# **Co-existing with Little Penguins in the Derwent Estuary**

**Information and Management Guidelines** 



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The Derwent Estuary Program (DEP) is a regional partnership between local governments, the Tasmanian State Government, commercial and industrial enterprises, and community-based groups to restore and promote our estuary. The DEP was established in 1999 and has been nationally recognised for excellence in coordinating initiatives to reduce water pollution, conserve habitats and species, monitor river health and promote greater use and enjoyment of the foreshore. Our major sponsors include: Brighton, Clarence, Derwent Valley, Glenorchy, Hobart and Kingborough councils, the Tasmanian State Government, Hobart Water, Tasmanian Ports Corporation, Norske Skog Boyer and Nyrstar Hobart Smelter.



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#### Preface

These guidelines have been developed as part of the Derwent Estuary Program Penguin Project (DEPP) Stage Three, funded by the Australian Government's Envirofund Program. They build on the Stage Two 'Management Recommendations & Guidelines 2006' written by Drew Lee and Kate Booth (2005), updated by Veronica Thorp and Drew Lee (August 2006). They have also drawn information from 'Guidelines for Works in areas of Little Penguin Habitat' produced by Perviz Marker: and Anna Wind in June 2003 and revised in November 2005.

The collaborative Derwent Estuary Penguin Project, funded by the Australian Government's Envirofund and Coastcare programs for the past four years, is strategically working with the community and State and local government to protect and enhance Little Penguin habitat in the Derwent estuary, where there is a constant interface between urban pressures and Little Penguin habitat. The threats of habitat destruction and degradation, human disturbance and predation are most evident at sites close to urban areas.

The guidelines provide practical information for land managers, Bushcare officers, Coastcare volunteers and those with an interest in successfully co-existing with Little Penguins in Tasmania. They focus on the Derwent estuary, but are relevant for all areas where Little Penguins face threats associated with urban development. They have been written specifically without reference to specific sites, as it is important to ensure that the Derwent estuary Little Penguin colonies are maintained, as much possible, in an undisturbed state.

DEPP is now into Stage Three and continues to build on and enhance the information gathered and the actions completed in the previous stages.

A companion guide called 'Co-existing with Little Penguins in the Derwent Estuary – Management Guidelines for Specific Sites' is available for land managers and Coastcare volunteers, who are considering on-ground works on the Derwent estuary coastline south of Cornelian Bay on the western shore and Geilston Bay on the eastern shore.

An advisory committee with representatives from the key stakeholders oversees the project (see Appendix 1 for stakeholder list).

For further information, visit the Derwent Estuary Program website: <u>www.derwentestuary.org.au</u> or contact the Derwent Estuary Program on: <u>derwent@environment.tas.gov.au</u> or 03 6233 3742.

#### **Executive Summary**

Little Penguins are small flightless birds that colonise coastal areas where there is suitable habitat and few predators. Their nests can vary from shelters under dense, protective vegetation to burrows in rock crevices. They breed between August and February, coinciding with an annual upsurge in marine productivity. The nestling period, around six to eight weeks, followed by the moult period (usually February to April) are particularly vulnerable times in the lives of Little Penguins, when they are most at risk of starvation or predation.

The Derwent Estuary Penguin Project (DEPP), which has consistently monitored the distribution and abundance of Little Penguins in the Derwent estuary since 2004, has demonstrated the success of particular, site-specific intervention strategies to secure safe breeding habitat along coastlines that are increasingly under threat from urbanisation pressures and erosion. In 2004, 98 pairs were found at 12 sites, in 2006/07 after some intervention, 120 pairs were found and for the past two years the numbers have been consistently over 175 pairs at 13 sites. The colony where the most active intervention strategy was implemented, has increased from 22 pairs to 60 pairs in four years.

The major threats to Little Penguins in the Derwent estuary are habitat degradation, predation by dogs and cats and human disturbance. There are also marine threats including oil pollution, contamination from heavy metals and entrapment by gill nets. Local government has a key role to play in the conservation of Little Penguin habitat as it manages much of the coastal zone, particularly around built-up areas. Its role extends to training of planners, maintenance crews and natural resource managers and education of coastal user groups. State government has a policy and research responsibility. Natural resource managers and volunteers play a critical role in providing on-ground support, particularly in habitat conservation and rehabilitation. DEPP, through strategic planning, habitat conservation and rehabilitation and community education, has succeeded in increasing the numbers of Little Penguins using sites in the Derwent estuary. Success has been most evident, where a number of active intervention strategies have been implemented.

This model can be transferred to other areas where Little Penguin populations are under threat from urban encroachment.

## SECTION 1 Introduction to Little Penguins (*Eudyptula minor*)

## 1.1 General characteristics

Little penguins (*Eudyptula minor*) are small, flightless birds standing about 30 cm tall, ranging in length from about 40 to 45 cm and weighing around one kilogram. Their average life expectancy is approximately seven years, although there are records of some reaching over 20 years.

Little penguins come ashore after dark and return to the sea before first light to reduce exposure to predators.

## 1.2 Habitat

Little Penguins can be found across southern Australia and in New Zealand. The primary breeding sites in Australia are on Tasmania's coasts and offshore islands, where they can forage in clear, temperate seas or estuaries and land wherever they are able to climb ashore – on sandy beaches, rocky shores and rock ledges. They can occupy coastal areas up to 500m from the shore and nest in a wide variety of habitats including both shallow and deep burrows, rock crevices and beneath dense vegetation canopies, which shelter them from the sun. A typical burrow consists of a tunnel 60 - 80cm long with a nest bowl at one end, large enough for a Little Penguin to stand in, even though the entrance may often be much smaller. They dig burrows with their feet and if the substrate is too friable or too hard, they will nest on the surface of the ground under vegetation. Nest material is added throughout the breeding season and consists of locally-available plant material. Little Penguins are opportunistic birds, nesting where they can achieve maximum shelter. The range of their habitat can extend from near sea level to over 100m above sea level and often up to 500m inland. In many cases it is shared by Short-tailed Shearwaters.

