Guidelines for works in, and management of, Little Penguin habitat.

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Recommendation

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1 Introduction

This document updates the *Guidelines for Works in areas of Little Penguin Habitat* (Marker and Wind 2008), and draws on more than a decade of research, knowledge, and management of Little Penguins (*Eudyptula minor*) in Tasmania. This document also supersedes earlier guidelines including Tasmanian Coastal Works Manual—Guideline 10.1—Working in Penguin Habitat (Page and Thorpe 2010).

To undertake works of any description in Little Penguin habitat, it is important to understand why, how, and what needs to be done to maintain and protect Little Penguins nesting and moulting habitats. This document briefly describes the status of the Little Penguin at all three levels of government, then follows with a brief introduction to the ecology of Little Penguins in Tasmania. The document also provides information on management, identifies threats to Little Penguins and recommends mitigation measures.

The coastal habitats that Little Penguins inhabit are also under pressure from a range of factors. Councils/developers and community groups, at one time or another, may adversely affect these areas. This document provides current guidelines for best practice in mitigating against threats and maintaining habitat for Little Penguins.

2 Conservation status of Little Penguins

The following gives an overview of the conservation status of Little Penguins.

2.1 International

Little Penguins are listed as being of Least Concern on the IUCN Red List of Threatened Species (IUCN 2022)—see https://www.iucnredlist.org/species/22697805/202126091#assessment-information

2.2 Commonwealth of Australia

Little Penguins are not listed as a threatened species under the *Environment Protection and Biodiversity Conservation Act 1999*, however they are listed on the Marine Appendix to the EPBC Act—see https://www.dcceew.gov.au/environment/epbc

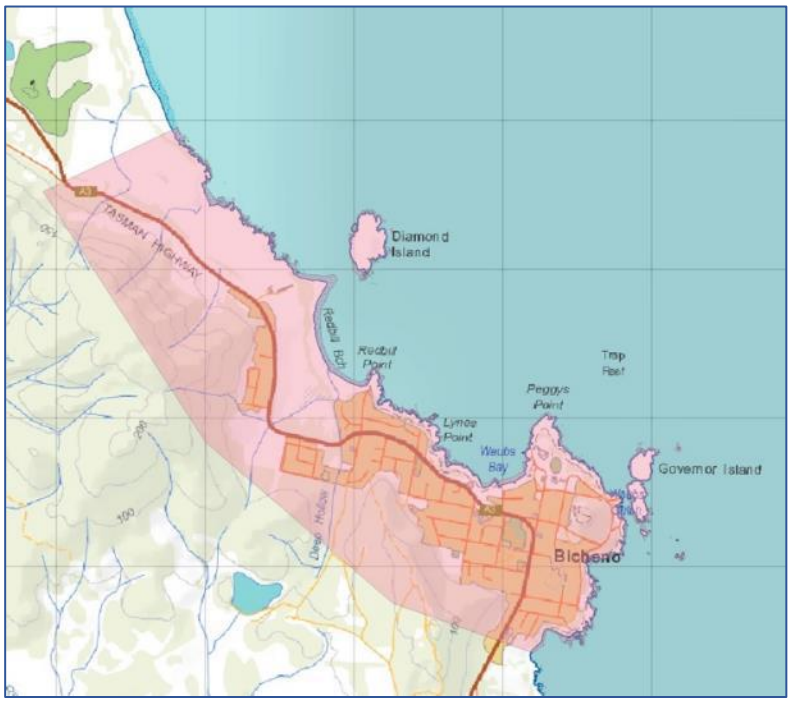
2.3 Tasmania

Little Penguins are listed in Schedule 1 (Protected Wildlife) of the *Nature Conservation (Wildlife) Regulations 2021* under the *Nature Conservation Act 2002*. In 2019, they were listed as Sensitive Wildlife within declared Sensitive Areas under the *Dog Control (Sensitive Wildlife and Areas) Order 2019,* Figure 1 and—https://nre.tas.gov.au/wildlife-management/marine-conservation-program/little-penguins-in-tasmania/monitoring-and-protection/dog-attacks-and-the-dog-control-act

a) Stanley

b) Low Head

Figure 1: *Maps showing Sensitive Wildlife Areas (pink polygons) as declared under the Dog Control (Sensitive Wildlife and Areas) Order 2019. Base map is the 1:50,000 Tasmap topographic series with 1km grid (https://maps.thelist.tas.gov.au).*



c) Bicheno

d) Wynyard to Devonport

Figure 1 (cont.): *Map showing Sensitive Wildlife Area (pink polygon) as declared under the Dog Control (Sensitive Wildlife and Areas) Order 2019. Base map is the 1:50,000 Tasmap topographic series with 10 km grid ((https://maps.thelist.tas.gov.au).*

3 Little Penguins in Tasmania

3.1 Ecology of Little Penguins in Tasmania

The Little Penguin is a coastal nesting seabird found around much of the Tasmanian and Bass Strait islands' foreshores (Marchant and Higgins 1990). Little Penguins require suitable habitat for nesting during their breeding and moulting seasons.

