergranulata*);
- the highly infrequent Grey Glasswort (*Halosarcia halocnemoides*);
- Chaffy Saw-sedge (*Gahnia filum*);

- Prickly Spear-grass (*Austrostipa stipoides*); and
- Australian Salt-grass (*Distichlis distichophylla*).

All are present at Murtnagurt Lagoon and their distribution aptly described by Yugovic (1985) and Biosis Research (2004) for the Ramsar and Golf Course sections, respectively.

Within the Coastal Saltmarsh aggregate, Beaded Glasswort (*Sarcocornia quinqueflora*) Herbland is extensive in low lying areas across both the Ramsar and Golf Course sites. Blackseed Glasswort (*Halosarcia pergranulata*) Shrubland is localised in higher areas of both sections of the Lagoon. Grey Glasswort (*Halosarcia halocmenoides*) Shrubland is restricted to the centre of the Lagoon (including the eastern end of the Ramsar site and western end of the Golf Course owned sections) and one small stand occurs on higher ground in the east. Shrubby Glasswort (*Sclerostegia arbuscula*) Shrubland is locally extensive in the southern areas of the Lagoon. Chaffy Saw-sedge (*Gahnia filum*) sedgeland fringes the landward edges of the Lagoon. Prickly Spear-grass (*Austrostipa stipoides*) grassland occurs on rises in central sections of the Lagoon. Coast Tussock (*Poa poiformis*) Grassland is localised in areas immediately adjacent to the Lagoon and on rises, especially on the Golf Course section, and with a very small occurrence in the northeast of the Ramsar site. Australian Salt-grass (*Distichlis distichophylla*) grassland occurs as small occurrences on slightly higher rises in the south and east of the Golf Course site and in the southwest and west of the Ramsar site. Sea Rush (*Juncus kraussi*) sedgeland occurs on the southern edge of the Golf Course site and on the southern and western edges of the Ramsar site.

A significant flora feature of Murtnagurt Lagoon is the dry saltmarsh. The Lagoon supports one of the best remaining and largest examples of coastal dry saltmarsh in Victoria (Biosis Research 2004). Dry saltmarsh is critically endangered in the Port Phillip/Bellarine region due to extensive elimination (e.g. 75-80% loss of both wet and dry saltmarsh through development) (Biosis Research 2004).

Also of note is the southerly limit of Grey Glasswort, a drought tolerant halophytic species of salt lakes throughout Australia. On the Bellarine Peninsula, it is isolated from its nearest occurrences in the Wimmera and Mallee (Biosis Research 2004).

A large fresh/brackish pond occurs outside the southwestern edge of Murtnagurt Lagoon (at the heritage-listed pump) (Plate 6). The pond is fed from an underlying aquifer. The pond supports Common Reed and Cumbungi (*Typha* sp.) reedbeds, *Myriophyllum* sp. and algae. The juxtaposition of this wetland immediately adjacent to the saline Murtnagurt Lagoon is of interest.

Two derived vegetation types occur on or surrounding the lagoon. Common Reed (*Phragmites australis*) is now a dominant species on the western edge of the Ramsar site (Plate 7). The species is progressively replacing two saltmarsh communities mapped by Yugovic (1985) – Sea Rush Rushland and Australian Salt-grass Grassland and is indicative of increasing freshwater influence. The expanding Common Reed has a strong topographic relationship with the adjoining golf course and residential development and this is suggestive of cause and effect. Salt Club-sedge (*Bolboschoenus caldwellii*) Sedgeland is invading Beaded Glasswort Herbfield from the fringes of a stormwater pond (c. 200 m²) in the eastern privately-owned section of the Lagoon (Plate 8). It is

associated with the Hopgood Place residential estate stormwater outflow and is having a highly detrimental effect on the saltmarsh vegetation, including the very rare Grey Glasswort Shrubland (Biosis Research 2004).

Overall, known or likely increased freshwater inputs from surrounding development are placing further stress on the saline system already divorced from its major source of salt-flooding of the Barwon River Estuary. This has important implications for the Ecological Character of the Ramsar site which is further discussed in Section 5.1.

The original vegetation of the surrounding calcarenite dunes, including the golf courses and the Macafee property was Coast Moonah (*Melaleuca lanceolata*) Woodland. This is a FFG-listed community and is a floristic community within the Coastal Alkaline Scrub EVC. Only small vestiges of Coast Moonah Woodland remain, including a stand of Moonah on the Macafee property.

Flora conservation status

No species listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC) or Victorian *Flora and Fauna Guarantee Act 1988* (FFG) is known to occur at Murtnagurt Lagoon. However, to our knowledge, there have been no recent systematic flora surveys undertaken at the Lagoon.

Coast Cranesbill (*Geranium* sp. nov. 23), which is listed as Vulnerable in Victoria by DSE (2005), was recorded in the eastern (Golf Course) section of Murtnagurt Lagoon by Biosis Research (2004).



Plate 1. Beaded Glasswort (*Sarcocornia quinqueflora*) Herbland is extensive in low lying areas across both the Ramsar and privately owned sections of Murtnagurt Lagoon (30 July 2008).



Plate 2. Estuarine Flats Grassland, dominated by Coast Tussock Grass (*Poa poiformis* var. *poiformis*), is a Vulnerable Ecological Vegetation Class (30 July 2008).



Plate 3. Zonation in Coastal Saltmarsh vegetation against the adjoining Saline Aquatic Meadow of the main lagoon (1 August 2008).



Plate 4. Saline Aquatic Meadow is characteristic of the main lagoon. Its status in the Bioregion is 'Rare' (1 August 2008).



Plate 5. Photo demonstrating the close proximity of Thirteenth Beach Residential Estate and Golf Course to the western edge of Murtnagurt Lagoon (Chaffy Saw-sedge *Gahnia filum* is in mid-ground and Beaded Glasswort in foreground) (1 August 2008).



Plate 6. Spring-fed freshwater pond supporting Common Reed (*Phragmites australis*), Cumbungi (*Typha* sp.), *Myriophyllum* sp. and algae at the southwestern edge of Murtnagurt Lagoon (background) (1 August 2008).



Plate 7. Common Reed (*Phragmites australis*) (yellow band in top half of photo), indicative of freshwater runoff from the adjoining golf course, is now a dominant species on the western edge of the Ramsar site and is progressively replacing saltmarsh communities (1 August 2008).



Plate 8. Derived freshwater pond fed by stormwater from Hopgood Place and Salt Club-sedge (*Bolboschoenus caldwellii*) Sedgeland invading saltmarsh in the eastern side of Murtnagurt Lagoon (1 August 2008).

Fauna habitats

Five fauna habitats were recognised for the study area: Terminology used for some of these is adopted from the EVC classification:

1. Coastal Saltmarsh Shrubland/Herbland;
2. Estuarine Sedgeland/Grassland;
3. Saline Aquatic Meadow;
4. Mudflats;
5. Spring-fed Freshwater Wetland (e.g. with Cumbungi *Typha* sp. and Common Reed *Phragmites australis* reedbeds); and
6. Artificial *Bolboschoenus* Freshwater Wetland fed by stormwater.

The natural fauna habitats occupy different zones according to saline influence. Common Reed reedbeds on the western end of Murtnagurt Lagoon appear to be anthropogenically derived. The Freshwater Wetland at the eastern end (in private land) is a result of stormwater from the Hopgood Place residential development. The freshwater effects at both ends of the Lagoon are degrading the natural values.

Coastal Saltmarsh Shrubland/Herbfield supports suitable habitat attributes (e.g. food plants, such as Grey Glasswort, Beaded Glasswort and Shrubby Glasswort) for the EPBC-listed Orange-bellied Parrot, which is well known from Lake Connewarre State Game Reserve to the north (Higgins 1999; Biosis Research 2004; Commonwealth of Australia 2005; Birds Australia records).

The large fresh/brackish pond outside the southwestern edge of Murtnagurt Lagoon supports good habitat (e.g. open water, emergent and submergent vegetation) for freshwater waterbird species (e.g. Eurasian Coot and Australian Grebe, ducks), small passerines dependent on wetland vegetation (e.g. Australian Reed-warbler) and locally-common frog species (Appendix 4).

Fauna recorded

A total of 31 vertebrate species was recorded at Murtnagurt Lagoon (Appendix 4). The natural habitats support a diverse array of fauna species typical of saltmarsh and adjoining saline/brackish vegetation (Appendix 4). The Brackish Wetland typically supports ducks, swans and egrets (e.g. Chestnut Teal, Grey Teal, Black Swan, Great Egret and Little Egret). Mudflats of Murtnagurt Lagoon support a number of international migratory shorebird/wader species (e.g. sandpipers, stints, stilts) (Table 1; Appendices 2, 4 and 5). The Coastal Saltmarsh/Herbland supports a variety of small passerines (e.g. Little Grassbird, Striated Fieldwren, Brown Thornbill, White-browed Scrubwren and White-fronted Chat) and the migratory Blue-winged Parrot. Adjoining Brackish Sedgeland/Grassland also supports small passerines (e.g. Striated Fieldwren and Golden-headed Cisticola). Grey Teal and Chestnut Teal breed in next boxes erected at the Lagoon by members of the Field and Game Australia Geelong Branch. Threatened duck species (e.g. Australasian

Shoveler, Musk Duck and Hardhead) are rarely, if ever, sighted (Daryl Heath, Field and Game Australia, pers. comm.).

Of note is the presence of the Blue-winged Parrot. The Blue-winged Parrot is not a threatened species, but often occupies coastal saltmarsh and adjoining habitats, including pasture edges, with smaller numbers of the EPBC- and FFG-listed Orange-bellied Parrot (Higgins 1999; Biosis Research 2004).

Table 1 Wader/shorebird species recorded at Murtnagurt Lagoon between 22 February 1981 and 29 June 2007 by the Australasian Wader Studies Group (AWSG) (data supplied by Birds Australia). Data supplied from 44 surveys. The maximum numbers of individuals of each wader species recorded during the highest five counts (or less) is provided.

A full list of bird species recorded, including non-wader species is provided in Appendix 2.

Common name	Number (and percentage) of counts	Maximum numbers of the wading species from five highest counts
Red-necked Stint	22 (50%)	100, 150, 1570, 140, 480
Red-capped Plover	32 (73%)	30, 50, 40, 65, 48
Pacific Golden Plover	3 (7%)	11, 7, 4
Masked Lapwing	38 (86%)	20, 80, 16, 11, 10
Double-banded Plover	9 (21%)	19, 20, 28, 33, 5
Black-winged Stilt	17 (39%)	36, 31, 39, 20, 40
Hooded Plover	3 (7%)	1, 5, 4
Banded Stilt	2 (4%)	1, 30
Red-necked Avocet	4 (9%)	4, 12, 6, 36
Greenshank	8 (18%)	17, 45, 50, 12, 33
Sharp-tailed Sandpiper	4 (9%)	360, 380, 1, 4
Curlew Sandpiper	3 (7%)	20, 200, 7
Marsh Sandpiper	1 (2%)	13
Red-kneed Dotterel	2 (5%)	2, 7
Lesser (Mongolian) Sandplover	1 (2%)	3

Fauna conservation status

The standard protocol for addressing threatened fauna species includes:

- Commonwealth EPBC-listed species (two categories):
 - threatened species (Critically Endangered [CE], Endangered [EN], Vulnerable [VU], Conservation Dependent [CD], and Presumed Extinct [EX]); and/or
 - migratory species (Migratory [Mi], and/or Marine-overfly [M]).
- Victorian FFG-listed species (threatened taxa listed under Schedule 2 of the Act [L]);

- Species otherwise classified as threatened under DSE (2007) (Regionally Extinct [RE], Extinct/Extinct in the Wild [EX], Critically Endangered [CE], Endangered [EN], Vulnerable [VU], Near Threatened [NT] and Data Deficient [DD]); and
- Species classified as threatened under a National Action Plan (Extinct/Extinct in the Wild [EX], Critically Endangered [CE], Endangered [EN], Vulnerable [VU], Rare [R], or Lower Risk (Near Threatened [NT] or Conservation Dependent [CD])).

A number of threatened species have previously been recorded in the fauna Data Review Area (DRA) under both the AVW (DSE 2007a; Appendix 1) and Birds Australia's Atlas database (Appendix 2). These include:

- 10 species listed under the EPBC Act 1999;
- an additional 16 species listed under the FFG Act 1988;
- 22 species classified only by DSE (2003); and
- six species classified only under a National Action Plan.

The DEWHA EPBC Act Protected Matters Database Search Tool highlighted a number of threatened and/or migratory EPBC-listed fauna species as potentially occurring, or suitable habitat for these species potentially occurring, in a 5 km radius of the study area, but which had never been recorded in the fauna DRA under both the AVW or Birds Australia's database (DSE 2007a; Table 3; Appendices 1, 3 and 5). These include a further 26 species listed as threatened under the EPBC Act 1999, 19 of which are also listed under the FFG Act (Appendix 5). The additional 26 species listed under the EPBC Act include the following species or species groups:

- 11 species of Albatross and the Soft-plumaged Petrel (species which feed in pelagic and inshore waters, but breed elsewhere e.g. breed on Antarctic and Sub-antarctic Islands or islands off New Zealand and Tasmania) (Emison et al. 1987, Marchant and Higgins 1990, Environment Australia 2001, Holliday 2003a);
- Australian Painted Snipe;
- the Regent Honeyeater, which is probably extinct in southern Victoria and on the decline in northern Victoria;
- five terrestrial mammals [Spot-tailed Quoll, Long-nosed Potoroo, Common Bent-wing Bat (southern subspecies), Grey-headed Flying-fox and Smoky Mouse];
- two species of whale (Blue Whale and Humpback Whale);
- the Growling Grass Frog;
- three freshwater fish species (Dwarf Galaxias, Australian Grayling and Yarra Pygmy Perch); and
- one saltwater fish species (Great White Shark, see Environment Australia 2002; Holliday 2003b).

Some of these DEWHA (EPBC-listed) predicted species, comprising Spot-tailed Quoll, Southern Brown Bandicoot, Long-nosed Potoroo and Common Bent-wing Bat (southern subspecies) either never occurred in the broader area, or have not been recorded in close vicinity in recent times (AVW, DSE 2007a). The DEWHA database predicts occurrences based on broad drainage basins. Thus, the predicted occurrences for some species highlighted in a data search extend well beyond their actual range.

Threatened species considered likely to occur

The likelihood of regular occurrence (LRO) of all threatened species is considered here, and is based upon: reporting rates (i.e. number, distribution and age of records) of the species as given in the AVW Records (DSE 2007a); their recording in Birds Australia's Atlas database; their known habitat requirements; the presence of suitable habitat in the study area; and results of the field inspection and literature review (Appendices 1, 2, 4 and 5). An additional species recorded outside the DRA, but well known from saltmarsh habitats, and considered here is the Swamp Skink (*Egernia coverntryi*).

Fourteen (14) threatened species have a moderate or higher LRO at Murtnagurt Lagoon, comprising:

- one species listed under the EPBC Act 1999 (Orange-bellied Parrot);
- eight species listed as threatened under the FFG Act (Lewin's Rail, Hooded Plover, Great Egret, Little Egret, Fairy Tern, Caspian Tern, Swamp Skink and Yellow Sedge-skipper (Altona Skipper Butterfly)); and
- five species otherwise classified as threatened in Victoria under DSE (2007b) (Pied Cormorant, Pacific Gull, Royal Spoonbill, Whiskered Tern and Glossy Grass Skink).

Species listed under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 and Victorian Flora and Fauna Guarantee Act 1988

***Orange-bellied Parrot* [Listed as Critically Endangered under EPBC Act, Listed under FFG Act and otherwise classified as Critically Endangered in Victoria by DSE (2007b)]**

The Orange-bellied Parrot is a winter migrant to mainland Australia from its breeding grounds in southwest Tasmania. The total population probably numbers less than 150 birds. During the overwintering period, the Parrot occupies diverse coastal saltmarsh vegetation and adjoining areas (e.g. pastures and other exotic grasslands) between southeastern South Australia and South Gippsland. In Victoria, the most important food plants are Beaded Glasswort, Southern Sea-heath (*Frankenia pauciflora*), Austral Seablite (*Suaeda australis*), Grey Glasswort and Shrubby Glasswort. Weedy species providing food in adjacent areas include Glaucus Goosefoot (*Chenopodium glaucum*), Hastate Atriplex (*Atriplex hastate*) and Cape Weed (*Arthrotheca calendula*) (DSE 2003f). The Bellarine Peninsula is one of the most important sites on the mainland for the Orange-bellied Parrot which has been recorded at Lake Connewarre, Swan Bay,

Freshwater Lake, Lake Victoria and a number of other sites (Orange-bellied Parrot Recovery Team and Birds Australia data).