## 1.3 Breeding

Both parents contribute to nest building but the majority is done by the male, who will then court the female through vocalising at the entrance. The nest may vary from a thick mat of grass to a few strands, usually collected within a few metres of the burrow entrance. Both parents are involved in burrow maintenance. In the Derwent estuary, burrows are not often built because Little Penguins are more likely to utilise existing cavities and artificial burrows. The female lays two eggs and incubation is shared equally, with varying shifts. The incubation lasts on average 36 days, with the shifts lasting usually 1-2 days. Changeover of nest duties occurs at night. Both parents share in the feeding, brooding and guarding of the young. Hatching of eggs may extend from 1-3 days from the initial pipping of the shell. Hatching success is fairly constant at approximately 60 percent, with predation and flooding being the major risk factors. The breeding season is between August and February, coinciding with an annual upsurge in marine productivity and laying usually occurs between September and November (see Figure 1). The annual breeding season may, however, vary from colony to colony depending on food availability (Stahel and Gales 1987). There is considerable variation in both the timing and duration of the breeding season between different years and different locations (*ibid*). This is particularly the case in the Derwent Estuary.

## 1.4 Development of the young

Little penguin chicks, when first hatched, are downy and weak and cannot raise their heads. They put on weight very slowly, especially during the first three weeks after hatching. The duration of the nestling period is approximately eight weeks. During the first three weeks of hatching, chicks are constantly guarded or brooded by one or other parent at the nest, with the adults changing roles regularly every evening. The relieving adult returns from the sea to feed the chicks by regurgitating semi-digested food into the chick's mouth. After this three week period, the chicks have developed enough to maintain their body temperature and can be left alone during the day while both parents feed at sea. At about five weeks of age, the chicks may sit outside their burrows each evening awaiting the return of their parents. Both parents still feed the chicks at night but are less attentive. Chicks leave their burrow to go to sea when they are between seven and nine weeks old, usually one sibling at a time. Waterproof feathers have fully replaced their initial downy plumage at this stage. The successful breeding and rearing of Little Penguins is dependent on the predictability, accessibility and stability of food supplies. The process of chick development heavily depends on the capacity of the adults to supply adequate food continuously to them.

#### 1.5 The young at sea

After fledging, young Little Penguins disperse widely and only return to their natal colony after about a year, when they return to moult. This pattern is repeated for three to four years as a precursor to them being ready to breed. Tasmanian Little Penguin chicks generally disperse in a northern direction and can travel hundreds of kilometres from their natal colony. Studies by the Penguin Study Group at Phillip

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Island in Victoria estimate an approximate 20% mortality rate of young fledging Little Penguins.

## 1.6 Moulting

Little Penguins moult after the breeding period, generally in February and March. Usually there is only one complete moult per year. Prior to moulting, which can last two to three weeks, they need to feed intensively to store substantial fat reserves. They can reach about two kilograms, twice their normal weight, which helps them survive their period of enforced starvation on land. They cannot survive at sea without a complete covering of their waterproof feathers, so they are limited to being on land for the entire period of their moult. They can be very vulnerable during this time, as they exhaust their fat stores and become emaciated.

## 1.7 Diet

Little Penguins are generally opportunistic feeders, preferring relatively shallow waters. Their diet consists mainly of small schooling fish and squid and to a lesser extent, krill. In Victoria, Little Penguins have a diet that is 76% fish and 24% squid. The fish are usually small – less than 10 centimetres long, primarily juvenile. If available, pilchards and anchovies are their preferred catch. In Tasmania, squid, krill and small flathead are more important food sources. Studies on the abundance and distribution of pilchards and anchovies, the two main prey species of Little Penguins in Port Phillip Bay, indicate that when these species are low in abundance, the foraging range of Little Penguins increases and breeding success decreases (Hobday, 1992). Although there are studies showing short-term breeding decline due to decreases in particular prey species, Little Penguins in the Derwent estuary seem to be catholic, adaptive feeders with a relatively wide range of food sources, including small squid, flathead and sea horses (D. Lee pers.comm.).

# 1.8 Vulnerability

There are several high-risk periods during the life-cycle of Little Penguins. During their entire breeding season (August to February) when they are primarily on land they are considerably more vulnerable, particularly to predation. Between three and nine weeks of age, young Little Penguins are left alone for the first time since hatching and will sometimes venture short distances from their nests, making them particularly susceptible to cat, dog or fox predation. Their fledgling period can also be dangerous, especially their first few weeks when, inexperienced, they set out for

their first extended trips to sea and potentially have to face a range of dangers and predators including gill nets, oil slicks, plastic ingestion, seals and sharks. During the moult period of two to three weeks, being emaciated and exhausted from their confinement on land away from their food source, Little Penguins are at a considerable disadvantage against land-based predators such as cats, dogs and foxes.

The rearing of young Little Penguins requires vast amounts of easily accessible food. For foraging, parents require visible water with adequate fish supplies of varying species close to their nest site to sustain their nestling's appetite and nutritional requirements. Any disturbance or siltation of water and/or compromised fish stocks will drastically reduce the young Little Penguin's chance of survival.



See 3.1 for a more detailed discussion of threats to Little Penguins.

Figure 1. Penguin breeding calendar

**Reference: Phillip Island Nature Reserve** 

# SECTION 2 Population trends

## 2.1 Australia

The Australian population is estimated to be less than 1,000,000 birds with pressures such as urbanisation, erosion, grazing and feral animal predation increasingly impacting on their habitat and ability to successfully breed.

For more information see <a href="http://www.austmus.gov.au/factsheets/little">http://www.austmus.gov.au/factsheets/little</a> penguin.htm

# 2.2 Tasmania

Parks and Wildlife biologists, who spent 19 years (1978 -1997) monitoring Little Penguin populations on Tasmanian off-shore islands, recorded the largest populations on the Bass Strait offshore islands, particularly in the Furneaux region. Irregular monitoring has occurred on the north-west coast and since 2004, the Derwent Estuary Program has been monitoring the Derwent estuary Little Penguin population. As there is no strategic statewide population monitoring program in Tasmania, it is difficult to gauge the Little Penguin population trends.

## 2.3 The Derwent Estuary

The Derwent Estuary Penguin Program has conducted Little Penguin distribution and abundance surveys in the Derwent estuary since 2004. The methods of the monitoring program involve walking the full length of the foreshore, or where terrestrial surveys are difficult, conducting the search by boat, looking for either the presence of, or signs of occupation of Little Penguins and the counting of breeding pairs. The verification of the presence of Little Penguins requires the confirmation of an adult, chick or egg within the colony, whilst signs of activity include footprints, penguin guano or feathers associated with well-defined nest bowls.