The Coastal Saltmarsh Shrubland/Herbland at Murtnagurt Lagoon supports suitable habitat attributes (e.g. food plants, such as Grey Glasswort, Beaded Glasswort and Shrubby Glasswort) for the Orange-bellied Parrot. The Parrot is well known from Lake Connemara State Game Reserve to the north, which has been well surveyed for at least two decades (Higgins 1999; DSE 2003f; Biosis Research 2004; Commonwealth of Australia 2005; Chris Tzaros, Birds Australia, pers. comm.; Birds Australia records). In contrast, Murtnagurt Lagoon is poorly surveyed, and hence, the absence of records should not be considered to be an absence of the species from the site.

Furthermore, the Blue-winged Parrot is considered to be an indicator species for the likely occurrence of its close relative, the Orange-bellied Parrot. The regular occurrence of Orange-bellied Parrots to the north of Murtnagurt Lagoon at Lake Connemara, the presence of suitable habitat at the Lagoon and the large numbers of Blue-winged Parrots recorded both at the Lagoon and in the Overflow Channel during the current field assessment suggests that the Orange-bellied Parrot has a moderate LRO at the Lagoon and in the Overflow Channel.

Species listed under the Victorian Flora and Fauna Guarantee Act 1999

***Lewin's Rail* [Listed under FFG Act and otherwise classified as Vulnerable in Victoria by DSE (2007b)]**

FFG-listed **Lewin's Rail** is a secretive waterbird species which favours areas of dense cover in a variety of wetland habitats ranging from swamp forest, through open freshwater with reedbeds, to coastal saltmarsh (Marchant and Higgins 1993; Ecology Australia 2005, 2006c, 2008d). Lewin's Rail is a well known inhabitant of saltmarsh, and is likely to favour tidal saltmarsh habitats (Ecology Australia 2008d), a situation which no longer occurs at Murtnagurt Lagoon due to the barriers created by the levee and Barwon Heads Road. There are no records for the DRA (DSE 2007). However, this may also reflect the species cryptic nature and previous lack of an appropriate survey technique (e.g. see Ecology Australia 2005, 2006c). In the absence of survey data, we suggest a moderate LRO.

***Fairy Tern* [Listed under FFG Act and otherwise classified as Endangered in Victoria by DSE (2007b)]**

FFG-listed **Fairy Tern** is a species of sheltered coastal environments, including lagoons, estuaries and river mouths, especially those with exposed sandbanks or sandspits. They nest on sandy substrates containing much shell-grit on sandspits, banks, ridges or islets and forage in shallow waters of estuaries, lakes and lagoons. They also roost, loaf or forage on sandy ocean beaches. In Victoria, Fairy Terns breed at scattered locations along the coast between East Gippsland and Port Phillip Bay, including Mallacoota Inlet, Corner Inlet, Westernport Bay, Werribee, Swan Bay and Mud Islands. Fairy Terns have a moderate LRO at Murtnagurt Lagoon (i.e. foraging over water) (Higgins and Davies 1996; DSE 2003c).

***Caspian Tern* [Listed under FFG Act and otherwise classified as Near Threatened in Victoria by DSE (2007b)]**

Caspian Terns also mostly occur in sheltered coastal embayments with muddy or sandy margins, but also occur on near-coastal or inland fresh or saline wetlands. In the broader area, they breed at Mud Islands (Higgins and Davies 1996; DSE 2003c). The waters of Murtnagurt Lagoon provide foraging habitat (moderate LRO).

***Great Egret* [Listed under FFG Act and otherwise classified as Vulnerable in Victoria by DSE (2007b)]**

Great Egrets occupy most wetland types from tidal flats to the margins of inland swamps and rivers. They are non-breeding residents in southern Victoria. In the Gippsland Lakes system, Great Egrets formerly bred at Heart Morass (west of Lakes Entrance) in freshwater Tea-tree swamps. However, they have not bred in East Gippsland for 10 years (for reasons unknown), and the main area for breeding in Victoria is along the Murray River system (Emison et al. 1987; Marchant and Higgins 1990; DSE 2003d; Martin O'Brien, DSE, DSE and Wetland Biologist; Actions for Biodiversity Conservation database, pers. comm.). They are likely to forage regularly at Murtnagurt Lagoon (high LRO).

***Little Egret* [Listed under FFG Act and otherwise classified as Endangered in Victoria by DSE (2007b)]**

Little Egrets inhabit mudflats, saltworks and shallow margins of tidal estuaries and inland rivers and lakes (Emison et al. 1987; Marchant and Higgins 1990; DSE 2003d). A colony of 6-12 pairs of Little Egrets has bred in Cypress trees at Geelong Grammar School, near Corio, for the last 10-12 years and it is most likely that these individuals are those observed feeding at Murtnagurt Lagoon (Barry Lingham, Geelong Field Naturalists Club, pers. comm.). The breeding colony at Corio is the only breeding colony in Victoria, following collapse of breeding at Barmah Forest and Gunbower Island along the Murray River (where they formally occurred in the thousands), and at Heart Morass in the Gippsland Lakes.

The Victorian population of Little Egrets is possibly less than 100 birds. The regional population of Little Egrets is probably the 6-12 breeding pairs at Corio (i.e. the 6-12 reflects annual variation in breeding). The birds range as far as Lake Connewarre, Limeburners Bay, the Western Treatment Plant and Point Wilson to forage (Martin O'Brien, DSE and Wetland Biologist; Actions for Biodiversity Conservation database, pers. comm.). Murtnagurt Lagoon is an important site for Little Egret in the context of the Victorian population (moderate LRO).

***Hooded Plover* [Listed under FFG Act and otherwise classified as Vulnerable in Victoria by DSE (2007b)]**

Hooded Plovers occupy sandy ocean beaches, generally preferring beaches with scattered piles of kelp and backed by dunes (Emison et al. 1987, DSE 2003e; Weston and Elgar 2005a, 2005b). The estimated eastern Australian population size of the Hooded Plover given in Garnett and Crowley (2000) is 2,270 birds. The Victorian population comprises less than 400 breeding pairs (Jim

Whitelaw, Australasian Wader Study Group, pers. comm.). The Hooded Plover has suffered a significant range decline since European settlement and their breeding success is very low to extremely low, particularly on beaches frequently visited by people and dogs. Major threats to the species are disturbance by humans and domestic dogs, walkers, horse-riders, nest and egg destruction by off-road vehicles and foot traffic, feral predators and destruction of nest sites through flood or storm damage. When management regimes are implemented (e.g. dog restrictions and decreasing areas for horse-riding), reproductive success increases (Dowling and Weston 1999; DSE 2003e; Weston and Elgar 2005a, 2005b).

Hooded Plovers breed at several locations on beaches close to Murtnagurt Lagoon (Birds Australia 2007; Geelong Field Naturalists Club 2007; Grainne Maguire, Birds Australia, pers. comm.; Birds Australia records). The pairs regularly breed at: Barwon Bluff, Barwon Heads (c. 2 km southeast of Murtnagurt Lagoon); the western end of Thirteenth Beach (c. 2 km southwest); Black Rocks (c. 4 km west southwest); Nobles Rocks, Breamlea (c. 7 km west southwest); Breamlea (c. 9 km southwest); and the Point Impossible Estuary (c. 10 km southwest).

Murtnagurt Lagoon is an important storm shelter/refuge for Hooded Plovers, supporting plovers from as far away as the Mornington Peninsula. Up to 20 Hooded Plovers are observed at the Lagoon during autumn (high LRO) (Geelong Field Naturalists Club 2007).

***Swamp Skink* [Listed under FFG Act and otherwise classified as Vulnerable in Victoria by DSE (2007b)]**

The Swamp Skink occurs in southeastern Australia, where it has a disjunct distribution throughout southern Victoria from the New South Wales border, and extending into the Mt Gambier region of South Australia. It is patchily distributed with concentrations of records in the Portland area, Grampians, Warrnambool, Port Campbell, Apollo Bay, Anglesea, Bellarine Peninsula, Mornington Peninsula/Western Port hinterland (including French Island), South Gippsland/Wilsons Promontory, Lakes Entrance and East Gippsland (Robertson 1998, Wilson and Swan 2003, DSE 2007a, Clemann 2006; Friends of Tootgarook Wetlands, undated).

The Swamp Skink is a cryptic and elusive species which is often associated with dense ground level vegetation at freshwater swamps and associated watercourses, or adjacent wet heaths, sedgelands and saltmarsh (e.g. Estuarine Flats Grassland, Swamp Scrub, Mountain Swamp Gum *Eucalyptus camphora* Swamp Woodland, Wet Heath, Coastal Saltmarsh), especially those supporting thickets of Paperbark (*Melaleuca* spp.) and Tea-tree (*Leptospermum* spp.). However, it has more recently been recorded in heathy woodland at the headwaters of a drainage line without any Paperbark thickets (near Ballarat) and in coastal heathland situated some distance from water (Schulz 1985, Clemann et al. 1998, Robertson 1998, Clemann and Beardsell 1999, Clemann 2000, 2004, 2006; Wildlife Profiles 2008; Ecology Australia 2008b; Andrew McMahon, Ecology Australia, pers. obs.). Within these habitats, it is not uniformly distributed, but selects micro-environments where vegetation is dense below two metres, but with little overstorey. Thus, it basks on grass tussocks (including weeds), reeds, sedges, logs and rocks, where there is a break in the canopy (Clemann 2006). For example, at Tootgarook Swamp in Rye, tall dense *Melaleuca*

ericifolia thickets are avoided, but margins of these thickets and adjacent *Gahnia* sp. sedgeland or other dense, low vegetation are used extensively (Robertson 1998).

There is a dated record (from 1989) for Swan Bay Island outside of the DRA (AVW, DSE 2007a). It has been more recently recorded (in 2007) in Riparian Scrub and Aquatic Sedgeland (EVCs) at the Anglesea Heathlands, c. 25 km away (Ecology Australia 2008c). Extensive suitable habitat occurs at Murtnagurt Lagoon and Lake Connewarre, including the Coastal Saltmarsh, Chaffy Saw-sedge sedgeland and *Poa poiformis* grasslands. In the absence of surveys specifically for this species, we suggest a moderate LRO.

***Yellow Sedge-skipper* (Altona Skipper Butterfly) [Listed under FFG Act and otherwise classified as Near Threatened in Victoria by DSE (2007b)]**

The Yellow Sedge-skipper was last recorded at Murtnagurt Lagoon in 1988 (AVW, DSE 2007a). Whilst the butterflies feed on nectar from a variety of plant species of saline environments (e.g. saltmarsh species), the key larval food plant is Chaffy Saw-sedge (*Gahnia filum*) (Crosby 1990; Braby 2004), an abundant species at Murtnagurt Lagoon. Dated records (all from 1988) occur: in the Overflow Channel to Murtnagurt Lagoon; at Lake Connewarre (c. 4 km north); at Breamlea Flora and Fauna Reserve (c. 5 km southwest); east of Marcus Hill (c. 13 km east of Murtnagurt Lagoon); and in the Geelong area (c. 25 km north). In the absence of recent records, we suggest a moderate LRO (Appendix 5).

Species otherwise classified as threatened by DSE (2007b)

Pied Cormorant (Near Threatened, moderate LRO), **Pacific Gull** (Near Threatened, high LRO) and **Royal Spoonbill** (Vulnerable, moderate LRO) are unlikely to breed at Murtnagurt Lagoon. They are likely to forage in the waters of Murtnagurt Lagoon or perch and roost on adjoining mudflat edges. **Whiskered Terns** (Near Threatened) are also known from saline wetlands in the Point Lonsdale area (Ecology Australia 2008a; Ecology Australia, unpublished data) (moderate LRO).

The **Swampland Cool-skink (Glossy Grass Skink)** (Near Threatened) occupies swamps and lake edges, saltmarshes and boggy creeks with dense vegetation (Wilson and Swan 2003). For the DRA, there is a single record from Lonsdale Lakes, from 1994; this is c. 8 km northeast of Murtnagurt Lagoon (DSE 2007a). This species possibly occurs in the Coastal Saltmarsh and Estuarine Flats Grassland of Murtnagurt Lagoon (moderate LRO).

Migratory species listed under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999

One hundred and thirty-eight (138) species occurring in the fauna DRA, or predicted to occur in a 5 km radius of the study area under the EPBC Act database are listed under the EPBC Act as Migratory and/or Marine Over-fly species. Fifty-three (53) of these species are considered to have a moderate or higher LRO at Murtnagurt Lagoon due to the presence of suitable habitat (Appendix 5).

Nineteen (19) of these species were recorded during the current field assessment: Masked Lapwing, Double-banded Plover, Red-capped Plover, Black-winged Stilt, Red-necked Stint, Australian White Ibis, Straw-necked Ibis, Black Swan, Pacific Black Duck, Chestnut Teal, Black-shouldered Kite, Nankeen Kestrel, Blue-winged Parrot, Welcome Swallow, Flame Robin, Magpie-lark, Little Grassbird, Australian Pipit and Little Raven (Appendices 4 and 5).

Of the 53 species considered to have a moderate or higher LRO at Murtnagurt Lagoon (Appendix 6):

- one species is listed under the EPBC Act 1999 (Orange-bellied Parrot);
- five species are listed as threatened under the FFG Act (Hooded Plover, Great Egret, Little Egret, Caspian Tern and Fairy Tern); and
- two species are otherwise classified as threatened in Victoria under DSE (2007b) (Pacific Gull and Whiskered Tern).

For the Orange-bellied Parrot, Murtnagurt Lagoon potentially supports an ecologically-significant proportion¹ (i.e. greater than 1%) of the National population. For the Little Egret, the Lagoon is likely to support an ecologically significant proportion of the Victorian population. For the Hooded Plover, and using the Victorian population estimate of 400 breeding pairs (i.e. a conservative total of 800 birds), the Lagoon is known to support an ecologically significant proportion of the Victorian population of this species (i.e. up to 20 birds).

For a migratory species, 'important habitat' is defined as (under the EPBC Act 1999, see DEH 2006):

- Under criterion 'a', habitat that occasionally or periodically supports an ecologically significant proportion of the population of the species (ecologically significant sensu Ramsar = 1% of the biogeographic population e.g. shorebirds – East Asian Australasian Flyway and Orange-bellied Parrot - national population); and
- Under criterion 'd', habitat in an area where the species is declining.

Even if the Orange-bellied Parrot occurs at Murtnagurt Lagoon or in the Overflow Channel in ecologically significant numbers only occasionally (we suggest a Moderate LRO), both the Lagoon

¹ Whether a site supports an ecologically significant proportion of a population is an important consideration for determining significant impacts on a migratory species in context of the EPBC Act 1999 (see DEH 2006). The steps needed are to define the biogeographic boundary of the population of the migratory species or subspecies in question, and then determine what is an ecologically significant proportion of that population. For waterbirds, Ramsar principles set criteria at 1% or more of a national or international population or 1% or more of the individuals in the East Asian – Australasian Flyway population) for determining important wetland sites (see Watkins 1993; ANCA 1996; DSE 2003c). For the Orange-bellied Parrot, we adopt the Ramsar criterion of 1% of the National population where the total population is probably less than 150 birds.

and channel would satisfy the definition of important habitat as outlined under criterion ‘a’. Furthermore, even though the Bellarine Peninsula is an important area where the species occurs annually at key sites (e.g. Lake Connewarre, Swan Bay), Birds Australia records collected over the past 30 years suggest that like all other areas where it occurs, the Parrot has clearly declined over that time, and therefore, Murtnagurt Lagoon is part of that ‘important habitat’ (criterion ‘d’).

Environmental Significance Overlay

Lake Connewarre State Game Reserve, including the western section of Murtnagurt Lagoon and the Overflow Channel, and the eastern privately-owned section of Murtnagurt Lagoon (not included in the Ramsar site), is covered by a Schedule to an Environmental Significance Overlay (ESO2) (Figure 1). A small indented parcel of land on the southern side of the Lagoon is owned by Thirteenth Beach Residential Estate and Golf Course and is also covered by the ESO2. The ESO2 covers high value wetlands and associated habitat protection. These areas are considered significant because the site:

- is an international wetland; forms part of the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site;
- provides habitat for migratory shorebirds, waterfowl and endangered species;
- is habitat for species listed under the international migratory bird agreements (China Australia Migratory Bird Agreement or CAMBA and Japan Australia Migratory Bird Agreement or JAMBA);
- is included in the East Asian – Australasian Flyway network of sites for migratory shorebirds/waders;
- is habitat for FFG-listed species; and
- contains habitat that is an extension of, or which provides a buffer to, high value wetland communities.

Amongst others, key objectives of the ESO2 include: maintaining the Ecological Character of Ramsar wetlands; protecting natural resources and maintaining ecological processes and genetic diversity; protecting habitat for threatened species; maintaining wetland function; and protecting water quality.

Important Bird Areas

Birds Australia is working with the Commonwealth Government to identify areas of significance to shorebirds in Australia (i.e. the Important Bird Areas program or IBAs) (Birds Australia 2007). The IBA program is an international non-governmental conservation scheme lead by BirdLife International Partners, such as Birds Australia. IBAs are sites of international importance for bird conservation. IBAs are sufficiently small to set practical targets for conservation management, but large enough to meet the global IBA criteria. The Australian IBA program will help protect a network of sites critical for the conservation of Australia’s birds by:

- promoting IBAs as a tool for biodiversity conservation planning;
- encouraging government to prioritise conservation at IBAs (e.g. in grant-giving schemes);
and
- encouraging and facilitating local community-based groups and land-owners to manage land sustainably and conserve key bird species.

Murtnagurt Lagoon is part of the larger Lake Connewarre and Barwon River Estuary Important Bird Area (IBA) identified by Birds Australia. Other areas forming the Bellarine Peninsula and Swan Bay IBAs include Lake Victoria, Freshwater Lake, Swan Bay and the coast between Queenscliff and Breamlea. Two key species used to identify the Bellarine Peninsula and Swan Bay IBAs are Orange-bellied Parrot and Hooded Plover (Birds Australia 2007).

Key values of Murtnagurt Lagoon

- The western section of Murtnagurt Lagoon forms part of Lake Connearre State Game Reserve, which is included in the internationally important Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar Wetland Site. Although the eastern section is owned by the Barwon Heads Golf Course, the biodiversity values are spread across the Lagoon.
- Murtnagurt Lagoon is covered by a Schedule to an Environmental Significance Overlay (ESO2) for high quality wetlands.
- Murtnagurt Lagoon is part of the larger Lake Connearre and Barwon River Estuary Important Bird Area (IBA) identified by Birds Australia.
- All EVCs occurring at Murtnagurt Lagoon are endangered.
- The Lagoon generally supports intact sequences of vegetation communities.
- Fauna habitats occurring at Murtnagurt Lagoon, including Coastal Saltmarsh Shrubland/Herbland, Estuarine Sedgeland/Grassland, Saline Aquatic Meadow and Mudflats are of high quality.
- Fourteen threatened fauna species have a moderate or higher LRO at Murtnagurt Lagoon, comprising: the EPBC- and FFG-listed Orange-bellied Parrot; FFG- listed Lewin's Rail, Hooded Plover, Great Egret, Little Egret, Fairy Tern, Caspian Tern, Swamp Skink and Yellow Sedge-skipper (Altona Skipper Butterfly); and four species otherwise classified as threatened in Victoria by DSE (2007) (Pied Cormorant, Pacific Gull, Royal Spoonbill, Whiskered Tern and Swampland Cool-skink).
- Key threatened fauna species known or considered likely to occur include the Orange-bellied Parrot (a winter migrant to coastal saltmarshes on the mainland from its breeding grounds in southwestern Tasmania, which regularly occurs on the Bellarine Peninsula e.g. Lake Connearre, Swan Bay), Hooded Plover (breeds on nearby beaches and uses the Lagoon as a refuge) and Little Egret (breeds at Corio in Geelong and is known to feed at the Lagoon).
- Murtnagurt Lagoon potentially supports an ecologically-significant proportion (i.e. greater than 1%) of the National population of the Orange-bellied Parrot and 'important habitat' as defined under the EPBC Act 1999. The Lagoon is likely to support an ecologically significant proportion of the Victorian populations of Little Egret and Hooded Plover.
- The mudflats of Murtnagurt Lagoon support a variety of international migratory wader/shorebird species.

4.3.2 Overflow Channel to Murtnagurt Lagoon (Lake Connewarre State Game Reserve)

Ecological Vegetation Classes

The Overflow Channel runs for c. 2.6 km from the Barwon River Estuary before it reaches Murtnagurt Lagoon. In the north, the channel is c. 50 m wide and dissected by a levee situated c. 450 m to the south side of the Estuary. The habitat to the south of the levee is narrow and dissected further by access tracks. The channel runs for c. 1200 m to Barwon Heads Road where the width is c. 250 m. To the south of Barwon Heads Road, the Overflow Channel to Murtnagurt Lagoon varies in width from 250 m just south of the Road to about 50-80 m for the remainder of its length.

The values of the Overflow Channel are compromised by the levee and tracks in the north.

The channel supports similar vegetation to Murtnagurt Lagoon (though fewer communities) with a patchwork of predominantly Chaffy Saw-sedge Sedgeland and Beaded Glasswort Herbland, with small occurrences of Blackseed Glasswort Shrubland, Coast Tussock Grassland and exotic vegetation (Yugovic 1985). All indigenous vegetation is currently within the Coastal Saltmarsh EVC and its status is Endangered (Plates 9-12).

Connectivity/Landscape context

The Overflow Connecting Channel is the critical hydrological and habitat link between the Barwon River Estuary and Murtnagurt Lagoon.

The hydrology of the Overflow Channel is not precisely understood. However, it would appear to support backflows from the Barwon River Estuary under high tidal influence or possibly from rainfall-induced flood events. The Overflow Channel is the only hydraulic link that connects Murtnagurt Lagoon to the balance of the Ramsar site. The Lagoon would only receive inflows when flooding/tides is sufficient to overcome the hydraulic restrictions of the levee and to overtop the Barwon Heads Road.

The Overflow Channel is the only functional habitat link between Murtnagurt Lagoon and the Barwon River Estuary/Lake Connewarre. It could be used by a broad range of species, including the EPBC- and FFG-listed Orange-bellied Parrot.

Fauna habitats

Three fauna habitats were identified for the Overflow Channel:

1. Coastal Saltmarsh Shrubland/Herbland;
2. Estuarine Sedgeland/Grassland; and
3. Exotic Grassland.

The fauna species likely to occur in these habitats are discussed in Section 4.3.1.

Fauna recorded

Of note is the large flock of 70 Blue-winged Parrots recorded during the field assessment because of the close affinities of ecology and behaviour between Blue-winged Parrots and nationally-threatened Orange-bellied Parrots (Plate 11). The Striated Fieldwren, a saltmarsh and sedgeland inhabitant was also recorded in the Overflow Channel (Appendix 4).

Fauna conservation status

The three key species likely to occur in the Overflow Channel are the EPBC- and FFG-listed Orange-bellied Parrot and the FFG-listed Swamp Skink and Yellow Sedge-skipper. The presence of Blue-winged Parrots in the Overflow Channel indicates that suitable habitat occurs there for Orange-bellied Parrots (moderate LRO). The Orange-bellied Parrot potentially forages in the Overflow Channel and uses the channel as a habitat link between the Barwon River Estuary/Lake Connewarre and Murtnagurt Lagoon in a similar fashion to the manner in which Blue-winged Parrots were observed using the Overflow Channel (see above). Given the entire population of Orange-bellied Parrots numbers less than 150 birds, the Overflow Channel is likely to support an ecologically significant proportion of the National population of this species.

Suitable habitat (i.e. saltmarsh and Chaffy Saw-sedge sedgeland) occurs in the Overflow Channel for the Swamp Skink and Yellow Sedge-skipper (moderate LRO) (see above).

Other threatened species known to or considered likely to occur at Murtnagurt Lagoon and known to occur at Lake Connewarre/Barwon River Estuary (e.g. Great Egret, Little Egret, threatened tern species, etc.) also probably use the Overflow Channel as a habitat link on a moderate to high basis, though are less likely to forage in the channel in the absence of regular flooding of the channel.

Key values of the Overflow Channel

- The Overflow Channel forms part of Lake Connewarre State Game Reserve, which is included in the internationally important Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar Wetland Site.
- The Overflow Channel is covered by a Schedule to an Environmental Significance Overlay (ESO2) for high quality wetlands.
- Vegetation communities occurring along the channel include a patchwork of predominantly Chaffy Saw-sedge Sedgeland and Beaded Glasswort Herbland, with small occurrences of Blackseed Glasswort Shrubland, Coast Tussock Grassland and exotic vegetation.
- All indigenous vegetation is currently within the Coastal Saltmarsh EVC and its status is Endangered.
- The Overflow Channel is the only hydraulic and habitat link that connects Murtnagurt Lagoon to

the balance of the Ramsar site.

- High quality fauna habitats identified along the Overflow Channel include Coastal Saltmarsh Shrubland/Herbland and Estuarine Sedgeland/Grassland.
- The EPBC- and FFG-listed Orange-bellied Parrot has a moderate LRO along the Overflow Channel. The Overflow Channel potentially supports an ecologically-significant proportion (i.e. greater than 1%) of the National population of the Orange-bellied Parrot and ‘important habitat’ as defined under the EPBC Act 1999.
- Suitable habitat for the FFG-listed Swamp Skink and Yellow Sedge-skipper also occurs along the Overflow Channel (moderate LRO).
- Other threatened species considered likely to occur at Murtnagurt Lagoon and known from Lake Connewarre/Barwon River Estuary (e.g. Great Egret, Little Egret, threatened tern species) also probably use the Overflow Channel as a habitat link on a moderate to high basis.



Plate 9. Photo looking from east to west (from Macafee’s Land) across a narrow (c. 50 m wide) section of the Overflow Connecting Channel. Land on the west side of the Overflow Channel (rear of photo) is currently zoned Comprehensive Development Zone (CDZ), but Council has recommended that it be rezoned back to Rural (30 July 2008).



Plate 10. Zonation of Ecological Vegetation Classes in the Overflow Channel connecting the Barwon River Estuary with Murtnagurt Lagoon. This section of the channel adjoins Macafee's Land (30 July 2008).



Plate 11. A flock of 70 Blue-winged Parrots (*Neophema chrysostoma*) was observed in the Overflow Connecting Channel. This species is an indicator of the potential occurrence of the Critically Endangered Orange-bellied Parrot (*Neophema chrysogaster*) (30 July 2008).



Plate 12. Photo looking northwards along the boundary between the Overflow Connecting Channel and Macafee's Land (right side of photo) demonstrating edge effects on the eastern side of the channel (30 July 2008).

4.3.3 Macafee's Land

Vegetation and fauna habitat

Macafee's Land supports low biodiversity value. The habitats comprise predominantly managed (e.g. mown) exotic grassland and exotic and non-indigenous garden and shelterbelt plantings (e.g. wattles, Drooping She-oaks). There is a clump of remnant Moonah trees in the hinterland and a small incursion of Coastal Saltmarsh EVC on the western boundary adjoining the Ramsar site. The Schedule to the Environmental Significance Overlay (ESO2) which covers Murtnagurt Lagoon and the Overflow Channel also extends onto Macafee's Land to include this incursion of Coastal Saltmarsh (Figure 1).

This combination of larger areas of open artificial habitat and smaller occurrences of indigenous habitat are likely to be used for nesting, feeding, perching and roosting by open country/grassland species (e.g. Black-shouldered Kite, Nankeen Kestrel, Galah, Masked Lapwing, Flame Robin, Magpie-lark, Willie Wagtail, Australian Magpie and Little Raven) and tree or shrub-dependent passerines capable of utilising plantings and remnant trees (e.g. Singing Honeyeater, New Holland Honeyeater, Spiny-cheeked Honeyeater, Red Wattlebird, White-fronted Chat, Brown Thornbill and

Yellow-rumped Thornbill) (Appendix 6). The migratory Blue-winged Parrot may also use open grassland and the incursion of saltmarsh for foraging. An artificial brackish wetland supported Chestnut Teal during the field assessment (Appendix 4).

Fauna recorded

A detailed survey of Macafee's Land was beyond the scope of this study. Eighteen (18) species were recorded during the current field inspection in June/July 2008, comprising 17 native bird species and one exotic mammal species (Appendix 4). The most notable species recorded is the Flame Robin (Appendix 4). The Flame Robin is an altitudinal migrant of southeastern Australia which breeds in upland (up to 1800 m altitude) wet and moist eucalypt forests and woodlands with open understoreys in spring and summer. During autumn and winter, it more often occurs in drier, more open areas at lower altitudes, such as in native and introduced grasslands and farmlands, and dry sclerophyll forests and woodlands (Emison et al. 1987; Higgins and Peter 2002).

The Spiny-cheeked Honeyeater was recorded in planted wattles and Drooping Sheoaks. It is of note because it is a resident species in the City of Greater Geelong where the population is well separated from its main Victorian population in northern and north-western Victoria (Emison et al. 1987; Ecology Australia 2001; Higgins et al. 2001).

Summary of Macafee's Land at 1920 Barwon Heads Road

- The proposed subdivision site at 1920 Barwon Heads Road abuts Murtnagurt Lagoon to the northeast and the Overflow Channel to the east.
- The property supports generally low flora and fauna values.
- A clump of remnant Moonah trees occurs in the central section of the land.
- A small incursion of Coastal Saltmarsh EVC occurs on the western boundary of the property adjoining the Ramsar site; it is covered by the ESO2.

4.3.4 Barwon Heads Golf Course and Thirteenth Beach Residential Estate and Golf Course

Vegetation and fauna habitat

Barwon Heads Golf Course borders the eastern and southern sides of Murtnagurt Lagoon. It supports some remnant, though highly modified vegetation. Scattered and highly modified Coast Moonah Woodland, including Coast Tea Tree (*Leptospermum laevigatum*) scrub occurs over managed (e.g. mown) exotic grassland with exotic and non-indigenous plantings.

Thirteenth Beach Residential Estate and Golf Course (and tourist resort) borders the western and southern sides of the Lagoon. It supports very little remnant vegetation, comprising exotic plantings over managed grassland.

These habitats are used by open country/grassland species (e.g. Black-shouldered Kite, Nankeen Kestrel, Galah, Eastern Rosella, Masked Lapwing, Flame Robin, Magpie-lark, Willie Wagtail, Australian Magpie and Little Raven) and tree or shrub-dependent passerines (e.g. Singing Honeyeater, New Holland Honeyeater, Spiny-cheeked Honeyeater, Red Wattlebird and Little Wattlebird) (Appendix 4).

Barwon Heads Golf Course and Thirteenth Beach Residential Estate and Golf Course divide Murtnagurt Lagoon from the coastal vegetation and disrupts the sequence of vegetation communities. However, unlike residential development, the east-west aligned fairways and retention of nodes of Coastal Scrub have not completely removed the habitat link between the coast and the Barwon River Estuary (Figure 1).

Fauna recorded

A detailed fauna assessment of the golf courses was not undertaken. Nine vertebrate species were incidentally recorded (Appendix 4). These were either typically open country species, species which are capable of utilising modified remnant or planted vegetation or common waterbird species.

Summary Barwon Heads Golf Course and Thirteenth Beach Residential Estate and Golf Course

- Barwon Heads Golf Course borders the southern and eastern sides of Murtnagurt Lagoon.
- Barwon Heads Golf Course supports some highly modified Coast Moonah Woodland over mown exotic grassland with exotic and non-indigenous plantings.
- Thirteenth Beach Residential Estate and Golf Course (and tourist resort) borders the western and southern edges of Murtnagurt Lagoon.
- Thirteenth Beach Residential Estate and Golf Course supports little remnant vegetation, comprising exotic plantings over managed grassland.
- The east-west aligned fairways and retention of nodes of Coast Moonah Woodland have not resulted in complete removal of the habitat link between the coast and the Barwon River Estuary.

5 Impacts

5.1 Ramsar – Ecological Character and Wise Use

“**Ecological Character**” is defined as the combination of the ecosystem components, processes, and benefits/services that characterise the **Ramsar** wetland at a given point in time (DEH 2006; Ramsar 2006; DEWHA 2008b). Within this context, ecosystem benefits are defined in accordance with the variety of benefits to people (ecosystem services). Under the phrase ‘at a given point in time’, it is essential that the **Ecological Character** of a site be described by the Contracting Party concerned at the time of designation of the Ramsar List, by completion of the Ramsar Information Sheet (DEH 2006; DEWHA 2008b).