The Derwent Estuary Penguin Project (DEPP) Stage One (2004-2005) identified 21 extant and extinct Little Penguin breeding sites throughout the survey area. Of these, nine were no longer occupied by Little Penguins, another ten had fewer than ten breeding pairs, and the remaining two had fewer than 25 breeding pairs. A total of 98 breeding pairs were located during the DEPP Stage One survey in 2004/5. The assessment of the historical distribution was assisted by the launch of a Penguin Hotline. This point of contact generated great public response and aided in the compilation of historical records and the presence of mortalities. It was also a means to channel community concerns and increase public awareness.

A total of 120 breeding pairs were located during 2006/7 – Stage Two of the project, when three more colonies were identified in some isolated sites difficult to access even by boat.

In 2007/8 colonies were found at thirteen of the fourteen sites located in the 2005/6 survey with the population estimated at 192 breeding pairs, an increase of 37%.

In 2008/09 the total number of breeding pairs in the Derwent estuary was approximately 177 at 13 sites. The largest number recorded in a colony was 60 pairs, with the smallest being one pair found at a new site.

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# SECTION 3 Co-existing with Little Penguins

## 3.1 Threats and Recommendations

Little Penguins face a variety of threats, both direct and indirect, with urban populations such as those found in the Derwent estuary exposed to far greater threatening processes than their offshore island counterparts. The desire of people to live and recreate in coastal locations, improvements in house-building technology (allowing increased access to steep, rocky sites) and the difficulty of planning mechanisms to adapt to new environmental knowledge and trends have resulted in houses and other infrastructure, such as sea walls, impinging on existing Derwent estuary Little Penguin colonies, with the following impacts:

- Direct disturbance of Little Penguin colonies
- Disturbance and/or removal of habitat vegetation
- Changes to the coastal and marine natural systems
- Increased siltation of adjacent waters
- Disturbance and death from domestic pets
- Increased activity, noise and light disturbance
- Inappropriate penguin-viewing activities
- Road kill
- Increased disturbance from boating activity
- Increased recreational fishing, including the use of gill nets
- Increased stormwater and sewage

The following sub-sections discuss key threats and recommendations that are relevant to any urban or peri-urban Little Penguin population, and which have particular application to the Derwent estuary populations.

# 3.1.2 Terrestrial Threats

# 3.1.2.1 Habitat Degradation

Destabilisation of slopes along the foreshore can inhibit burrow creation. Destabilisation is primarily caused by vegetation disturbance or clearing and inappropriate land use and development. Weed infestation, thorny bushes and thistles may inhibit penguin access. However, older more established exotic vegetation such as boxthorn may provide shelter from larger predators.

Removing vegetation, boulders, old logs, and even weeds and refuse (without careful management), can destroy burrow habitat and nesting material. Throughout the evening Little Penguins are often active outside their burrows and are especially vulnerable when traversing between the landing zone and nest site. Removing protective cover or 'refuges' within the colony exposes Little Penguins to greater risks. In addition, vegetation around the nest site acts as insulation and protects the birds from heat stress. Even alteration to the upper canopy can increase temperatures inside the nest and may affect breeding success (Ropert-Coudert et al. 2004).

The dumping of garden wastes along the foreshore can block burrow entrances and disturb the breeding cycle. There have been a number of examples of this in the Derwent estuary over the past few years.

## **Recommended Actions**

- Develop a vegetation map and weed management plan for each site with Little Penguin colonies. Note that each site will potentially have different management requirements, as site issues are likely to vary.
- Ensure that Council planners, Bushcare officers and Coastcare volunteers are aware of and use the maps and plans.
- Work with Councils and the Department of Infrastructure Energy and Resources to develop guidelines for the most appropriate earthmoving and vegetation clearance methods around Little Penguin colonies and incorporate into on-going training for maintenance crews. Ensure that works are only carried out outside sensitive penguin occupancy periods (e.g. breeding and moulting) (see calendar Figure 1, p. 4).
- Ensure that training occurs every two years to allow for staff turnover.

## 3.1.2.2 Human Disturbance

Little Penguins are shy animals, generally avoiding lit places when feeding and landing. Illumination of foreshore areas (e.g. via house or street lights) may inhibit the birds' eyesight, exposing them to greater risk of attack. It also makes them a more obvious target for predators.

Irregular, unusual or particularly loud noises or intense vibrations can cause disturbance to Little Penguin nesting behaviours.

The presence of humans on the foreshore can delay or even prevent penguins from remaining on or returning to nest sites. Combined with the demands of chick rearing, this type of disturbance can have devastating effects on the breeding success of individuals, and even lead to nest abandonment.

If young fledgling Little Penguins are disturbed and abandon a nesting site, their future young will not have the memory of this site to return to, resulting in the site being potentially abandoned for generations.

## **Recommended Actions**

- Incorporate triggers within Development Application processes that alert planners to potential adverse impacts of the proposed development on Little Penguin colonies and liaise with penguin experts to undertake actions to mitigate these where possible.
- Educate adjacent landholders, coastal users and school students about the potential impacts of their use of the coast and how they can minimise these impacts.
- Educate Council planners and maintenance crews about the adverse impacts on Little Penguin colonies from lighting, noise and intense vibration and explore management options to reduce these impacts.
- Educate Council planners and maintenance crews to ensure they only conduct works in Little Penguin colonies outside sensitive occupancy periods (see calendar Figure 1, p. 4).
- Ensure that local residents are included in management actions to encourage the development of an active, supportive community who is engaged in protecting their local Little Penguin population.

## 3.1.2.3 Predators



Unguarded penguin chicks are very vulnerable in exposed nesting sites.

Predators include both domestic and introduced animals such as dogs, cats, foxes and ferrets. They have been responsible for large declines, and local population extinctions in Little Penguin populations throughout Australia (Dann 1992). An investigation by the Tasmanian Fox Taskforce into chicken and native hen kills in the Blackmans Bay to Snug area has shown that the animals were killed in a manner consistent with an attack by a carnivore such as a fox, quoll, cat or dog. However, no physical evidence of fox activity was found during subsequent searches or monitoring of the area. There is ongoing monitoring in a number of locations in the area, with multiple cameras being deployed in the field. In general, animals killed by foxes are typically killed from behind, with numerous small puncture wounds around the neck and head. Birds less than a few kilograms may only have the head and neck eaten, with large feathers chewed off, rather than plucked out.

Instances of dog attacks are well-documented in the Derwent estuary and on the north-west coast of Tasmania. Examples include the death of ten adult penguins at one site in early 2004. The presence of dogs in colonies, even on leashes, can attract other dogs through scent.