The act of designating (listing) under the Convention a wetland that is internationally important is an appropriate first step along a conservation and **sustainable** use pathway, the endpoint of which is achieving the long-term “**wise (sustainable) use**” of the site (Ramsar 2006; DEWHA 2008b). As part of the Ramsar Convention, contracting parties are expected to manage their Ramsar sites so as to maintain the **Ecological Character** of **Ramsar** sites, remain vigilant and informed of any changes to the **Ecological Character** and notify the Ramsar Secretariat of any changes at the earliest opportunity (Ramsar 2006; DEWHA 2008b). **Change** to the **Ecological Character** is defined as the human-induced adverse alteration of any ecosystem component, process and/or ecosystem benefit or service (DEWHA 2008b). “**Changes**” to the **Ecological Character** of the wetland outside the natural variations (i.e. the definition recognises that wetlands are complex systems) may signal that uses or externally derived impacts on the site are **unsustainable** and may lead to the degradation of natural processes and thus, the ultimate breakdown of the ecological, biological and hydrological functioning of the wetland (DEWHA 2008b). Thus, “**Wise Use**” is defined as the maintenance of **Ecological Character**, achieved through the implementation of ecosystem approaches, within the context of **sustainable** development (DEWHA 2008b).

5.2 Existing Threats and Wise Use

The Lagoon and Overflow Channel are currently subject to a number of stresses which threaten the wetlands **Ecological Character**. These include:

- **Significant hydrological change** – the Barwon Heads Road and the more northern levee bank severely restrict any tidal/estuarine flooding of the Lagoon. This has two possible consequences:
 - Firstly, a long-term decline in salinity, and particularly so if atmospheric and ground water inputs are minimal, and
 - Secondly, less frequent and extensive flooding.
- **On-going perimeter development for the Ramsar site** – approximately 60% of the Lagoon’s Ramsar site’s immediate perimeter is developed, including:

- the Thirteenth Beach Residential Estate and Golf Course, and
- the Barwon Heads Golf Course.
- **On-going perimeter development for the balance of the Lagoon:** - approximately 70% of the balance of the Lagoon is surrounded by Barwon Heads Golf Course.
- **Further, there are no perimeter buffers² and all developments overlook the Lagoon.**
- **Township expansion** - the development on the western side of the township - mostly west of Golf Links Road and from 1990's onwards, has moved residential areas to within 500 m or so of the Lagoon and within 600-700 m of the Overflow Channel. To our knowledge, there are few if any measures that effectively manage this interface.

While these existing developments would already challenge the concept of **“Wise Use”**, further encroachment, particularly juxtaposed to the strategic Ramsar Overflow Channel, would potentially result in the Ramsar site becoming an enclave to development. This would appear to be in clear contravention of **Wise Use**.

The **Ecological Character** of Murtnagurt Lagoon and the Overflow Channel are under threat. There is already a demonstrable breakdown in **hydrological functioning** and **edge effects³** (Plates 7, 8, 9 and 12). **Disturbance** and other externally derived impacts, such as stormwater run-off, are presently degrading biological values with a significant risk that the cumulative impacts are unsustainable. Further breakdown in proximity to the Ramsar site has a high potential to exacerbate the problem.

² The primary purpose of an ecological buffer zone is to insulate areas where biodiversity conservation is the primary objective from potentially damaging external influences and particularly from those caused by inappropriate forms of landuse. This is achieved by providing space between development/humans and natural areas, and by principle, this function permits a variety of sustainable human activities (Bennett and Mulongoy 2006). A perimeter buffer would therefore provide an area with a buffering function around the entire perimeter of a conservation zone.

³ Edge effects are many and varied and there is a wide literature on the subject (e.g. Ranney et al. 1981; Loyn 1987; Taylor 1987; Hobbs 1989; Bennett 1990; Hester and Hobbs 1992; Saunders et al. 1993; Antos and White 2004; Donaldson and Bennett 2004). ‘Edge zones’ occur at the interface of cleared and uncleared land, and experience different physical conditions to ‘undisturbed’ or ‘interior zones’. These physical conditions relate to micro-climate, surface soil conditions and increased stress and disturbance levels (Ranney et al. 1981; Taylor 1987). Edge zones generally favour opportunistic plant and animal species. Hobbs (1989) and Hester and Hobbs (1992), for example, demonstrated a positive relationship between weed invasion and the edge zone. Loyn (1987), Bennett (1990) and Antos and White (2004) described an increase in edge specialist fauna species, such as Noisy Miners, foxes and birds of prey, which may displace interior/forest species. In general, edge zones exhibit degraded ecological value.

5.3 Changes to the Ecological Character

As discussed under Section 4.3.1, there are **changes to vegetation communities** at Murtnagurt Lagoon associated with development. Two derived vegetation types occur on or surrounding the lagoon in response to **altered drainage**. Salt Club-sedge is invading the Coastal Saltmarsh EVC from the fringes of a small pond (c. 200 m²) in the eastern (privately-owned) section of the Lagoon (Plate 8). This is a result of the Hopgood Place residential estate and stormwater run-off (Biosis Research 2004).

Common Reed is replacing Estuarine Wetland on the western edge of the Ramsar site assisted by, or due to, freshwater influence/runoff from the adjoining Thirteenth Beach Residential Estate and Golf Course. This is a notable **edge effect** (Plate 7).

These two derived vegetation types are degrading the natural values of the indigenous vegetation at Murtnagurt Lagoon. While the stormwater pond is outside the Ramsar boundary, Biosis Research (2004) has reported freshwater impacts well beyond the collection point and in habitat directly continuous with the Ramsar section of the Lagoon. Both these changes are indicative of **changes to the Ecological Character** of the Lagoon.

Edge effects are many and varied and there is a wide literature on the subject (e.g. see Ranney et al. 1981; Loyn 1987; Taylor 1987; Hobbs 1989; Bennett 1990; Hester and Hobbs 1992; Saunders et al. 1993; Antos and White 2004; Donaldson and Bennett 2004).

Another impact is **disturbance** to fauna associated with existing development. Considering the extent of perimeter development, some level of disturbance undoubtedly persists, but to our knowledge, it has not been assessed. Further, while each development may have incremental impacts, the costs of any general habituation by fauna (e.g. reduced numbers of individuals of particular species, loss of sensitive species and/or reduced or altered habitat usage by particular species or groups of species in areas experiencing higher levels of disturbance) are unknown, and similarly, the likelihood of cumulative impacts.

Such potential changes to biological use with flow-on consequences for **Ecological Character** remain a key risk under the **Wise Use** concept.

Summary of Threats to Ramsar values

The biodiversity values are spread equally across the western Ramsar part of Murtnagurt Lagoon and the privately owned eastern sector. Existing threats to the Lagoon include the following.

1. Hydrological and habitat severance associated with the Barwon Heads Road and the levee just south of the Barwon River Estuary.
2. Perimeter effects associated with surrounding modified/cleared land and the absence of a buffer between Murtnagurt Lagoon/Overflow Channel and existing

development is probably not consistent with the “Wise Use” of a Ramsar site.

3. The proposed rezoning at 1920 Barwon Heads Roads would result in development adjoining the Overflow Channel’s Ramsar boundary further threatening the “Ecological Character” of the Ramsar site. This would not be consistent with the principle of “Wise Use” of a Ramsar wetland.
4. Development of Common Reed on the western edge of the Lagoon is assisted by, or due to, freshwater runoff from Thirteenth Beach Residential Estate and Golf Course and is indicative of change to the Ecological Character of the Ramsar site.
5. Stormwater input to the eastern side of Murtnagurt Lagoon from Hopgood Place estate resulting in development of a freshwater wetland in the saltmarsh with freshwater effects reaching habitat continuous with the Ramsar site.
6. The extent of disturbance to fauna at Murtnagurt Lagoon due to existing development is not known. Species may currently exhibit some degree of habituation to the background levels of disturbance, but may alter their habitat preferences in response to incremental development, such as development of 1920 Barwon Heads Road.
7. Demonstrable impacts of hydrological severance, edge effects, stormwater runoff and disturbance are degrading biological values so that cumulative impacts are unsustainable. Further development has high potential to exacerbate this.

5.4 Further Encroachment

This section focuses on the Macafee rezoning proposal but the principles could be applied more generally. Previous sections outline the existing key threats to the Ecological Character of Murtnagurt Lagoon and the Overflow Channel driven by severe changes to hydrology and surrounding development. The Macafee rezoning and subsequent development would adjoin the Overflow Channel where the potential risks are magnified. Unlike Murtnagurt Lagoon, the Channel is narrow-linear and the likelihood of the entire habitat becoming an ‘edge’ environment is disproportionately high.

It is reasonable to describe the Lagoon in the context of edge and core habitats. The evidence suggests that while the edge is expanding and there is ecological change, core habitat may still occupy the majority of the site - *albeit* contracting.

There would be no such buffering effect for the Overflow Channel. The narrow channel varies in width between 50-80 m (at Barwon Heads Road the width is c. 250 m) with sharp boundaries to cleared land on both sides. In a landscape context it is a classical corridor (Plates 9 and 12).

While existing edge effects are observable, notably weed incursion (Plate 12), most of the habitat is in good condition, and the adjoining rural uses probably sustain a reasonable degree of core habitat in relation to disturbance. In other words, rural landuses include less disturbance related threats than urban landuse. The core habitat could be rapidly compromised with a change in landuse to residential with foreseeable increases in disturbance (pedestrian traffic, dogs, maintenance vehicles and machinery) and predation (dogs and cats).

Increased predation and disturbance could significantly impede known foraging habitat for the migratory Blue-winged Parrots, potential foraging habitat for EPBC- and FFG-listed Orange-bellied Parrot, habitat for passerines, such as the Striated Fieldwren, and ultimately compromise the habitat link function between Murtnagurt Lagoon and the Barwon River Estuary/Lake Connewarre.

While management measures may be proposed, these are rarely as effective as stated and under the Wise Use concept the margin of error applied to this strategic Ramsar link should effectively be zero.

5.5 Climate Change

Murtnagurt Lagoon and surrounding low lying land could play a strategic role as sea levels rise and inundate coastal wetlands associated with the Barwon River Estuary. While this is complex and largely untested, such opportunities need to be thoroughly explored as the ultimate loss and modification of coastal wetlands under a 0.8 m sea level rise (as specified in Victoria's Coastal Strategy, DSE 2008c) is a very real possibility. For arguments sake, with more frequent inundation, Murtnagurt Lagoon may become an important wetland refugia under climate change impacts. In turn, nearby residential development, such as that proposed for the Macafee property, and the risk of residences flooding, may place severe constraints on this role.

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Appendix 1. Fauna species recorded from within a 5 km radius of Murtnagurt Lagoon, Barwon Heads.

Murtnagurt Lagoon 5 km Fauna DRA			
Species list from irregular area bounded by the rectangle :			
Latitude: -38°13'56" to -38°18'01" Longitude: +144°24'59" to +144°24'36"			
Number of Surveys in Search Area = 432			
Species range : 1 - 5999 Number of species found = 216			
Data from Atlas of Victorian Wildlife – June 2007			

Key

EPBC – Environmental Protection and Biodiversity Conservation Act 1999

NAP – National Action Plan

FFG – Flora and Fauna Guarantee Act 1988

DSE – Status according to DSE (2003): Advisory List of Threatened Vertebrate Fauna in Victoria – 2003.

CE – Critically Endangered; EN – Endangered; VU – Vulnerable; NT – Near Threatened; LC – Least Concern; LR-NT – Lower Risk- Near Threatened; R-IK – Rare or Insufficiently Known; R/R – Rare and Restricted; DD – Data Deficient; CD – Conservation Dependent.

L – Listed under the FFG Act 1988.

N – Nominated for listing under the FFG Act 1988

I – Ineligible for listing under the FFG Act 1988.

Mi – Migratory species under the EPBC Act 1999

M – Marine overfly species under the EPBC Act 1999

Last – Year of last record

Recs – Number of records in Fauna DRA

Common Name	Scientific Name	Last	Recs	EPBC	NAP	FFG	DSE
Birds							
Little Penguin	<i>Eudyptula minor</i>	2001	19	M			
Stubble Quail	<i>Coturnix pectoralis</i>	2001	2	M			
Diamond Dove	<i>Geopelia cuneata</i>	2000	2			L	NT
Black-tailed Native-hen	<i>Gallinula ventralis</i>	2001	1				
Dusky Moorhen	<i>Gallinula tenebrosa</i>	2000	1				
Purple Swamphen	<i>Porphyrio porphyrio</i>	2000	1	M			
Eurasian Coot	<i>Fulica atra</i>	2000	5				
Great Crested Grebe	<i>Podiceps cristatus</i>	2000	2				
Australasian Grebe	<i>Tachybaptus novaehollandiae</i>	2000	2				
Hoary-headed Grebe	<i>Poliiocephalus poliocephalus</i>	2006	13				
Wilson's Storm-Petrel	<i>Oceanites oceanicus</i>	1985	1	Mi,M	VU		
White-faced Storm-Petrel	<i>Pelagodroma marina</i>	2000	1	M			NT
Little Shearwater	<i>Puffinus assimilis</i>	1973	1	M	VU		
Fluttering Shearwater	<i>Puffinus gavia</i>	2001	10	M			
Short-tailed Shearwater	<i>Puffinus tenuirostris</i>	2001	13	Mi,M			
Great-winged Petrel	<i>Pterodroma macroptera</i>	1954	1	M			
White-headed Petrel	<i>Pterodroma lessonii</i>	1958	1	M	VU		
Cape Petrel	<i>Daption capense</i>	2000	2	M	VU		
Blue Petrel	<i>Halobaena caerulea</i>	1999	1	VU,M	CE		
Fairy Prion	<i>Pachyptila turtur</i>	2001	11	VU,M	EN		VU
Common Diving-Petrel	<i>Pelecanoides urinatrix</i>	2001	6	M			NT
Black-browed Albatross	<i>Thalassarche melanophris</i>	1988	1	Mi,M	EN	I	EN

Common Name	Scientific Name	Last	Recs	EPBC	NAP	FFG	DSE
Shy Albatross	<i>Thalassarche cauta</i>	2000	4	VU,Mi,M	VU	L	VU
Great Cormorant	<i>Phalacrocorax carbo</i>	2006	41				
Little Black Cormorant	<i>Phalacrocorax sulcirostris</i>	2006	24				
Pied Cormorant	<i>Phalacrocorax varius</i>	2006	30				NT
Little Pied Cormorant	<i>Phalacrocorax melanoleucos</i>	2006	42				
Darter	<i>Anhinga melanogaster</i>	2001	2				
Australasian Gannet	<i>Morus serrator</i>	2001	9	M			
Australian Pelican	<i>Pelecanus conspicillatus</i>	2006	33	M			
Whiskered Tern	<i>Chlidonias hybridus</i>	1999	7	Mi,M			NT
Gull-billed Tern	<i>Sterna nilotica</i>	1999	10	Mi,M		L	EN
Caspian Tern	<i>Sterna caspia</i>	2006	30	Mi,M		L	NT
White-fronted Tern	<i>Sterna striata</i>	2000	2	Mi,M			NT
Crested Tern	<i>Sterna bergii</i>	2006	29	Mi,M			
Little Tern	<i>Sterna albifrons sinensis</i>	1989	1	Mi,M		L	VU
Fairy Tern	<i>Sterna nereis</i>	1999	5	Mi,M		L	EN
Silver Gull	<i>Larus novaehollandiae</i>	2006	81	Mi,M			
Pacific Gull	<i>Larus pacificus pacificus</i>	2006	59	Mi,M			NT
Ruddy Turnstone	<i>Arenaria interpres</i>	2000	7	Mi,M			
Pied Oystercatcher	<i>Haematopus longirostris</i>	2006	8	Mi			
Sooty Oystercatcher	<i>Haematopus fuliginosus</i>	1992	2	Mi			NT
Masked Lapwing	<i>Vanellus miles</i>	2006	93	Mi			
Banded Lapwing	<i>Vanellus tricolor</i>	1999	2	Mi			
Pacific Golden Plover	<i>Pluvialis fulva</i>	2001	5	Mi,M			NT
Hooded Plover	<i>Thinornis rubricollis</i>	2005	35	Mi,M	VU	L	VU
Double-banded Plover	<i>Charadrius bicinctus</i>	2006	16	Mi,M			
Red-capped Plover	<i>Charadrius ruficapillus</i>	2006	37	Mi,M			
Black-fronted Dotterel	<i>Elsayornis melanops</i>	1963	1	Mi			
Black-winged Stilt	<i>Himantopus himantopus leucocephalus</i>	2006	4	Mi,M			
Red-necked Avocet	<i>Recurvirostra novaehollandiae</i>	2006	6	Mi			
Eastern Curlew	<i>Numenius madagascariensis</i>	2006	27	Mi,M			NT
Whimbrel	<i>Numenius phaeopus</i>	1986	1	Mi,M			VU
Bar-tailed Godwit	<i>Limosa lapponica</i>	2006	9	Mi,M			
Grey-tailed Tattler	<i>Heteroscelus brevipes</i>	1988	1	Mi,M		L	CE
Common Sandpiper	<i>Actitis hypoleucos</i>	2001	8	Mi,M			VU
Common Greenshank	<i>Tringa nebularia</i>	2006	31	Mi,M			
Marsh Sandpiper	<i>Tringa stagnatilis</i>	2000	1	Mi,M			
Terek Sandpiper	<i>Xenus cinereus</i>	1998	1	Mi,M		N	EN
Curlew Sandpiper	<i>Calidris ferruginea</i>	2006	20	Mi,M			
Red-necked Stint	<i>Calidris ruficollis</i>	2006	35	Mi,M			
Sharp-tailed Sandpiper	<i>Calidris acuminata</i>	2006	15	Mi,M			
Red Knot	<i>Calidris canutus</i>	2001	8	Mi,M			NT
Great Knot	<i>Calidris tenuirostris</i>	2001	3	Mi,M		L	EN
Sanderling	<i>Calidris alba</i>	1999	3	Mi,M			NT
Broad-billed Sandpiper	<i>Limicola falcinellus</i>	1992	1	Mi,M			
Latham's Snipe	<i>Gallinago hardwickii</i>	1998	1	Mi,M			NT
Brolga	<i>Grus rubicunda</i>	2006	1	Mi		L	VU
Glossy Ibis	<i>Plegadis falcinellus</i>	1978	1	Mi,M			NT
Australian White Ibis	<i>Threskiornis molucca</i>	2006	59	M			
Straw-necked Ibis	<i>Threskiornis spinicollis</i>	2001	32	M			
Royal Spoonbill	<i>Platalea regia</i>	2006	35				VU
Yellow-billed Spoonbill	<i>Platalea flavipes</i>	2006	9				

Common Name	Scientific Name	Last	Recs	EPBC	NAP	FFG	DSE
Little Egret	<i>Egretta garzetta</i>	2006	12	M		L	EN
Great Egret	<i>Ardea alba</i>	2006	27	Mi,M		L	VU
White-faced Heron	<i>Egretta novaehollandiae</i>	2006	69				
White-necked Heron	<i>Ardea pacifica</i>	2001	1				
Australasian Bittern	<i>Botaurus poiciloptilus</i>	1992	2		VU	L	EN
Black Swan	<i>Cygnus atratus</i>	2006	58	Mi			
Australian Shelduck	<i>Tadorna tadornoides</i>	2001	16	Mi			
Pacific Black Duck	<i>Anas superciliosa</i>	2006	31	Mi			
Chestnut Teal	<i>Anas castanea</i>	2006	22	Mi			
Grey Teal	<i>Anas gracilis</i>	2006	8	Mi			
Australasian Shoveler	<i>Anas rhynchos</i>	2006	7	Mi			VU
Pink-eared Duck	<i>Malacorhynchus membranaceus</i>	1979	1	Mi			
Hardhead	<i>Aythya australis</i>	1993	3	Mi			VU
Musk Duck	<i>Biziura lobata</i>	2006	2	Mi,M			VU
Swamp Harrier	<i>Circus approximans</i>	2001	19	Mi,M			
Grey Goshawk	<i>Accipiter novaehollandiae</i>	1991	2	Mi		N	VU
Brown Goshawk	<i>Accipiter fasciatus</i>	2006	3	Mi,M			
Little Eagle	<i>Hieraaetus morphnoides</i>	1997	2	Mi			
White-bellied Sea-Eagle	<i>Haliaeetus leucogaster</i>	2005	3	Mi,M		L	VU
Whistling Kite	<i>Haliastur sphenurus</i>	2006	16	Mi,M			
Black-shouldered Kite	<i>Elanus axillaris</i>	2001	16	Mi			
Australian Hobby	<i>Falco longipennis</i>	2000	2	Mi			
Peregrine Falcon	<i>Falco peregrinus</i>	1999	1	Mi			
Brown Falcon	<i>Falco berigora</i>	2001	15	Mi			
Nankeen Kestrel	<i>Falco cenchroides</i>	2000	4	Mi,M			
Rainbow Lorikeet	<i>Trichoglossus haematodus</i>	2001	2				
Musk Lorikeet	<i>Glossopsitta concinna</i>	2000	3				
Yellow-tailed Black-Cockatoo	<i>Calyptrorhynchus funereus</i>	2001	16				
Gang-gang Cockatoo	<i>Callocephalon fimbriatum</i>	1992	2				
Sulphur-crested Cockatoo	<i>Cacatua galerita</i>	2001	8				
Little Corella	<i>Cacatua sanguinea</i>	1990	1				
Long-billed Corella	<i>Cacatua tenuirostris</i>	2000	1				
Galah	<i>Eolophus roseicapilla</i>	2001	21				
Crimson Rosella	<i>Platycercus elegans elegans</i>	2001	7				
Eastern Rosella	<i>Platycercus eximius</i>	2001	27				
Red-rumped Parrot	<i>Psephotus haematotus</i>	2000	3				
Orange-bellied Parrot	<i>Neophema chrysogaster</i>	2006	68	EN,Mi,M	CE	L	CE
Blue-winged Parrot	<i>Neophema chrysostoma</i>	2006	20	M			
Swift Parrot	<i>Lathamus discolor</i>	2002	1	EN,M	EN	L	EN
Laughing Kookaburra	<i>Dacelo novaeguineae</i>	1998	1				
Sacred Kingfisher	<i>Todiramphus sanctus</i>	1999	1	M			
Pallid Cuckoo	<i>Cuculus pallidus</i>	2001	1	M			
Fan-tailed Cuckoo	<i>Cacomantis flabelliformis</i>	2000	4	M			
Horsfield's Bronze-Cuckoo	<i>Chrysococcyx basalis</i>	2001	5	M			
Shining Bronze-Cuckoo	<i>Chrysococcyx lucidus</i>	1998	3	M			
Welcome Swallow	<i>Hirundo neoxena</i>	2001	62	M			
Tree Martin	<i>Hirundo nigricans</i>	1989	1	M			
Grey Fantail	<i>Rhipidura albiscapa</i>	2001	23				
Willie Wagtail	<i>Rhipidura leucophrys</i>	2006	64				
Leaden Flycatcher	<i>Myiagra rubecula</i>	1992	1				

Common Name	Scientific Name	Last	Recs	EPBC	NAP	FFG	DSE
Restless Flycatcher	<i>Myiagra inquieta</i>	1998	1				
Flame Robin	<i>Petroica phoenicea</i>	2000	2	M			
Pink Robin	<i>Petroica rodinogaster</i>	2000	3	M			
Magpie-lark	<i>Grallina cyanoleuca</i>	2001	36	M			
Black-faced Cuckoo-shrike	<i>Coracina novaehollandiae</i>	1999	2	M			
White-fronted Chat	<i>Epthianura albifrons</i>	2006	31				
Striated Thornbill	<i>Acanthiza lineata</i>	2001	1				
Yellow Thornbill	<i>Acanthiza nana</i>	2000	1				
Brown Thornbill	<i>Acanthiza pusilla</i>	2006	31				
Yellow-rumped Thornbill	<i>Acanthiza chrysorrhoa</i>	2001	12				
White-browed Scrubwren	<i>Sericornis frontalis</i>	2001	12				
Striated Fieldwren	<i>Calamanthus fuliginosus</i>	2005	24				
Brown Songlark	<i>Cincloramphus cruralis</i>	1999	2	Mi			
Little Grassbird	<i>Megalurus gramineus</i>	2006	16	Mi			
Australian Reed-Warbler	<i>Acrocephalus australis</i>	2000	1	Mi			
Golden-headed Cisticola	<i>Cisticola exilis</i>	2001	18				
Southern Emu-wren	<i>Stipiturus malachurus</i>	2006	2				
Superb Fairy-wren	<i>Malurus cyaneus</i>	2001	35				
Mistletoebird	<i>Dicaeum hirundinaceum</i>	2001	2				
Spotted Pardalote	<i>Pardalotus punctatus punctatus</i>	2006	6				
Silveryeye	<i>Zosterops lateralis</i>	2001	35	M			
Eastern Spinebill	<i>Acanthorhynchus tenuirostris</i>	2001	13				
Singing Honeyeater	<i>Lichenostomus virescens</i>	2001	19				
Yellow-faced Honeyeater	<i>Lichenostomus chrysops</i>	2001	3				
White-plumed Honeyeater	<i>Lichenostomus penicillatus</i>	2000	5				
New Holland Honeyeater	<i>Phylidonyris novaehollandiae</i>	2001	50				
Noisy Miner	<i>Manorina melanocephala</i>	2000	3				
Little Wattlebird	<i>Anthochaera chrysoptera</i>	2005	4				
Red Wattlebird	<i>Anthochaera carunculata</i>	2006	61				
Spiny-cheeked Honeyeater	<i>Acanthagenys rufogularis</i>	2006	21				
Australian Pipit	<i>Anthus australis</i>	2001	9	M			
Singing Bushlark	<i>Mirafra javanica</i>	1999	1				
Beautiful Firetail	<i>Stagonopleura bella</i>	1993	1				
Pied Currawong	<i>Strepera graculina</i>	2001	2				
Grey Currawong	<i>Strepera versicolor</i>	2001	2				
Grey Butcherbird	<i>Cracticus torquatus</i>	2001	31				
Australian Magpie	<i>Gymnorhina tibicen</i>	2006	79				
Southern Giant-Petrel	<i>Macronectes giganteus</i>	1988	3	EN,Mi,M	EN	L	VU
Australian Raven	<i>Corvus coronoides</i>	2000	4				
Kerguelen Petrel	<i>Aphrodroma brevirostris</i>	1975	1	M			
Northern Giant-Petrel	<i>Macronectes halli</i>	1988	1	VU,Mi,M	VU	L	NT
Salvin's Prion	<i>Pachyptila salvini</i>	1985	2	M			
Slender-billed Prion	<i>Pachyptila belcheri</i>	2001	4	M			
*Mallard	<i>Anas platyrhynchos</i>	2000	1	Mi			
Little Raven	<i>Corvus mellori</i>	2006	56	M			
*Rock Dove	<i>Columba livia</i>	2001	1				
Striated Pardalote	<i>Pardalotus striatus</i>	2000	1				
Cattle Egret	<i>Ardea ibis</i>	2001	2	Mi,M			
Kelp Gull	<i>Larus dominicanus</i>	1999	2	Mi,M			
*Spotted Turtle-Dove	<i>Streptopelia chinensis</i>	2006	65				
*Common Blackbird	<i>Turdus merula</i>	2001	73				

Common Name	Scientific Name	Last	Recs	EPBC	NAP	FFG	DSE
*Skylark	<i>Alauda arvensis</i>	2001	17				
*Eurasian Tree Sparrow	<i>Passer montanus</i>	2001	1				
*House Sparrow	<i>Passer domesticus</i>	2001	39				
*European Goldfinch	<i>Carduelis carduelis</i>	2001	28				
*Common Myna	<i>Acridotheres tristis</i>	2001	32				
*Common Starling	<i>Sturnus vulgaris</i>	2001	47				
Mammals							
Short-beaked Echidna	<i>Tachyglossus aculeatus</i>	1993	2				
Brush-tailed Phascogale	<i>Phascogale tapoatafa tapoatafa</i>	1958	1		NT	L	VU
Southern Brown Bandicoot	<i>Isodon obesulus obesulus</i>	1968	1	EN	NT	I	NT
Common Brushtail Possum	<i>Trichosurus vulpecula</i>	1967	1				
Common Ringtail Possum	<i>Pseudocheirus peregrinus</i>	1969	2				
Koala	<i>Phascolarctos cinereus</i>	1987	1		NT		
*House Mouse	<i>Mus musculus</i>	1988	2				
*Rabbit	<i>Oryctolagus cuniculus</i>	1992	2				
*Fox	<i>Vulpes vulpes</i>	1999	4				
Australian Fur-seal	<i>Arctocephalus pusillus doriferus</i>	1999	7	M	CD		
Leopard Seal	<i>Hydrurga leptonyx</i>	1990	5	M			
Southern Right Whale	<i>Eubalaena australis</i>	1997	1	EN	VU	L	CE
Killer Whale	<i>Orcinus orca</i>	2004	1				
Bottlenose Dolphin	<i>Tursiops truncatus</i>	1987	2				
Common Dolphin	<i>Delphinus delphis</i>	1988	1				
Reptiles							
Robust Ctenotus	<i>Ctenotus robustus</i>	1977	3				
Metallic Cool-skink	<i>Niveoscincus metallicum</i>	1969	1				
Eastern Blue-tongued Lizard	<i>Tiliqua scincoides</i>	1967	1				
Marine Turtle	<i>Chelonidae sp.</i>	1991	1				
Tussock Skink/Alpine Bog Skink	<i>Pseudemoia pagenstecheri/cryodroma</i>	1988	1				
Southern Grass Skink	<i>Pseudemoia entrecasteauxii</i>	1977	2				
Unidentified grass skink	<i>Pseudemoia sp.</i>	1977	12				
Frogs							
Common Eastern Froglet	<i>Crinia signifera</i>	1962	42				
Fish							
Sandy Sprat	<i>Hyperlophus vittatus</i>	1987	2				
Australian Smelt	<i>Retropinna semoni</i>	1987	1				
Common Jollytail	<i>Galaxias maculatus</i>	1987	3				
Spotted Pipefish	<i>Stigmatopora argus</i>	1987	1				
Yelloweye Mullet	<i>Aldrichetta forsteri</i>	1987	3				
Lagoon Goby	<i>Tasmanogobius lasti</i>	1987	3				
Invertebrates							
Yellow Sedge Skipper	<i>Hesperilla flavescens flavescens</i>	1988	25			L	NT
Small Ant Blue	<i>Acrodipsas myrmecophila</i>	1925	2			L	EN

Appendix 2. Wader/shorebirds species and non-wading bird species recorded at Murtnagurt Lagoon between 22 February 1981 and 29 June 2007 by the Australasian Wader Studies Group (AWSG) (data supplied by Birds Australia). Data supplied from 44 surveys.

Common name	Number (and percentage) of counts	Maximum numbers of the wading species from five highest counts
Red-necked Stint	22 (50%)	100, 150, 1570, 140, 480
Red-capped Plover	32 (73%)	30, 50, 40, 65, 48
Pacific Golden Plover	3 (7%)	11, 7, 4
Masked Lapwing	38 (86%)	20, 80, 16, 11, 10
Double-banded Plover	9 (21%)	19, 20, 28, 33, 5
Black-winged Stilt	17 (39%)	36, 31, 39, 20, 40
Hooded Plover	3 (7%)	1, 5, 4
Banded Stilt	2 (4%)	1, 30
Red-necked Avocet	4 (9%)	4, 12, 6, 36
Greenshank	8 (18%)	17, 45, 50, 12, 33
Sharp-tailed Sandpiper	4 (9%)	360, 380, 1, 4
Curlew Sandpiper	3 (7%)	20, 200, 7
Marsh Sandpiper	1 (2%)	13
Red-kneed Dotterel	2 (5%)	2, 7
Lesser (Mongolian) Sandplover	1 (2%)	3
Great Cormorant		
Silver Gull		
Australian White Ibis		
Straw-necked Ibis		
White-faced Heron		
Black Swan		
Pacific Black Duck		
Swamp Harrier		
Black-shouldered Kite		
Nankeen Kestrel		
Blue-winged Parrot		
Welcome Swallow		
Willie Wagtail		
Flame Robin		
Magpie-Lark		
White-fronted Chat		
Yellow-rumped Thornbill		
Striated Fieldwren		
White-browed Scrubwren		
Superb Fairy-wren		
New Holland Honeyeater		
Red Wattlebird		
Richard's Pipit		
Golden-headed Cisticola		
Red-browed Finch		
Australian Magpie		
Little Raven		
*Common Blackbird		

Common name	Number (and percentage) of counts	Maximum numbers of the wading species from five highest counts
*Skylark		
*European Goldfinch		
*Common Starling		

The maximum numbers of individuals of each wader species recorded during the highest five counts (or less) is provided. Note that count data for non-wading species were not collected and/or provided.

Species scientific names are provided in Appendix 4. The Birds Australia list for Murtnagurt Lagoon included an additional three bird species which were not listed under the AVW (DSE 2007a; Appendix 1): Banded Stilt (*Cladorhynchus leucocephalus*), Red-kneed Dotterel (*Erythrogonys cinctus*) and Lesser (Mongolian) Sandplover (*Charadrius mongolus*).

Appendix 3. Flora and fauna species and significant sites listed under the Federal *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and listed as potentially occurring (or potential habitat occurring) within a 5 km radius of the study area using the EPBC Protected Matters Search Tool database (DEWHA 2008b). Accessed July 2008.