Cats are also a direct threat to little penguins. Cats will enter burrows unattended by adult birds to prey on unguarded chicks. Unlike dogs, which can kill significant numbers in a single attack, cats will generally not kill more than a few birds at once. They can, however, have a large cumulative adverse impact. The level of stress and general disturbance created by cats is yet to be quantified.

Ferrets and stoats (*Mustelids*) have been implicated in declines of New Zealand Little Penguin populations (Hocken 2000). The proximity of many Derwent estuary Little Penguin colonies to urban environments and ongoing coastal subdivision exposes birds to potential predation.

#### **Recommended Actions**

- Educate dog and cat owners about the potential impacts their pets can have on Little Penguins and ways they can minimise these impacts.
- Liaise with Councils to explore the potential for applications for new housing developments within 100 m of Little Penguin colonies to have covenants that prevent residents from keeping cats and dogs. This will help to reduce the potential of dog and cat attacks on Little Penguins.
- Strategic fencing along public walkways or adjacent to housing areas can help prevent the encroachment of pets into Little Penguin colonies.
- Signage that indicates 'No Dogs' and/or the presence of a sensitive wildlife area erected near colonies, but not directly indicating the presence

of Little Penguins, can help to educate dog walkers and the general public.

 If cats are deemed to be a major predator, a cat-trapping program can be developed with permission from Parks and Wildlife Service (PWS), as the land manager of coastal reserves, and the Department of Primary Industries and Water (DPIW) as the licensing agent for trapping animals.

## 3.1.2.4 Climate Change

The predicted increase in storm surges and high tides associated with climate change has the potential to cause some dislocation to low-lying Little Penguin colonies. This is particularly an issue where vulnerable colonies have limited habitat to relocate into because of pressures relating to urbanisation. The vulnerability of different geomorgphological types along the Tasmanian coastline to the effects of climate change has been mapped by Chris Sharples and included on the Land Information Systems (LIST) database (see www.thelist.tas.gov.au).

## **Recommended Actions**

 Incorporate climate change information about coastal vulnerability to storm surges and high tides in GIS maps used by planners and land managers, and educate them about the potential impacts on Little Penguin colonies and the importance of protecting habitat for colony relocation where possible.

## 3.1.2.5 Human structures

The increased development of coastal areas for urban expansion, industry and recreational boating activities has led to the construction of structures such as sea walls and marinas. These structures can have impacts on the flow and predictability of river level and the natural coastal deposition processes that can affect Little Penguin nesting habitat. The ability of penguins to access nesting sites can also be significantly impeded by these types of human structures.

## **Recommended Actions**

 Incorporate triggers within Development Application processes for marinas, seawalls and other similar structures that alert planners to potential adverse impacts of the proposed development on Little Penguin colonies and liaise with penguin experts to undertake actions to mitigate these where possible.

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#### 3.1.3 Marine Threats

Little Penguins also face a number of human-induced threats whilst at sea.

## 3.1.3.1 Oil pollution

Large-scale oil spills can have a devastating effect on large numbers of individuals as exemplified by the *Iron Baron* incident in 1995 off the north coast of Tasmania when 300 tonnes of fuel oil escaped from the large tanker that was grounded on Hebe Reef (Goldsworthy et al. 2000). However, of more relevance in the Derwent is the localised spillage and seepage of petrochemicals, common with industrial and recreational use of the estuary. A penguin recovered in 2003 from Sullivans Cove in the wharf area of Hobart was unable to swim effectively and subsequently died due to the amount of oil covering the feathers and possible ingestion. Only small amounts of oil will inhibit Little Penguins' ability to swim.

#### **Recommended Actions**

- Ensure that the oil spill response kits located in the Derwent estuary are maintained and their locations promoted to the relevant authorities.
- Ensure that oil spills in the Derwent estuary, even minor ones, are reported to the Department of Primary Industries and Water, Biodiversity Conservation Branch to provide an early and appropriate response.
- Educate boat owners to conduct regular engine maintenance and dispose of oil responsibly.

## 3.1.3.2 Heavy Metals

High levels of heavy metals such as mercury and lead may potentially be found in the Derwent Estuary Little Penguins. Seabirds are commonly found exhibiting levels of mercury highly toxic to terrestrial birds (Monteiro & Furness 1997) and Little Penguins from Sydney and Phillip Island have been shown to bioaccumulate organochlorines (Gibbs 1995). Over the last thirty years there has been a decline in heavy metal contamination in the Derwent estuary. However by national and international standards, levels in water, sediment and living organisms (eg. shellfish) remain high.

Heavy metals can be toxic to estuarine and marine mammals, and to humans if ingested through the seafood consumption. For more information on the results of heavy metal monitoring in the Derwent estuary, see <a href="http://www.derwentestuary.org.au/index.php?id=26">http://www.derwentestuary.org.au/index.php?id=26</a>

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## **Recommendation Actions**

Monitor heavy metal (especially mercury) levels in the Derwent estuary little penguins.

## 3.1.3.3 Gill Netting

There has been anecdotal evidence of Little Penguin bycatch in gill nets in the Derwent estuary. Gill nets, if set adjacent to colonies, can potentially have a devastating effect on penguin numbers. Little Penguins congregate just off shore prior to landing, and thus gill nets set in this zone may result in captures that will have a significant effect on the small Derwent colonies. The data on penguin by-catch in Australia is limited primarily due to the reluctance of fishermen to report such incidents.



Much of the Derwent estuary is a no-netting zone including upstream from Crayfish Point and Droughty Point (and as indicated on the map by the red). For more information visit <u>http://www.dpiw.tas.gov.au/inter.nsf/WebPages/ALIR-4YX2TS?open</u>. However some areas adjacent to important Little Penguin colonies in the estuary have no netting restrictions thus creating a considerable potential threat to those colonies. Most recreational netting occurs at the most crucial phase in the Little Penguins' breeding cycle, when they need unlimited foraging access to inshore areas.

#### **Recommended Actions**

- Review current gill-netting practices in areas adjacent to Little Penguin colonies.
- Investigate modifications to fishing regulations if there are significant risks.

## 3.2 Responses to threats: current processes and recommendations

## 3.2.1 Local Government

Local government has a key role to play in protecting Little Penguin habitat in the Derwent estuary as many of the colonies are within local government tenure. The councils that have most responsibility for Little Penguin sites in the Derwent estuary are Hobart City Council, Kingborough Council and Clarence Council. The support and capability of local government planners and natural resource managers are vital to ensuring the long-term success and viability of these colonies.

## **Recommended Actions**

- Information and communication channels need to be enhanced to ensure that local government planners and natural resource management personnel can access the latest municipality-specific data on Little Penguin population trends and threats. This could be in the form of:
  - Annual meetings with planners and works managers at each of the relevant councils to update them on the status of Little Penguins and to raise awareness and interest.
  - A secure-access website that houses templates and planning tools to help ensure that local government planning decisions about infrastructure siting and/or maintenance and natural resource programs can be based on minimising disturbance to Little Penguin colonies.
  - Regular training of local government maintenance and works personnel to ensure that works on coastal structures such as stormwater drains and vegetation maintenance take into account the possible presence of Little Penguins.
  - Easy mechanisms to contact appropriate DEP, PWS and/or DPIW staff for advice and assistance in mitigating potential disturbance to colonies.
- Work with local government to explore the potential for applications for new housing developments within 100 m of Little Penguin colonies to have covenants that prevent residents from keeping cats and dogs. This will help to reduce the potential of dog and cat attacks on Little Penguins.

# 3.2.2 State Government

Apart from the mitigation of erosion and siltation of Little Penguin habitat through its State Policy on Water Quality Management 1997, State government responsibilities extend to providing research and monitoring opportunities to protect one of the State's most iconic species. Information provided on the Land Information Systems (LIST) database allows local government and the community to have the ability to access information about localized projected sea level rise and storm surge activity, which may adversely impact on Little Penguin colonies. The Tasmanian Climate Futures project should be able to enhance this information. Under the *Pollution of waters by oil and noxious substances act 1987*, the State Government has responsibility for ensuring that oil spillage is prevented in State Waters from ships of 400 tonnes or more. The *Environmental Management and Pollution Control Act 1994* (Tas) (EMPCA Act) provides for the management of the environmental management' and outlines procedures for environmental impact assessment, improvement programs, agreements and audits, enforcement, and financial assurances.

## **Recommended Actions**

- Continue to support the research and monitoring of Little Penguin habitat and population.
- Extend the research to include Derwent estuary Little Penguin breeding and feeding behaviours.
- Support the biological monitoring of heavy metals in the Derwent estuary and extend to include effects on Little Penguins.
- Liaise with DEP and local government about at-risk colonies. Where colonies are deemed at risk and there is no ability for the penguins to naturally move to nests above the encroachment of the sea, support the building of artificial burrows in adjacent safe areas to accommodate them.

## 3.2.3 Natural Resource Managers

Natural resource managers include local government personnel, Aboriginal communities and local land and coast care groups. Before planning or undertaking any works in the coastal zone of the Derwent estuary, it is recommended to contact the Derwent Estuary Program staff for information on the location of Little Penguin colonies that may be vulnerable to disturbance. See Appendix 1 for contact details. It is also important to liaise with the landowner (in most cases Parks and Wildlife Service), the Tasmanian Aboriginal Land and Sea Council, relevant local government authorities and adjacent landholders to gain the required permission to undertake works on their land. The following questions should also be taken into consideration.

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# a) Is there evidence of Little Penguins?

The telltale signs of the presence of Little Penguins are well-worn runways, evidence of scats (white faecal matter in 3cm – 5cm streaks), footprints, and the calls they make at night. Feathers can be seen around the entrance of burrows or resting spots during the moulting time. Little Penguins can generally be smelt before they are found, as they emit a strong fishy odour. Depending on the time of the year, checks should be carried out more than once, just in case an absence of birds on first inspection may be falsely taken as no presence of birds in the area.



Little Penguin pathways through coastal vegetation



Signs of Little Penguin activity

# b) When should the works be carried out?

There is a very small window of opportunity to undertake works such as revegetation, weeding and construction. The best months for works are from May to July, when it is likely that Little Penguins have finished breeding, moulting and raising their chicks. Breeding is asynchronous throughout the colony and can be quite variable with some mature birds breeding at the beginning of June and producing two clutches. In some cases, there will be birds present at colonies throughout the year, so it is important to seek the assistance of a Parks and Wildlife Ranger or a biologist from the Biodiversity Conservation Branch of the Department of Primary Industries and Water. They will be able to check the site for signs of Little Penguin presence and/or activity. Planned works can then be approved or modified accordingly.

# c) How should weed removal and revegetation be carried out?

A detailed botanical assessment should be conducted in any area where potential works are to be undertaken. This should include mapping the diversity of species that exist (including introduced species) and planning for the collection and propagation of seed from existing plants. See Appendix 4 for an example of a site plan incorporating weed management and revegetation action plans.

Weed removal must be gradual and needs to be undertaken simultaneously with revegetation to ensure sufficient nesting habitat is provided at all times. Revegetation

should only occur when there are no signs of Little Penguin activity or habitation at the colony.

If introduced species are the dominant habitat species, careful long-term weed management planning must be undertaken before any on-ground works occur. Spraying of herbicides should be discouraged when conducting vegetation management in penguin colonies and should not be conducted in sites with sandy soils. Herbicides may persist within the soil, as the low organic content inhibits the breakdown of herbicides and may be harmful to nesting penguins. If herbicide needs to be used, the 'cut and paste', 'scrape and paint' or 'drill and fill' methods are recommended, where appropriate.

Where boxthorn is present and the penguins use this for nesting, large bushes should be gradually removed by scraping and painting or drilling and filling with herbicide, which prevents re-seeding, but leaves the dead skeleton in situ. This retains the root system and the branches, which continues to provide valuable habitat for the penguins and maintains soil stability. Any small plants should be removed promptly. *Tetragonia implexicoma* or *Rhagodia candolleana* can be planted to grow over the dead boxthorn to provide further cover.

For more information on weed control see:

http://www.dpiw.tas.gov.au/inter.nsf/WebPages/RPIO-523VU9?open.



An African Boxthorn (Lycium ferocissimum) bush



Boxthorn fruit

The preferred species for revegetation in and around Little Penguin colonies in the Derwent Estuary generally include *Tetragonia implexicoma, Rhagodia candolleana* and *Poa sp,* but this depends on the site. *Acacia sophorae* is generally not a suitable species as its lower branches become rooted in the ground and become too entangled for penguins to negotiate. For more information contact the Understorey Network at <u>www.understorey-network.org.au</u>.