Matters of National Environmental Significance

Wetlands of International Significance (Ramsar Sites)		
PORT PHILLIP BAY (WESTERN SHORELINE) AND BELLARINE		
WESTERN DISTRICT LAKES		Within same catchment as Ramsar site
Threatened Ecological Communities	Status	Type of Presence
Natural Temperate Grassland of the Victorian Volcanic Plain	Critically Endangered	Community known to occur within area
Threatened Species	Status	Type of Presence
Birds		
<i>Diomedea amsterdamensis</i> Amsterdam Albatross	Endangered	Species or species habitat may occur within area
<i>Diomedea dabbenena</i> Tristan Albatross	Endangered	Foraging may occur within area
<i>Diomedea epomophora (sensu stricto)</i> Southern Royal Albatross	Vulnerable	Species or species habitat may occur within area
<i>Diomedea exulans (sensu lato)</i> Wandering Albatross	Vulnerable	Species or species habitat may occur within area
<i>Diomedea gibsoni</i> Gibson's Albatross	Vulnerable	Species or species habitat may occur within area
<i>Diomedea sanfordi</i> Northern Royal Albatross	Endangered	Species or species habitat may occur within area
<i>Halobaena caerulea</i> Blue Petrel	Vulnerable	Species or species habitat may occur within area
<i>Lathamus discolor</i> Swift Parrot	Endangered	Species or species habitat may occur within area
<i>Macronectes giganteus</i> Southern Giant-Petrel	Endangered	Species or species habitat may occur within area
<i>Macronectes halli</i> Northern Giant-Petrel	Vulnerable	Species or species habitat may occur within area
<i>Neophema chrysogaster</i> Orange-bellied Parrot	Critically Endangered	Species or species habitat known to occur within area
<i>Pterodroma mollis</i> Soft-plumaged Petrel	Vulnerable	Species or species habitat may occur within area
<i>Rostratula australis</i> Australian Painted Snipe	Vulnerable	Species or species habitat may occur within area

<i>Thalassarche bulleri</i> Buller's Albatross	Vulnerable	Species or species habitat may occur within area
<i>Thalassarche cauta (sensu stricto)</i> Shy Albatross, Tasmanian Shy Albatross	Vulnerable	Species or species habitat may occur within area
<i>Thalassarche chrysostoma</i> Grey-headed Albatross	Vulnerable	Species or species habitat may occur within area
<i>Thalassarche impavida</i> Campbell Albatross	Vulnerable	Species or species habitat may occur within area
<i>Thalassarche melanophris</i> Black-browed Albatross	Vulnerable	Species or species habitat may occur within area
<i>Thalassarche salvini</i> Salvin's Albatross	Vulnerable	Species or species habitat may occur within area
<i>Xanthomyza phrygia</i> Regent Honeyeater	Endangered	Species or species habitat may occur within area
Frogs		
<i>Litoria raniformis</i> Growling Grass Frog, Southern Bell Frog, Warty Bell Frog, Green and Golden Frog	Vulnerable	Species or species habitat may occur within area
Mammals		
<i>Balaenoptera musculus</i> Blue Whale	Endangered	Species or species habitat likely to occur within area
<i>Dasyurus maculatus maculatus (SE mainland population)</i> Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population)	Endangered	Species or species habitat may occur within area
<i>Eubalaena australis</i> Southern Right Whale	Endangered	Species or species habitat known to occur within area
<i>Isodon obesulus obesulus</i> Southern Brown Bandicoot	Endangered	Species or species habitat likely to occur within area
<i>Megaptera novaeangliae</i> Humpback Whale	Vulnerable	Species or species habitat likely to occur within area
<i>Miniopterus schreibersii bassanii</i> Southern Bent-wing Bat	Critically Endangered	Species or species habitat may occur within area
<i>Potorous tridactylus tridactylus</i> Long-nosed Potoroo (SE mainland)	Vulnerable	Species or species habitat may occur within area
<i>Pseudomys fumeus</i> Konoom, Smoky Mouse	Endangered	Species or species habitat may occur within area
<i>Pteropus poliocephalus</i> Grey-headed Flying-fox	Vulnerable	Species or species habitat likely to occur within area
Ray-finned fishes		
<i>Galaxiella pusilla</i> Dwarf Galaxias	Vulnerable	Species or species habitat likely to occur within area
<i>Nannoperca obscura</i> Yarra Pygmy Perch	Vulnerable	Species or species habitat likely to occur within area
<i>Prototroctes maraena</i> Australian Grayling	Vulnerable	Species or species habitat known to occur within area

Sharks		
<i>Carcharodon carcharias</i> Great White Shark	Vulnerable	Species or species habitat may occur within area
Plants		
<i>Carex tasmanica</i> Curly Sedge	Vulnerable	Species or species habitat likely to occur within area
<i>Glycine latrobeana</i> Purple Clover, Clover Glycine	Vulnerable	Species or species habitat likely to occur within area
<i>Prasophyllum frenchii</i> Maroon Leek-orchid, Slaty Leek-orchid, Stout Leek-orchid, French's Leek-orchid	Endangered	Species or species habitat likely to occur within area
<i>Thelymitra epipactoides</i> Metallic Sun-orchid	Endangered	Species or species habitat likely to occur within area
<i>Xerochrysum palustre</i> Swamp Everlasting	Vulnerable	Species or species habitat likely to occur within area
Migratory Species	Status	Type of Presence
Migratory Terrestrial Species		
Birds		
<i>Haliaeetus leucogaster</i> White-bellied Sea-Eagle	Migratory	Species or species habitat likely to occur within area
<i>Hirundapus caudacutus</i> White-throated Needle-tail	Migratory	Species or species habitat may occur within area
<i>Merops ornatus</i> Rainbow Bee-eater	Migratory	Species or species habitat may occur within area
<i>Myiagra cyanoleuca</i> Satin Flycatcher	Migratory	Breeding likely to occur within area
<i>Neophema chrysogaster</i> Orange-bellied Parrot	Migratory	Species or species habitat known to occur within area
<i>Rhipidura rufifrons</i> Rufous Fantail	Migratory	Breeding may occur within area
<i>Xanthomyza phrygia</i> Regent Honeyeater	Migratory	Species or species habitat may occur within area
Migratory Wetland Species		
Birds		
<i>Ardea alba</i> Great Egret, White Egret	Migratory	Species or species habitat may occur within area
<i>Ardea ibis</i> Cattle Egret	Migratory	Species or species habitat may occur within area
<i>Calidris acuminata</i> Sharp-tailed Sandpiper	Migratory	Species or species habitat likely to occur within area
<i>Calidris ferruginea</i> Curlew Sandpiper	Migratory	Species or species habitat likely to occur within area
<i>Gallinago hardwickii</i> Latham's Snipe, Japanese Snipe	Migratory	Species or species habitat may occur within area

<i>Rostratula benghalensis s. lat.</i> Painted Snipe	Migratory	Species or species habitat may occur within area
Migratory Marine Birds		
<i>Apus pacificus</i> Fork-tailed Swift	Migratory	Species or species habitat may occur within area
<i>Ardea alba</i> Great Egret, White Egret	Migratory	Species or species habitat may occur within area
<i>Ardea ibis</i> Cattle Egret	Migratory	Species or species habitat may occur within area
<i>Diomedea amsterdamensis</i> Amsterdam Albatross	Migratory	Species or species habitat may occur within area
<i>Diomedea dabbenena</i> Tristan Albatross	Migratory	Foraging may occur within area
<i>Diomedea epomophora (sensu stricto)</i> Southern Royal Albatross	Migratory	Species or species habitat may occur within area
<i>Diomedea exulans (sensu lato)</i> Wandering Albatross	Migratory	Species or species habitat may occur within area
<i>Diomedea gibsoni</i> Gibson's Albatross	Migratory	Species or species habitat may occur within area
<i>Diomedea sanfordi</i> Northern Royal Albatross	Migratory	Species or species habitat may occur within area
<i>Macronectes giganteus</i> Southern Giant-Petrel	Migratory	Species or species habitat may occur within area
<i>Macronectes halli</i> Northern Giant-Petrel	Migratory	Species or species habitat may occur within area
<i>Sterna albifrons</i> Little Tern	Migratory	Species or species habitat may occur within area
<i>Thalassarche bulleri</i> Buller's Albatross	Migratory	Species or species habitat may occur within area
<i>Thalassarche cauta (sensu stricto)</i> Shy Albatross, Tasmanian Shy Albatross	Migratory	Species or species habitat may occur within area
<i>Thalassarche chlororhynchos</i> Yellow-nosed Albatross, Atlantic Yellow-nosed Albatross	Migratory	Species or species habitat may occur within area
<i>Thalassarche chrysostoma</i> Grey-headed Albatross	Migratory	Species or species habitat may occur within area
<i>Thalassarche impavida</i> Campbell Albatross	Migratory	Species or species habitat may occur within area
<i>Thalassarche melanophris</i> Black-browed Albatross	Migratory	Species or species habitat may occur within area
<i>Thalassarche salvini</i> Salvin's Albatross	Migratory	Species or species habitat may occur within area
Migratory Marine Species		
Mammals		
<i>Balaenoptera edeni</i> Bryde's Whale	Migratory	Species or species habitat may occur within area

<i>Balaenoptera musculus</i> Blue Whale	Migratory	Species or species habitat likely to occur within area
<i>Caperea marginata</i> Pygmy Right Whale	Migratory	Species or species habitat may occur within area
<i>Eubalaena australis</i> Southern Right Whale	Migratory	Species or species habitat known to occur within area
<i>Lagenorhynchus obscurus</i> Dusky Dolphin	Migratory	Species or species habitat may occur within area
<i>Megaptera novaeangliae</i> Humpback Whale	Migratory	Species or species habitat likely to occur within area
<i>Orcinus orca</i> Killer Whale, Orca	Migratory	Species or species habitat may occur within area
Sharks		
<i>Carcharodon carcharias</i> Great White Shark	Migratory	Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species	Status	Type of Presence
Birds		
<i>Apus pacificus</i> Fork-tailed Swift	Listed - overfly marine area	Species or species habitat may occur within area
<i>Ardea alba</i> Great Egret, White Egret	Listed - overfly marine area	Species or species habitat may occur within area
<i>Ardea ibis</i> Cattle Egret	Listed - overfly marine area	Species or species habitat may occur within area
<i>Calidris acuminata</i> Sharp-tailed Sandpiper	Listed	Species or species habitat likely to occur within area
<i>Calidris ferruginea</i> Curlew Sandpiper	Listed - overfly marine area	Species or species habitat likely to occur within area
<i>Catharacta skua</i> Great Skua	Listed	Species or species habitat may occur within area
<i>Diomedea amsterdamensis</i> Amsterdam Albatross	Listed	Species or species habitat may occur within area
<i>Diomedea dabbenena</i> Tristan Albatross	Listed	Foraging may occur within area
<i>Diomedea epomophora (sensu stricto)</i> Southern Royal Albatross	Listed	Species or species habitat may occur within area
<i>Diomedea exulans (sensu lato)</i> Wandering Albatross	Listed	Species or species habitat may occur within area
<i>Diomedea gibsoni</i> Gibson's Albatross	Listed	Species or species habitat may occur within area
<i>Diomedea sanfordi</i> Northern Royal Albatross	Listed	Species or species habitat may occur within area
<i>Gallinago hardwickii</i> Latham's Snipe, Japanese	Listed - overfly	Species or species habitat may

Snipe	marine area	occur within area
<i>Haliaeetus leucogaster</i> White-bellied Sea-Eagle	Listed	Species or species habitat likely to occur within area
<i>Halobaena caerulea</i> Blue Petrel	Listed	Species or species habitat may occur within area
<i>Hirundapus caudacutus</i> White-throated Needletail	Listed - overfly marine area	Species or species habitat may occur within area
<i>Lathamus discolor</i> Swift Parrot	Listed - overfly marine area	Species or species habitat may occur within area
<i>Macronectes giganteus</i> Southern Giant-Petrel	Listed	Species or species habitat may occur within area
<i>Macronectes halli</i> Northern Giant-Petrel	Listed	Species or species habitat may occur within area
<i>Merops ornatus</i> Rainbow Bee-eater	Listed - overfly marine area	Species or species habitat may occur within area
<i>Myiagra cyanoleuca</i> Satin Flycatcher	Listed - overfly marine area	Breeding likely to occur within area
<i>Neophema chrysogaster</i> Orange-bellied Parrot	Listed - overfly marine area	Species or species habitat known to occur within area
<i>Pterodroma mollis</i> Soft-plumaged Petrel	Listed	Species or species habitat may occur within area
<i>Rhipidura rufifrons</i> Rufous Fantail	Listed - overfly marine area	Breeding may occur within area
<i>Rostratula benghalensis s. lat.</i> Painted Snipe	Listed - overfly marine area	Species or species habitat may occur within area
<i>Sterna albifrons</i> Little Tern	Listed	Species or species habitat may occur within area
<i>Thalassarche bulleri</i> Buller's Albatross	Listed	Species or species habitat may occur within area
<i>Thalassarche cauta (sensu stricto)</i> Shy Albatross, Tasmanian Shy Albatross	Listed	Species or species habitat may occur within area
<i>Thalassarche chlororhynchos</i> Yellow-nosed Albatross, Atlantic Yellow-nosed Albatross	Listed	Species or species habitat may occur within area
<i>Thalassarche chrysostoma</i> Grey-headed Albatross	Listed	Species or species habitat may occur within area
<i>Thalassarche impavida</i> Campbell Albatross	Listed	Species or species habitat may occur within area
<i>Thalassarche melanophris</i> Black-browed Albatross	Listed	Species or species habitat may occur within area
<i>Thalassarche salvini</i> Salvin's Albatross	Listed	Species or species habitat may occur within area
<i>Thinornis rubricollis rubricollis</i> Hooded Plover (eastern)	Listed - overfly marine area	Species or species habitat likely to occur within area
Mammals		

<i>Arctocephalus forsteri</i> New Zealand Fur-seal	Listed	Species or species habitat may occur within area
<i>Arctocephalus pusillus</i> Australian Fur-seal, Australo-African Fur-seal	Listed	Species or species habitat may occur within area
Ray-finned fishes		
<i>Heraldia nocturna</i> Upside-down Pipefish	Listed	Species or species habitat may occur within area
<i>Hippocampus abdominalis</i> Eastern Potbelly Seahorse, New Zealand Potbelly, Seahorse, Bigbelly Seahorse	Listed	Species or species habitat may occur within area
<i>Hippocampus breviceps</i> Short-head Seahorse, Short-snouted Seahorse	Listed	Species or species habitat may occur within area
<i>Hippocampus minotaur</i> Bullneck Seahorse	Listed	Species or species habitat may occur within area
<i>Histiogamphelus briggsii</i> Briggs' Crested Pipefish, Briggs' Pipefish	Listed	Species or species habitat may occur within area
<i>Histiogamphelus cristatus</i> Rhino Pipefish, Macleay's Crested Pipefish	Listed	Species or species habitat may occur within area
<i>Hypsognathus rostratus</i> Knife-snouted Pipefish	Listed	Species or species habitat may occur within area
<i>Kaupus costatus</i> Deep-bodied Pipefish	Listed	Species or species habitat may occur within area
<i>Leptoichthys fistularius</i> Brushtail Pipefish	Listed	Species or species habitat may occur within area
<i>Lissocampus caudalis</i> Australian Smooth Pipefish, Smooth Pipefish	Listed	Species or species habitat may occur within area
<i>Lissocampus runa</i> Javelin Pipefish	Listed	Species or species habitat may occur within area
<i>Maroubra perserrata</i> Sawtooth Pipefish	Listed	Species or species habitat may occur within area
<i>Mitotichthys mollisoni</i> Mollison's Pipefish	Listed	Species or species habitat may occur within area
<i>Mitotichthys semistriatus</i> Half-banded Pipefish	Listed	Species or species habitat may occur within area
<i>Notiocampus ruber</i> Red Pipefish	Listed	Species or species habitat may occur within area
<i>Phycodurus eques</i> Leafy Seadragon	Listed	Species or species habitat may occur within area
<i>Phyllopteryx taeniolatus</i> Weedy Seadragon, Common Seadragon	Listed	Species or species habitat may occur within area
<i>Pugnaso curtirostris</i> Pug-nosed Pipefish	Listed	Species or species habitat may occur within area
<i>Solegnathus robustus</i> Robust Spiny Pipehorse, Robust Pipehorse	Listed	Species or species habitat may occur within area