Below is a list of species that were used for revegetation at several of the Derwent estuary sites. For more information about species' common names see 'The Little Book of Common Names for Tasmanian Plants' at the following link:

#### http://www.dpiw.tas.gov.au/inter.nsf/Attachments/LJEM-

#### 6K8W4N/\$FILE/Common names booklet.pdf

Tetragonia implexicoma Carpobrotus rossii Rhagodia candolleana subsp. candolleana Poa poiformis var. poiformis Dodonaea viscosa subsp. spatulata Poa labillardieriei var labillardierei Bursaria spinosa Banksia marginate Lomandra longifolia Allocasuarina verticillata Pomaderris apetala subsp. apetala Pomaderris elliptica var. elliptica Acacia melanoxylon Acacia dealbata subsp. dealbata Acacia verticillata subsp. verticillata Coprosma quadrifida Dianella tasmanica

(bower spinach) (native pigface) (coastal saltbush) (coastal tussockgrass) (broadleaf hopbush) (silver tussockgrass) (prickly box) (silver banksia) (sagg) (drooping sheoak) (common dogwood) (yellow dogwood) (blackwood) (silver wattle) (prickly moses) (native currant) (forest flaxlily)



Revegetation undertaken at a Little Penguin site in June 2008

## d) How can artificial burrows be effectively used?

An effective management tool is the use of artificial burrows, which can compensate for habitat loss, provide increased nesting opportunities and facilitate colony expansion to more favourable areas. Artificial burrows have proven successful in northern Tasmania, the Derwent Estuary and elsewhere on the Australian mainland (Phillip Island). Two types of artificial burrows may be used. One type, constructed of wood, has been used successfully in colonies where the presence of humans is restricted or rare. The other design, constructed with concrete and some vegetative matter (e,g bark) for lightness, is much more tamper-proof and can be installed in areas frequented by humans. Artificial burrows should be installed off existing penguin walkways to maximise the potential for occupation. However a buffer of at least two metres from major walkways should be observed to avoid territorial disputes by birds using these walkways. Burrows should also be placed more than two metres apart, and preferably face away from each other. Where possible, burrows should be positioned out of direct exposure to the sun, preferably with a vegetative cover to provide insulation against temperature extremes. See Appendix 2 for a template for designing wooden burrows and Appendix 3 for a template for creating concrete burrows.

Naturally occurring materials should be used, where possible, when establishing new nesting opportunities. For example, rocks can be piled and/or cemented using a colour natural to the site to create a barrier around more exposed cavities, or a hollow log repositioned to allow shelter. This is of particular importance in areas visible to human traffic, as it reduces the chance of disturbance or vandalism. Pavers or bricks installed at entrances can help to restrict access to the burrows by digging dogs.



Wooden burrows installed May 2008



Concrete burrow installed May 2008

#### e) What needs to be considered when designing nest boxes?

There are a few critical considerations required when undertaking the design and construction of nest boxes. Little Penguins are highly specialised for life in the marine environment. Having to come to shore in order to breed exposes them to human disturbance, predators and a different set of environmental parameters. Little Penguins are unable to deal with exposure to heat, as they are incapable of producing sweat. To avoid overheating, burrows need to be well ventilated. The designs that are currently employed have ventilation holes on the front section of the box at the highest point. They have also been designed with a lip to avoid inundation from rain. The larger the ventilation holes the better, however it is advised that gauze (flyscreen) is attached to the inside of the box to minimise light penetration and

disturbance. The entrance needs to be large enough to allow a larger bird to pass through, though small enough to discourage predators (15cm is more than sufficient). For long-term durability, marine ply is probably the most suitable material. For more information contact Drew Lee (drew.lee@dpiw.tas.gov.au) or lan Johnston Marine on 6267 1434. See Appendix 2 for construction instructions for the wooden burrows. See Appendix 3 for construction instructions for the concrete burrows.

## f) How can fencing help protect Little Penguins?

A major risk for Little Penguins inhabiting areas close to human settlements is vehicular traffic. This is an issue best dealt with by local government urban planning, particularly through the process of assessment of development applications for infrastructure near Little Penguin colonies. Effective barriers to prevent Little Penguin injury or death on roads can be constructed with fences made from 25 mm chicken mesh fastened to fencing wire with ring fasteners and strained tightly between star pickets. Safety caps must be placed on top of star pickets to protect people.

The fence should be built with 600 mm high mesh that is buried 100 mm into the ground. If the ground is too hard to allow burial, turn the lower 100 mm in toward the seaside of the fence and weigh or pin it down very securely. The fence should end at some structure or natural feature that the birds cannot get past, or angle the last section of the fence back to towards the coast well past the nesting area. Brace the corners of the fence, and where it changes direction – with short sections of star picket and pegs secured by wiring. To deal with unevenly sloping ground, insert a post at each change of slope, cut the mesh at the post and attach another piece of mesh. Pedestrian openings should ideally be away from penguin areas but if this is not possible, fit a small gate (constructed by a local metal fabricator).

Keep the fence clear of vegetation or objects that the birds can use as platforms to hop over the fence – penguins are quite athletic. To avoid birds getting caught on the wrong side of the fence, a ramp of rocks or boards should be provided so that they can escape.

Fencing should only be used when there is a documented case of direct risk to Little Penguins, weighed up against the long-term risk of restricting the available habitat afforded to them. Fencing can also corral birds during predator attacks and can lead to numerous deaths without the option of escape.

# g) What signs should I erect?

Signs should be as generic as possible, while still presenting a clear message to target audiences (see below). They should be strategically placed in areas that have

high public visibility but at the same time should avoid indicating the presence of Little Penguin burrows.



# SECTION 4 The Derwent Estuary Little Penguin Program (DEPP) Experience

The collaborative Derwent Estuary Penguin Project, funded by the Australian Government's Envirofund and Coastcare programs, relies on partnerships with the community and State and local government to protect and enhance Little Penguin habitat in the Derwent estuary, where there is a constant interface between urban pressures and Little Penguin habitat. A steering committee with representatives from the key stakeholders oversees the project (see Appendix 4 for stakeholder list). The DEPP is now into Stage Three and continues to build on and enhance the information gathered and the actions completed in the previous stages. The program has collected monitoring data for four consecutive years.

# 4.1 Characteristics of the Derwent Estuary

The Derwent estuary is the largest estuary in south-eastern Tasmania, covering an area of nearly 200 km<sup>2</sup>. It extends from New Norfolk (the maximum extent of salt water) to the mouth, which lies between Tinderbox and the Iron Pot light. Its foreshore extends for 224 km (see Figure 2).