<i>Solegnathus spinosissimus</i> Spiny Pipehorse, Australian Spiny Pipehorse	Listed	Species or species habitat may occur within area
<i>Stigmatopora argus</i> Spotted Pipefish	Listed	Species or species habitat may occur within area
<i>Stigmatopora nigra</i> Wide-bodied Pipefish, Black Pipefish	Listed	Species or species habitat may occur within area
<i>Stipecampus cristatus</i> Ring-backed Pipefish	Listed	Species or species habitat may occur within area
<i>Urocampus carinirostris</i> Hairy Pipefish	Listed	Species or species habitat may occur within area
<i>Vanacampus margaritifer</i> Mother-of-pearl Pipefish	Listed	Species or species habitat may occur within area
<i>Vanacampus phillipi</i> Port Phillip Pipefish	Listed	Species or species habitat may occur within area
Whales and Other Cetaceans	Status	Type of Presence
<i>Balaenoptera acutorostrata</i> Minke Whale	Cetacean	Species or species habitat may occur within area
<i>Balaenoptera edeni</i> Bryde's Whale	Cetacean	Species or species habitat may occur within area
<i>Balaenoptera musculus</i> Blue Whale	Cetacean	Species or species habitat likely to occur within area
<i>Caperea marginata</i> Pygmy Right Whale	Cetacean	Species or species habitat may occur within area
<i>Delphinus delphis</i> Common Dolphin	Cetacean	Species or species habitat may occur within area
<i>Eubalaena australis</i> Southern Right Whale	Cetacean	Species or species habitat known to occur within area
<i>Grampus griseus</i> Risso's Dolphin, Grampus	Cetacean	Species or species habitat may occur within area
<i>Lagenorhynchus obscurus</i> Dusky Dolphin	Cetacean	Species or species habitat may occur within area
<i>Megaptera novaeangliae</i> Humpback Whale	Cetacean	Species or species habitat likely to occur within area
<i>Orcinus orca</i> Killer Whale, Orca	Cetacean	Species or species habitat may occur within area
<i>Tursiops aduncus</i> Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin	Cetacean	Species or species habitat likely to occur within area
<i>Tursiops truncatus</i> s. str. Bottlenose Dolphin	Cetacean	Species or species habitat may occur within area
Places on the RNE Note that not all Indigenous sites may be listed.		
Natural		
Lake Connewarre State Game Reserve VIC		

Extra Information

State and Territory Reserves		
Lake Connewarre Natural Features Reserve - Wildlife Reserve (hunting), VIC		
Regional Forest Agreements		
West Victoria RFA, Victoria		

Appendix 4. Vertebrate species recorded on Macafee’s Land at 1920 Barwon Heads Road, and at Murnagurt Lagoon/Lake Connewarre State Game Reserve, the Overflow Connecting Channel from the Barwon River Estuary and adjoining golf courses, Barwon Heads, 31 July and 1 August 2008.

Habitat Codes: M = Mudflats; BW = Brackish Wetland; CS/H = Coastal Saltmarsh Shrubland/Herbland; BS = Brackish Sedgeland; FW = Freshwater Wetland; RT/S = Remnant Trees/Shrubs; EG = Exotic Grassland; and PT/S = Planted Trees/Shrubs.

Numbers of individuals are provided where available. FOH = Flew Overhead. P = Present (i.e. numbers not recorded).

Species common name	Macafee’s Land	Murnagurt Lagoon	Connecting channel	Freshwater spring	Golf courses	Coast Dune Scrub
Birds						
Eurasian Coot				2		
Australasian Grebe				1		
Masked Lapwing		2 (M, BW)				
Double-banded Plover		1 (M)				
Red-capped Plover		2 (M)				
Black-winged Stilt		2 (M, BW)				
Red-necked Stint		12 (M)				
Australian White Ibis		2 (FW)				
Straw-necked Ibis	14 (FOH)					
White-faced Heron		8 (FW)				
Black Swan		5 (BW)				

Species common name	Macafee's Land	Murtnagurt Lagoon	Connecting channel	Freshwater spring	Golf courses	Coast Dune Scrub
Pacific Black Duck		2 (FW)				
Chestnut Teal	8	27 and 5 (BW, FW)				
Black-shouldered Kite	1 (PT/S)					
Nankeen Kestrel		1 (Aerial)			1 (PT/S)	
Galah	2 (PT/S)					
Crimson Rosella					P (RT/S, PT/S)	
Eastern Rosella					P (EG, PT/S)	
Blue-winged Parrot		13 (CS/H)	70 (CS/H)			
Welcome Swallow		P (Aerial)				
Willie Wagtail	P (EG, PT/S)	1 (CS)				
Flame Robin	3 (EG, PT/S)					
Magpie-lark	P (EG, PT/S)	P (CS/H)			P (EG, PT/S)	
White-fronted Chat	P (EG, PT/S)	P (CS/H, BS)	P (CS/H, BS)			
Brown Thornbill	P (PT/S)	P (CS/H)			P (RT/S, PT/S)	
Yellow-rumped Thornbill	P (EG, PT/S)	20 (CS/H)				
White-browed Scrub-wren		P (CS/H)				
Striated Fieldwren		P (CS/H, BS)	P (BS)			

Species common name	Macafee's Land	Murtnagurt Lagoon	Connecting channel	Freshwater spring	Golf courses	Coast Dune Scrub
Little Grassbird		P				
Golden-headed Cisticola		1				
Superb Fairy-wren	P (EG, PT/S)	P	P (BS)			P
Singing Honeyeater	P (PT/S)					P
New Holland Honeyeater	P (PT/S)					P
Little Wattlebird						P
Red Wattlebird	P (PT/S)					
Spiny-cheeked Honeyeater	P (PT/S)		FOH			
Australian Pipit	8 (EG)	P (CS/H, EG)				
Grey Butcherbird					P (PT/S)	
Australian Magpie	P (EG, PT/S)	P	P (CS/H)		P (EG, RT/S, PT/S)	
Little Raven	P (EG, PT/S)	P and 2 (FW)	P (CS/H)		P (EG, PT/S)	P
*Spotted Turtle-Dove						P
*Skylark		P (CS/H)				
*House Sparrow		P (CS/H)				
*Common Starling	P (EG, PT/S)					



Species common name	Macafee's Land	Murtnagurt Lagoon	Connecting channel	Freshwater spring	Golf courses	Coast Dune Scrub
Mammals						
*Rabbit	P (EG)					
*Hare		P (BS)		P	P (EG)	
*Fox		P (CS/H, BS))	1			
*Dog		P (CS/H)				
Total Number of Species	18 (*2)	30 (*5)	8 (*1)	3 (*1)	9 (*1)	6 (*1)

Appendix 5. Threatened and Migratory/Marine-overfly species recorded under the Atlas of Victorian Wildlife (DSE 2005b) for the Murtnagurt Lagoon Data Review Area (DRA), or listed as potentially occurring (or suitable habitat potentially) under the DEWHA EPBC Protected Matters database, and their likelihood of regular occurrence (LRO) in the study area.

Key

EPBC – *Environmental Protection and Biodiversity Conservation Act 1999*

NAP – National Action Plan

FFG – *Flora and Fauna Guarantee Act 1988*

DSE – Status according to DSE (2003): Advisory List of Threatened Vertebrate Fauna in Victoria – 2003.

CE – Critically Endangered; EN – Endangered; VU – Vulnerable; NT – Near Threatened; LC – Least Concern; LR-NT – Lower Risk- Near Threatened; R-IK – Rare or Insufficiently Known; R/R – Rare and Restricted; DD – Data Deficient; CD – Conservation Dependent.

L – Listed under the FFG Act 1988.

N – Nominated for listing under the FFG Act 1988

I – Ineligible for listing under the FFG Act 1988.

Mi – Migratory species under the EPBC Act 1999

M – Marine overfly species under the EPBC Act 1999

Ce – Cetacean species under the EPBC Act 1999

Last – Year of last record

Recs – Number of records in Fauna DRA under AVW (DSE 2005b)

BA – not recorded under the AVW (DSE 2005b), but recorded under Birds Australia's Atlas database for the 5 km DRA

and NR – Not recorded under Fauna DRA (DSE 2005b), but listed as potentially occurring or suitable habitat potentially occurring under the DEWHA EPBC Act Protected Matters Search Tool database web page.

LRO = Likelihood of Regular Occurrence – Neg = Negligible; L= Low; Mod = Moderate; H = High; and Con = Confirmed.

Species highlighted in bold type were recorded during the field assessment.

Common Name	Scientific Name	Last	Recs	EPBC	NAP	FFG	DSE	Likelihood of Regular Occurrence
Birds								
Little Penguin	<i>Eudyptula minor</i>	2001	19	M				No habitat at Lagoon or on private properties
Stubble Quail	<i>Coturnix pectoralis</i>	2001	2	M				Occasional visitor to Murtnagurt Lagoon and adjoining grasslands; low
Diamond Dove	<i>Geopelia cuneata</i>	2000	2			L	NT	Rare visitor to broader area from northern Victoria; low
Purple Swamphen	<i>Porphyrio porphyrio</i>	2000	1	M				Occasional visitor to Murtnagurt Lagoon; moderate in freshwater spring (resident)
Wilson's Storm-Petrel	<i>Oceanites oceanicus</i>	1985	1	Mi,M	VU			Rare vagrant; potential poor weather refuge at Murtnagurt Lagoon
White-faced Storm-Petrel	<i>Pelagodroma marina</i>	2000	1	M			NT	Rare vagrant; potential poor weather refuge at Murtnagurt Lagoon

Common Name	Scientific Name	Last	Recs	EPBC	NAP	FFG	DSE	Likelihood of Regular Occurrence
Little Shearwater	<i>Puffinus assimilis</i>	1973	1	M	VU			Rare vagrant; potential poor weather refuge at Murtnagurt Lagoon
Fluttering Shearwater	<i>Puffinus gavia</i>	2001	10	M				Rare vagrant; potential poor weather refuge at Murtnagurt Lagoon
Short-tailed Shearwater	<i>Puffinus tenuirostris</i>	2001	13	Mi,M				Rare vagrant; potential poor weather refuge at Murtnagurt Lagoon
Great-winged Petrel	<i>Pterodroma macroptera</i>	1954	1	M				Rare vagrant; potential poor weather refuge at Murtnagurt Lagoon
White-headed Petrel	<i>Pterodroma lessonii</i>	1958	1	M	VU			Rare vagrant; potential poor weather refuge at Murtnagurt Lagoon
Cape Petrel	<i>Daption capense</i>	2000	2	M	VU			Rare vagrant; potential poor weather refuge at Murtnagurt Lagoon
Blue Petrel	<i>Halobaena caerulea</i>	1999	1	VU,M	CE			Rare vagrant; potential poor weather refuge at Murtnagurt Lagoon
Fairy Prion	<i>Pachyptila turtur</i>	2001	11	VU,M	EN		VU	Rare vagrant; potential poor weather refuge at Murtnagurt Lagoon
Common Diving-Petrel	<i>Pelecanoides urinatrix</i>	2001	6	M			NT	Rare vagrant; potential poor weather refuge at Murtnagurt Lagoon
#Soft-plumaged Petrel	<i>Pterodroma mollis</i>	NR	NR	VU,M				Rare vagrant; potential poor weather refuge at Murtnagurt Lagoon
Black-browed Albatross	<i>Thalassarche melanophris</i>	1988	1	VU,Mi,M	EN	I	EN	Rare vagrant; potential poor weather refuge at Murtnagurt Lagoon
Shy Albatross	<i>Thalassarche cauta</i>	2000	4	VU,Mi,M	VU	L	VU	Rare vagrant; potential poor weather refuge at Murtnagurt Lagoon
#Amsterdam Albatross	<i>Diomedea amsterdamensis</i>	NR	NR	EN,Mi,M	EN			Rare vagrant; potential poor weather refuge at Murtnagurt Lagoon
#Tristan Albatross	<i>Diomedea dabbenena</i>	NR	NR	EN,Mi,M	EN			Rare vagrant; potential poor weather refuge at Murtnagurt Lagoon
#Southern Royal Albatross	<i>Diomedea epomophora (sensu stricto)</i>	NR	NR	VU,Mi,M	VU	L	VU	Rare vagrant; potential poor weather refuge at Murtnagurt Lagoon
#Wandering Albatross	<i>Diomedea exulans (Sensu lato)</i>	NR	NR	VU,Mi,M	VU	L	EN	Rare vagrant; potential poor weather refuge at Murtnagurt Lagoon
#Gibson's Albatross	<i>Diomedea gibsoni</i>	NR	NR	VU,Mi,M	VU			Rare vagrant; potential poor weather refuge at Murtnagurt Lagoon
#Northern Royal Albatross	<i>Diomedea sandfordi</i>	NR	NR	EN,Mi,M	EN			Rare vagrant; potential poor weather refuge at Murtnagurt Lagoon
#Buller's Albatross	<i>Thalassarche bulleri</i>	NR	NR	VU,Mi,M	VU	L		Rare vagrant; potential poor weather refuge at Murtnagurt Lagoon
#Grey-headed Albatross	<i>Thalassarche chrysostoma</i>	NR	NR	VU,Mi,M	VU	L	VU	Rare vagrant; potential poor weather refuge at Murtnagurt Lagoon
#Campbell Albatross	<i>Thalassarche chrysostoma</i>	NR	NR	VU,Mi,M	VU			Rare vagrant; potential poor weather refuge at Murtnagurt Lagoon
#Salvin's Albatross	<i>Thalassarche salvini</i>	NR	NR	VU,Mi,M	VU			Rare vagrant; potential poor weather refuge at Murtnagurt Lagoon
#Yellow-nosed Albatross	<i>Thalassarche chlororhynchus</i>	NR	NR	VU,Mi,M	VU	L	VU	Rare vagrant; potential poor weather refuge at Murtnagurt Lagoon
Pied Cormorant	<i>Phalacrocorax varius</i>	2006	30				NT	Regular visitor; moderate
Australasian Gannet	<i>Morus serrator</i>	2001	9	M				Rare vagrant; potential poor weather refuge at Murtnagurt Lagoon
Australian Pelican	<i>Pelecanus conspicillatus</i>	2006	33	M				Regular visitor to Murtnagurt Lagoon; moderate
Whiskered Tern	<i>Chlidonias hybridus</i>	1999	7	Mi,M			NT	Regular visitor to Murtnagurt Lagoon; moderate
Gull-billed Tern	<i>Sterna nilotica</i>	1999	10	Mi,M		L	EN	Occasional visitor to Murtnagurt Lagoon; low-moderate
Caspian Tern	<i>Sterna caspia</i>	2006	30	Mi,M		L	NT	Regular visitor to Murtnagurt Lagoon; moderate
White-fronted Tern	<i>Sterna striata</i>	2000	2	Mi,M			NT	Occasional visitor to Murtnagurt Lagoon; low
Crested Tern	<i>Sterna bergii</i>	2006	29	Mi,M				Regular visitor to Murtnagurt Lagoon; high
Little Tern	<i>Sterna albifrons sinensis</i>	1989	1	Mi,M		L	VU	Regular visitor to Murtnagurt Lagoon; low