The Derwent estuary lies at the heart of the Hobart metropolitan area and is an asset of great natural beauty and diversity. In addition, it is an integral part of Tasmania's natural, cultural and economic heritage. The estuary is an important and productive ecosystem supporting areas of wetlands, aquatic grasses, tidal flats and rocky reefs, and the foreshore retains about 34% of its original native vegetation. Approximately 40% of Tasmania's population – 192 000 people – live around the estuary. The Derwent is widely used for recreation, boating, fishing and marine transport, and is Tasmania's third largest port. The estuary supports several large industries, including paper production, zinc smelting and boat building.

In recent years there have been numerous developments and projects along the foreshore associated with residential, tourism, recreational, and industrial or commercial developments. In some areas, the foreshore has changed dramatically since the early 1800s due to infilling. The Derwent foreshore is well endowed with numerous parks, reserves and conservation areas owned and managed by state and local governments. These include formal gardens, sport and recreation grounds, playgrounds and picnic areas, and a large number of foreshore reserves and conservation areas. Approximately 50% of the foreshore is publicly owned (Green & Coughanowr 2003).



Figure 2. The Derwent Estuary Program Area

Base data from the LIST (www.thelist.tas.gov.au), © State of Tasmania

#### 4.2 Stages of the DEPP

#### Stage One: Establishment of baseline information, awareness-raising

During 2004-2005 a baseline survey of Little Penguin habitat and threats in the estuary identified 21 existing and extinct sites supporting 98 breeding pairs. Emphasis was on awareness-raising and education, particularly targeting schools, community groups and local government planners.

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Research also identified that the Derwent estuary Little Penguin colonies occupy a variety of tenure. As can been seen by Figure 3 below, two-thirds of the Derwent penguins breed within local government tenure.



Figure 3. Tenure status of Derwent estuary penguin populations (2004/5)

#### Stage Two: Habitat restoration, partnerships with landholders

During 2005-2006, DEPP focussed on targeted habitat restoration, which involved working closely with community volunteers and council officers to revegetate, install artificial burrows, upgrade existing burrows, and improve protection from predators through fencing and signage. A total of 113 concrete and 16 wooden nest boxes were installed in both existing and new habitat areas. Where cliffs provided nest sites, rocks burrows were reinforced with cement to give them greater security from predators. Over 1000 new plants provided shelter for the new burrows. In several higher public use areas, paths and steps were rerouted and upgraded to encourage people to stay away from existing burrows. Several neighbouring residents fenced and planted on their properties to facilitate greater Little Penguin access and security. Fifty people attended a field day to learn how to protect and manage penguin habitat. Over 80 volunteers, many of them local people, were involved in making and installing burrows and in producing a colour brochure about the Derwent penguins.

#### Stage Three: Monitoring, maintenance and communication

Monitoring during the 2007/08 season saw an increase in active nests. There were 192 breeding pairs across 12 active sites. One hundred and fifty new nests were installed. Weeding and revegetation using 800 plants specifically grown for the project by the Understorey Network enhanced several of the key sites and artificial burrows and burrow enhancement have proven successful. A longer-term monitoring program will assist in evaluating the sustainability of the success of current management actions. A forum for local government planners, community groups and natural resource managers will further promote Little Penguin management guidelines and tools to help conserve this species and its crucial habitat. 2008/09 monitoring indicate an increase in the number of Little Penguin sites to 13 and a slight decrease in the number of breeding pairs to 177, which is within the range of natural fluctuations.

## 4.3 Habitat monitoring results of the DEPP

There is historical evidence that potential Little Penguin habitat in the Derwent estuary existed as far north as Berriedale. Currently, however, potential Little Penguin habitat does not appear to extend north of Cornelian Bay on the western shore and Geilston Bay on the eastern shore. This is most likely due to the extensive foreshore modification that has taken place especially around Selfs Point, Lutana and Prince of Wales Bay.

In the area currently identifiable as potentially suitable Little Penguin habitat, significant stretches of foreshore are unsuitable for the species. These include both naturally unsuitable areas such as tidal flats (eg. Ralphs Bay) and sheer cliffs (eg. near Lindisfarne), and areas that have been highly modified by human activity such as infilling (eg. Sullivans Cove), sandmining (eg. Bellerive) and the construction of sea walls (eg. Rose Bay).

There is still much to understand about Little Penguin ecology and behaviour; hence it can be difficult to accurately determine why they may choose one area over another. However, we now know that the presence of the following factors will increase the likelihood of Little Penguins using a site:

- A history of use of the area by the species as a nesting or moulting site.
- Hollows, cavities and shelter provided by natural features, vegetation, man-made structures and/or debris, that provide shade and adequate protection from wind, rain and predators.
- Sheltered areas or refuges between the species' landing spots and nesting sites.
- An accessible landing point such as a beach or rock platform.
- No excessive noise, vibrations (such as those from earth-moving equipment) or regular disturbance.
- Limited foreshore illumination.

All the extant sites and some of the extinct sites surveyed in the Derwent have these features.

The 2004/2005 surveys found that over 85% of occupied burrows in the Derwent estuary consist of boulders, rockfalls, rock crevices or rock walls. This preference for rock-based structures for nesting over burrows may be a reflection of available

habitat or a response to the greater degree of protection from vertebrate predators offered by and stability of the nest-sites. Colonies that consisted predominantly of sand or soil, such as at Pigeon Holes, Droughty Point and Cornelian Bay, are now extinct. Soil and sand burrows are predominantly found in association with Shorttailed Shearwaters.

## 4.4 Importance of the DEPP

This project has provided the first comprehensive data of the distribution and abundance of Derwent estuary little penguin populations. Now in its fourth year, it is also establishing trends in Little Penguin populations in the estuary. Its main achievements have been addressing the decline in the Derwent estuary Little Penguin population by enhancing habitat, creating more nesting opportunities through installing over 150 artificial burrows, upgrading about 30 existing burrows, revegetating sites with native plants and reducing encroachment by predators through erecting fencing, swing gates and signs at critical sites. The project has also raised awareness and understanding within schools and the community about the need to protect and conserve Little Penguins. The priorities of managers should continue to be enhancing habitat and increasing nesting opportunities, managing threatening processes such as predation, habitat disturbance and modification, and raising community awareness. It is also important to maintain the work done so far by following up the weed and vegetation management, repairing fences and inspecting burrows. Continued biological surveys of the penguin populations are vital to monitor their breeding success and to evaluate the effectiveness of the site-specific management actions. The success of the implementation of the management guidelines will only be apparent if we see a stabilisation of the population, and a subsequent increase over time.