Common Name	Scientific Name	Last	Recs	EPBC	NAP	FFG	DSE	Likelihood of Regular Occurrence
Fairy Tern	<i>Sterna nereis</i>	1999	5	Mi,M		L	EN	Regular visitor to Murtnagurt Lagoon; moderate
Silver Gull	<i>Larus novaehollandiae</i>	2006	81	Mi,M				Regular visitor to Murtnagurt Lagoon and adjoining grasslands; moderate; high
Pacific Gull	<i>Larus pacificus pacificus</i>	2006	59	Mi,M			NT	Regular visitor to Murtnagurt Lagoon; high
Ruddy Turnstone	<i>Arenaria interpres</i>	2000	7	Mi,M				Occasional visitor to Murtnagurt Lagoon; and adjoining grasslands; low
Pied Oystercatcher	<i>Haematopus longirostris</i>	2006	8	Mi				Occasional visitor to Murtnagurt Lagoon; low
Sooty Oystercatcher	<i>Haematopus fuliginosus</i>	1992	2	Mi			NT	Occasional visitor; low
Masked Lapwing	<i>Vanellus miles</i>	2006	93	Mi				Resident, possibly breeding at Murtnagurt Lagoon and on adjoining grasslands; high
Banded Lapwing	<i>Vanellus tricolor</i>	1999	2	Mi				Rare visitor to Murtnagurt Lagoon and adjoining grasslands; low
Pacific Golden Plover	<i>Pluvialis fulva</i>	2001	5	Mi,M			NT	Regular visitor to Murtnagurt Lagoon; moderate
Hooded Plover	<i>Thinornis rubricollis</i>	2005	35	Mi,M	VU	L	VU	Breeding resident on nearby beaches and regular visitor to Murtnagurt Lagoon; high
Double-banded Plover	<i>Charadrius bicinctus</i>	2006	16	Mi,M				Confirmed; annual migrant to Murtnagurt Lagoon; high
Red-capped Plover	<i>Charadrius ruficapillus</i>	2006	37	Mi,M				Confirmed at Murtnagurt Lagoon; breeding resident; high
Black-fronted Dotterel	<i>Elseya melanops</i>	1963	1	Mi				Rare visitor to Murtnagurt Lagoon; low
Black-winged Stilt	<i>Himantopus himantopus leucocephalus</i>	2006	4	Mi,M				Confirmed; resident at Murtnagurt Lagoon; high
Red-necked Avocet	<i>Recurvirostra novaehollandiae</i>	2006	6	Mi				Regular visitor to Murtnagurt Lagoon; moderate
Eastern Curlew	<i>Numenius madagascariensis</i>	2006	27	Mi,M			NT	Regular visitor to Murtnagurt Lagoon; moderate
Whimbrel	<i>Numenius phaeopus</i>	1986	1	Mi,M			VU	Occasional visitor to Murtnagurt Lagoon; low
Bar-tailed Godwit	<i>Limosa lapponica</i>	2006	9	Mi,M				Regular visitor to Murtnagurt Lagoon; moderate
Grey-tailed Tattler	<i>Heteroscelus brevipes</i>	1988	1	Mi,M		L	CE	Occasional visitor to Murtnagurt Lagoon; low
Common Sandpiper	<i>Actitis hypoleucos</i>	2001	8	Mi,M			VU	Regular visitor to Murtnagurt Lagoon; moderate
Common Greenshank	<i>Tringa nebularia</i>	2006	31	Mi,M				Regular visitor to Murtnagurt Lagoon; high
Marsh Sandpiper	<i>Tringa stagnatilis</i>	2000	1	Mi,M				Occasional visitor to Murtnagurt Lagoon; low
Terek Sandpiper	<i>Xenus cinereus</i>	1998	1	Mi,M		N	EN	Occasional visitor to Murtnagurt Lagoon; low
Curlew Sandpiper	<i>Calidris ferruginea</i>	2006	20	Mi,M				Regular visitor to Murtnagurt Lagoon; high
Red-necked Stint	<i>Calidris ruficollis</i>	2006	35	Mi,M				Confirmed at at Murtnagurt Lagoon; regular visitor; high
Sharp-tailed Sandpiper	<i>Calidris acuminata</i>	2006	15	Mi,M				Regular visitor to Murtnagurt Lagoon; high
Red Knot	<i>Calidris canutus</i>	2001	8	Mi,M			NT	Occasional visitor to Murtnagurt Lagoon; low-moderate
Great Knot	<i>Calidris tenuirostris</i>	2001	3	Mi,M		L	EN	Occasional visitor to Murtnagurt Lagoon; low-moderate

Murtnagurt Lagoon, Barwon Heads, Flora and Fauna Assessment



Common Name	Scientific Name	Last	Recs	EPBC	NAP	FFG	DSE	Likelihood of Regular Occurrence
Sanderling	<i>Calidris alba</i>	1999	3	Mi,M			NT	Occasional visitor to Murtnagurt Lagoon; low
Broad-billed Sandpiper	<i>Limicola falcinellus</i>	1992	1	Mi,M				Occasional visitor to Murtnagurt Lagoon; low
#Australian Painted Snipe	<i>Rostratula australis</i>	NR	NR	VU,Mi,M	VU	L	CE	Rare visitor to broader area; negligible
Latham's Snipe	<i>Gallinago hardwickii</i>	1998	1	Mi,M			NT	Occasional visitor to Murtnagurt Lagoon; low
Brolga	<i>Grus rubicunda</i>	2006	1	Mi		L	VU	Occasional visitor to Murtnagurt Lagoon; low
Glossy Ibis	<i>Plegadis falcinellus</i>	1978	1	Mi,M			NT	Occasional visitor to Murtnagurt Lagoon; low
Australian White Ibis	<i>Threskiornis molucca</i>	2006	59	M				Confirmed, regular visitor to Murtnagurt Lagoon and on adjoining lands; high
Straw-necked Ibis	<i>Threskiornis spinicollis</i>	2001	32	M				Confirmed, regular visitor to Murtnagurt Lagoon and on adjoining lands; high
Royal Spoonbill	<i>Platalea regia</i>	2006	35				VU	Regular visitor to Murtnagurt Lagoon; moderate
Little Egret	<i>Egretta garzetta</i>	2006	12	M		L	EN	Regular visitor to Murtnagurt Lagoon; moderate
Great Egret	<i>Ardea alba</i>	2006	27	Mi,M		L	VU	Non-breeding resident in broader area; regular visitor to Murtnagurt Lagoon; high
Australasian Bittern	<i>Botaurus poiciloptilus</i>	1992	2		VU	L	EN	Occasional visitor to Murtnagurt Lagoon; low
Black Swan	<i>Cygnus atratus</i>	2006	58	Mi				Confirmed, resident at Murtnagurt Lagoon; high
Australian Shelduck	<i>Tadorna tadornoides</i>	2001	16	Mi				Regular visitor to Murtnagurt Lagoon; moderate
Pacific Black Duck	<i>Anas superciliosa</i>	2006	31	Mi				Confirmed at Murtnagurt Lagoon; high
Chestnut Teal	<i>Anas castanea</i>	2006	22	Mi				Confirmed, breeding resident at Murtnagurt Lagoon; high
Grey Teal	<i>Anas gracilis</i>	2006	8	Mi				Breeding resident at Murtnagurt Lagoon; high
Australasian Shoveler	<i>Anas rhynchotis</i>	2006	7	Mi			VU	Occasional visitor to Murtnagurt Lagoon; low
Pink-eared Duck	<i>Malacorhynchus membranaceus</i>	1979	1	Mi				Occasional visitor at Murtnagurt Lagoon; low
Hardhead	<i>Aythya australis</i>	1993	3	Mi			VU	Occasional visitor to Murtnagurt Lagoon; low
Musk Duck	<i>Biziura lobata</i>	2006	2	Mi,M			VU	Occasional visitor to Murtnagurt Lagoon; low
Swamp Harrier	<i>Circus approximans</i>	2001	19	Mi,M				Resident at Murtnagurt Lagoon
Grey Goshawk	<i>Accipiter novaehollandiae</i>	1991	2	Mi		N	VU	Occasional visitor to broader area; low
Brown Goshawk	<i>Accipiter fasciatus</i>	2006	3	Mi,M				Regular visitor to broader area; moderate
Little Eagle	<i>Hieraaetus morphnoides</i>	1997	2	Mi				Occasional visitor to broader area; low
White-bellied Sea-Eagle	<i>Haliaeetus leucogaster</i>	2005	3	Mi,M		L	VU	Occasional visitor to Murtnagurt Lagoon; low
Whistling Kite	<i>Haliastur sphenurus</i>	2006	16	Mi,M				Regular visitor and resident in broader area; moderate all sites/habitats
Black-shouldered Kite	<i>Elanus axillaris</i>	2001	16	Mi				Confirmed on Macafee's Land; resident in area; high
Australian Hobby	<i>Falco longipennis</i>	2000	2	Mi				Resident in broader area; moderate on all sites/habitats

Murtnagurt Lagoon, Barwon Heads, Flora and Fauna Assessment



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Peregrine Falcon	<i>Falco peregrinus</i>	1999	1	Mi				Occasional visitor; low-moderate
Brown Falcon	<i>Falco berigora</i>	2001	15	Mi				Probable resident in broader area; moderate in all habitats
Nankeen Kestrel	<i>Falco cenchroides</i>	2000	4	Mi,M				Confirmed over Murtnagurt Lagoon, resident in area
Orange-bellied Parrot	<i>Neophema chrysogaster</i>	2006	68	EN,Mi,M	CE	L	CE	Annual winter migrant, moderate
Blue-winged Parrot	<i>Neophema chrysostoma</i>	2006	20	M				Confirmed at Murtnagurt Lagoon, annual winter migrant, high
Swift Parrot	<i>Lathamus discolor</i>	2002	1	EN,M	EN	L	EN	Rare vagrant to broader areas; low
Sacred Kingfisher	<i>Todiramphus sanctus</i>	1999	1	M				Rare vagrant to broader areas; low
#White-throated Needletail	<i>Hirundaptus caudacutus</i>	NR	NR	Mi,M				Regular aerial visitor to broader area; moderate
#Fork-tailed Swift	<i>Apus pacificus</i>	NR	NR	Mi,M				Regular aerial visitor to broader area; moderate
Pallid Cuckoo	<i>Cuculus pallidus</i>	2001	1	M				Occasional visitor to Macafee's Land, Golf course and Murtnagurt
Fan-tailed Cuckoo	<i>Cacomantis flabelliformis</i>	2000	4	M				Occasional visitor to Macafee's Land and golf courses; low
Horsfield's Bronze-Cuckoo	<i>Chrysococcyx basalis</i>	2001	5	M				Moderate visitor to saltmarsh of Murtnagurt Lagoon and Coastal Scrub; low on Macafee's Land and golf courses
Shining Bronze-Cuckoo	<i>Chrysococcyx lucidus</i>	1998	3	M				Regular visitor to golf courses and other habitats; moderate
#Regent Honeyeater	<i>Xanthomyza phrygia</i>	NR	NR	EN,Mi	EN	L	CE	Probably extinct in southern Victoria
Welcome Swallow	<i>Hirundo neoxena</i>	2001	62	M				Confirmed on Macafee's Land, golf courses and Murtnagurt Lagoon, resident
Tree Martin	<i>Hirundo nigricans</i>	1989	1	M				Occasional visitor to broader area; low
#Rainbow Bee-eater	<i>Merops ornatus</i>	NR	NR	Mi,M				Occasional visitor to broader area; low
#Satin Flycatcher	<i>Myiagra cyanoleuca</i>	NR	NR	M				Occasional visitor to broader area; low
#Rufous Fantail	<i>Rhipidura rufirons</i>	NR	NR	M				Occasional visitor to broader area (e.g. Coast Scrub); low
Flame Robin	<i>Petroica phoenicea</i>	2000	2	M				Confirmed Macafee's Land, migratory to area from higher altitudes; high
Pink Robin	<i>Petroica rodinogaster</i>	2000	3	M				Occasional altitudinal migrant; low
Magpie-lark	<i>Grallina cyanoleuca</i>	2001	36	M				Confirmed on Macafee's Land and Murtnagurt Lagoon, resident; high
Black-faced Cuckoo-shrike	<i>Coracina novaehollandiae</i>	1999	2	M				Regular visitor on Macafee's Land; moderate
Brown Songlark	<i>Cincloramphus cruralis</i>	1999	2	Mi				Occasional visitor to grasslands on all sites; low
Little Grassbird	<i>Megalurus gramineus</i>	2006	16	Mi				Confirmed Murtnagurt Lagoon, high
Australian Reed-Warbler	<i>Acrocephalus australis</i>	2000	1	Mi				Potential to use reedbeds at western edge of Murtnagurt Lagoon and around freshwater spring on golf course; moderate
Silvereeye	<i>Zosterops lateralis</i>	2001	35	M				Regular visitor to Macafee's Land and golf courses; high

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Australian Pipit	<i>Anthus australis</i>	2001	9	M				Confirmed Macafee's Land and Murtnagurt Lagoon, high
Southern Giant-Petrel	<i>Macronectes giganteus</i>	1988	3	EN,Mi,M	EN	L	VU	Rare vagrant; potential poor weather refuge at Murtnagurt Lagoon
Kerguelen Petrel	<i>Aphrodroma brevirostris</i>	1975	1	M				Rare vagrant; potential poor weather refuge at Murtnagurt Lagoon
Northern Giant-Petrel	<i>Macronectes halli</i>	1988	1	VU,Mi,M	VU	L	NT	Rare vagrant; potential poor weather refuge at Murtnagurt Lagoon
Salvin's Prion	<i>Pachyptila salvini</i>	1985	2	M				Rare vagrant; potential poor weather refuge at Murtnagurt Lagoon
Slender-billed Prion	<i>Pachyptila belcheri</i>	2001	4	M				Rare vagrant; potential poor weather refuge at Murtnagurt Lagoon
#Great Skua	<i>Catharacta skua</i>	NR	NR	M				Rare vagrant; potential poor weather refuge at Murtnagurt Lagoon
Little Raven	<i>Corvus mellori</i>	2006	56	M				Confirmed on Macafee's Land and Murtnagurt Lagoon, resident; high
Cattle Egret	<i>Ardea ibis</i>	2001	2	Mi,M				Occasional non-breeding visitor
Kelp Gull	<i>Larus dominicanus</i>	1999	2	Mi,M				Occasional visitor to Murtnagurt Lagoon; low
Mammals								
Brush-tailed Phascogale	<i>Phascogale tapoatafa tapoatafa</i>	1958	1		NT	L	VU	Locally extinct
#Spot-tailed Quoll	<i>Dasyurus aculates maculatus</i>	NR	NR	EN	VU	L	EN	Locally extinct
Southern Brown Bandicoot	<i>Isoodon obesulus obesulus</i>	1968	1	EN	NT	I	NT	Locally extinct
#Long-nosed Potoroo	<i>Potorous tridactylus tridactylus</i>	NR	NR	VU	VU	L	EN	Locally extinct
Koala	<i>Phascolarctos cinereus</i>	1987	1		NT			No habitat
#Southern Bent-wing Bat	<i>Miniopterus schreibersii bassanii</i>	NR	NR	CE		L	EN	Rare vagrant
#Grey-headed Flying-fox	<i>Pteropus poliocephalus</i>	NR	NR	VU	VU	L	VU	Rare vagrant
#Smoky Mouse	<i>Pseudomys fumeus</i>	NR	NR	EN	R	L	CE	No habitat
Australian Fur-seal	<i>Arctocephalus pusillus doriferus</i>	1999	7	M	CD			No habitat
#New Zealand Fur-seal	<i>Arctocephalus forsteri</i>	NR	NR	M	CD		VU	No habitat
Leopard Seal	<i>Hydrurga leptonyx</i>	1990	5	M				No habitat
Southern Right Whale	<i>Eubalaena australis</i>	1997	1	EN,Mi,Ce	VU	L	CE	No habitat
#Pygmy Right Whale	<i>Caperea marginata</i>	NR	NR	Mi,Ce				No habitat
Killer Whale	<i>Orcinus orca</i>	2004	1	Mi,M,Ce				No habitat
#Blue Whale	<i>Balenoptera musculus</i>	NR	NR	EN,Mi,M,Ce		L	CE	No habitat
#Humpback Whale	<i>Megaptera novaeangliae</i>	NR	NR	VU,Mi,M,Ce	VU	L	VU	No habitat
#Bryde's Whale	<i>Balaenoptera edeni</i>	NR	NR	Mi,M,Ce			DD	No habitat
#Minke Whale	<i>Balaenoptera acutorostrata</i>	NR	NR	Ce				No habitat
Bottlenose Dolphin	<i>Tursiops truncatus</i>	1987	2	Ce				No habitat
Common Dolphin	<i>Delphinus delphis</i>	1988	1	Ce				No habitat
#Dusky Dolphin	<i>Lagenorhynchus obscurus</i>	NR	NR	Mi,M,Ce				No habitat

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#Spotted Bottlenose Dolphin	<i>Tursiops aduncus</i>	NR	NR	Ce				No habitat
#Risso's (Grampus) Dolphin	<i>Grampus griseus</i>	NR	NR	Ce				No habitat
Reptiles								
Swamp Skink	<i>Egernia coventryi</i>	NR	NR		R/IK	L	VU	Moderate
Glossy Grass Skink	<i>Pseudomoia rawlinsoni</i>	NR	NR		RIK		NT	
Frogs								
#Growling Grass Frog	<i>Litoria raniformis</i>	NR	NR	VU	VU	L	EN	Low-moderate potential in freshwater spring
Fish								
#Dwarf Galaxias	<i>Galaxia pusilla</i>	NR	NR	VU	VU	L	VU	No habitat
#Yarra Pygmy Perch	<i>Nannoperca obscura</i>	NR	NR	VU	VU	L	NT	No habitat
#Australian Grayling	<i>Prototroctes maraena</i>	NR	NR	VU	VU	L	VU	Occasional in Murtnagurt Lagoon when barrier is flooded out
#Great White Shark	<i>Carcharodon carcharias</i>	NR	NR	VU,Mi	VU	L	VU	Negligible
Invertebrates								
Yellow Sedge Skipper	<i>Hesperilla flavescens flavescens</i>	1988	25			L	NT	Possibly still resident in Brackish Sedgeland at Murtnagurt Lagoon; Moderate
Small Ant Blue	<i>Acrodipsas myrmecophila</i>	1925	2			L	EN	Probably locally extinct; Low