This project has not had the scope to address threats to Little Penguins in the marine environment, partly due to the lack of understanding of the areas of foraging and food sources.

It is imperative that community involvement continues to be encouraged, as community action will be the key to the survival of Little Penguins in the heavily populated estuary.

It is hoped that this project can be used as a template for other Little Penguin conservation projects.

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# 4.5 Lessons learnt from the DEPP

From the DEPP experience, the following steps are recommended to groups who wish to help ensure the success of conserving and protecting Little Penguins in their local area:

- 1. Establish an advisory group involving the key stakeholders.
- 2. Establish and prioritise the aims of the project.
- 3. Work only on two or three key objectives at one time.
- 4. Apply for funding.
- 5. Ensure that the stakeholders are kept informed and that there are at least two key people involved from each stakeholder group.
- 6. Establish a regular monitoring program with a trained team.
- 7. Establish partnerships to help with monitoring, revegetation and rehabilitation.
- 8. Develop site plans for all on-ground works at each site.
- 9. Keep a written and photographic record of progress.
- 10. Develop and implement a communications plan for adjacent landholders, schools, local government planners and natural resource management personnel.
- 11. Promote your successes.

# 4.6 Further research recommended for the Derwent estuary

These areas of potential future research relate specifically to the Derwent estuary Little Penguins and penguin habitat:

- Monitoring the breeding success with relation to artificial nest box design
- Foraging range and use of the estuary by little penguins.
- The occurrence of heavy metals in Little Penguins and penguin habitat, and the potential of penguins as an indicator species for heavy metal levels.
- Climate change impacts on Little Penguin habitat and survival rates.
- A geomorphology survey of Little Penguin habitats to help assess vulnerability.

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# Appendix 1

## **Contact List**

Useful contacts for conducting a Little Penguin program include:

Organisation	Website	Phone no.
Derwent Estuary Program	www.derwentestuary.org.au	6233 3742
Tasmanian Conservation Trust	www.tct.org.au	6234 3552
Birds Tasmania	www.birdsaustralia.com.au	
Hobart City Council	www.hobartcity.com.au	6238 2739
Kingborough Council	www.kingborough.tas.gov.au	6211 8299
		0429 011 920
Clarence Council	www.ccc.tas.gov.au	6245 8600
Understorey Network	www.understorey-network.org.au	6234 4286
DPIW (Biodiversity Conservation Branch)	www.dpiw.tas.gov.au	6233 8011
DPIW (Fox Eradication Program)	www.dpiw.tas.gov.au	1300 369 688
Parks and Wildlife Service	www.parks.tas.gov.au	6233 8011
Tasmanian Aboriginal Land and Sea Council	www.talsc.net.au	6231 0288
Southern Coastcare Association of Tasmania	www.scat.org.au	6233 3947
		0447 003 540

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#### Appendix 2 Design for Little Penguin Wooden Burrows





All wood is 2.5cm thick treated pine.

Design of Artificial Wooden Burrow for Little Penguins Prepared by Roz Jessop, 2001 Phillip Island Nature Park, PO Box 97, Cowes. 3922. Australia.

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#### Appendix 3 Design for Little Penguin concrete igloos





Stages in making a penguin igloo



1. Make mound of sand about 90 cm long, 25 cm high and 40 cm wide (at its highest point) tapering to the entrance and place a 150mm plastic flower pot at the entrance.



2. Place a 2 cm layer of tufa\* over the sand.



Shape mesh reinforcing (50 mm chicken wire) to fit over the layer of tufa.



Place a second 2 cm layer of tufa over the reinforcing ensuring that it bonds with the first layer and covers the reinforcing.

Trowel some ochre over the surface for camouflage.

5. Allow 20 minutes for the mixture to stiffen slightly and then poke a sharpened 25 cm dowell through the sides several times to form ventilation holes.

After two days remove the burrow from the sand and clean up the edges.

Allow to cure for at least a week (preferably two) before transportation. Can be stacked 3 to 4 high.

\* "Tufa" or "Hypertufa" is made by using a cement mixer to combine:

1 part bricklayers' sand (fat sand)

- 1 part cement
- 2 parts screened pinebark or peat

Sufficient water to make a creamy consistency

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#### Appendix 4

Example of site works plan

Site	Plan	Species/Numbers to plant	Penguin Habitat	Weed Control	Monitoring		
Penguin	Plant a mix close to existing and	Tetragonia implexicoma = 150	Wooden burrows	Weed Control:	Revegetation		
Habitat	proposed burrow sites to	Carpobrotus rossii= 190	(placement to be	- Grasses,	- Photopoints for each		
Revegetation	disguise and shade burrows.		determined)		revegetation area (e.g.		
		Density – close spacing 0.5m apart		- 2/4 weeks prior to	Penguin Habitat,		
(=planting to	Note: Could disguise burrows			planting (combination	Buffer, Tree) (yearly).		
disguise and	with debris from the beach?			of spraying, hand-		and the second second	
shade nest				pulling, cutting/	Penguins	Land Land	
sites)				painting).	- Nest activity		
Buffer	Plant a mix beyond burrow	Poa labillardieriei= 100			- Breeding success		
Revegetation	plantings (above) to buffer the	Poa poiformis = 50 (source)		- Wulch LUCH thick (If	Disturbance		
( alonthoots	area used by penguins.	Lomandra longifolia = 50 (source)		teasible)	Disturbance		
(=planting to		Density along an air 1 an anat		Matan	- Sandpads at entrance		
deter		Density – close spacing im apart		Water:	Bamata video (comoro		
disturbance				- Water II dry winter	- Remote video/camera	Contraction of the second	
to Little				- During I summer			
Troo	Plant a mix across the site to	Ranksia marginata -10 (source)	27 <b>-</b> 0			<u> </u>	
Reveretation	help stabilise the slope and	Bursaria spiposa $-10$ (source)					
Revegetation	provide shade	Dodonaeg viscose = 10 (source)	110				
	provide sindle.			/ ~			
		Density -spacing 2m apart		1	$\bigcirc$		
Note: Plant	s in italics need to be source	d		1	1000000		
Note: Trant	s in italies need to be source	d	1 1 m				
Timotoblo f	* Kovo gotation			1			
Timetable id	or revegetation						
Date: Sun 22	2 <sup>ma</sup> June						
Time: 10.30a	am-12.30pm, 1.30-3.30pm						
Activities: Pl	anting, installing guards (shru	ubs, trees), watering,					
mulching (if	feasible)		I I CONTA	<b>1</b>			
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