In Tasmania, Little Penguins are present in coastal areas up to 1 km from the shore (Woehler *et al.* 2014), where they nest in various natural habitats, including in shallow and deep burrows, rock crevices, and underneath any sort of vegetative cover that forms a burrow structure. They also nest in and under anthropogenic structures such as concrete culverts, coastal buildings and domestic gardens, or any stationary items, including man-made igloos and nest-boxes (Weerheim *et al.* 2003, Bourne *et al* 2004, Woehler 2012, 2015, Marker 2016, Woehler *et al.* 2021). In the north west, the distribution of Little Penguin habitat is constrained to the coastal strip due to the proximity of transport infrastructure (roads and railway line).

Vegetation of all descriptions (native and introduced) can be used by penguins during the breeding and moulting seasons, with birds typically returning to the same burrow from year to year. Careful management is needed if there is a requirement to remove vegetation, old logs, weeds and refuse from coastal areas, as penguin nests/burrows and nesting material can be inadvertently damaged or destroyed. Recent surveys and studies have shown that penguins may now be ashore at any time of the year in Tasmania (PF Marker unpub. data, Woehler *et al.* 2021).

Vegetation may have different effects on burrow temperature, but generally it acts as insulation and protects the birds from heat stress (Ropert-Coudert *et al.* 2004, Marker 2016), particularly during higher temperatures. Little Penguins readily adopt artificial burrows as alternative and supplementary breeding and moulting sites (Marker 2016, Woehler *et al.* 2021).

3.2 Annual life cycle in Tasmania

Little Penguins begin breeding between 2 and 3 years of age, generally returning to the colony from which they fledged. Their typical annual cycle can be summarised into the following seven broad life-history stages:

Burrow attendance—Between June (but sometimes as early as May) and August, males return to their colonies to reconstruct old burrows, dig new ones and await females.

Courtship—From June onwards (or earlier), male and female penguins re-establish pair bonds and spend several days at their selected nest site, approximately one month before egg laying.

Pre-laying exodus—Males and females leave their nest site for 1–2 weeks, during which time the females accumulate energy reserves for producing the eggs, and the males for undertaking the first incubation shift.

Egg laying and incubation—Males return to the nest site before the females to defend their nests and reduce the risk of losing paternity. Once females return, they generally remain in the nest for approximately five days before laying their clutch of 1–2 eggs. Incubation can last up to 35 days, and penguins are particularly vulnerable to disturbance at this stage and can abandon their eggs.

Chick raising—This is divided into two stages:

i) The guard stage, in which parents look after the chicks for 14–21 days on average, although this can vary with availability of food and prevailing weather conditions (Chiaradia and Kerry 1999). Chicks are constantly guarded during this stage by one parent. The chicks are very small and can be found nestling under the parents to keep warm as they are unable to regulate their body temperatures.

ii) The post-guard stage follows once the chicks are big enough to maintain their body temperature and are too big to be sitting under a parent bird. At this stage, both parents forage at sea leaving the nest unguarded during the day. Throughout the chick-raising period, parents allocate time and energy to undertake foraging trips of varied duration to meet the dual food demands of their chicks and for their own sustenance (Hoskins *et al.* 2008). At 8–10 weeks of age, the chicks have matured: their plumage is waterproof, and they are ready to leave their nest site (fledging).

Moult—After the breeding season, adults undertake a foraging trip to accumulate sufficient fat reserves to sustain them during their annual moult (the replacement of old feathers), which usually occurs between January and March and lasts approximately 17–20 days. Their weight can increase up to 2 kg, approximately twice their normal weight, which allows them to fast for the entire period while they are on land undergoing moult. This is one of the most vulnerable times of their life cycle as they cannot go to sea until their moult is completed. The penguins are often emaciated after moulting (Stahel *et al.* 1987).

Post moult—Adults spend most of this time at sea but return to their colonies periodically during the non-breeding period. Eventually they increase the time spent at the colony in preparation for the next breeding season.

The following diagram summarises the typical annual cycle of the Little Penguin. It should be noted that the breeding season of Little Penguins is increasingly asynchronous and aseasonal, with birds beginning to breed at various times over an extended period (i.e. several months), although the more concentrated summer breeding season usually takes place from September to January.

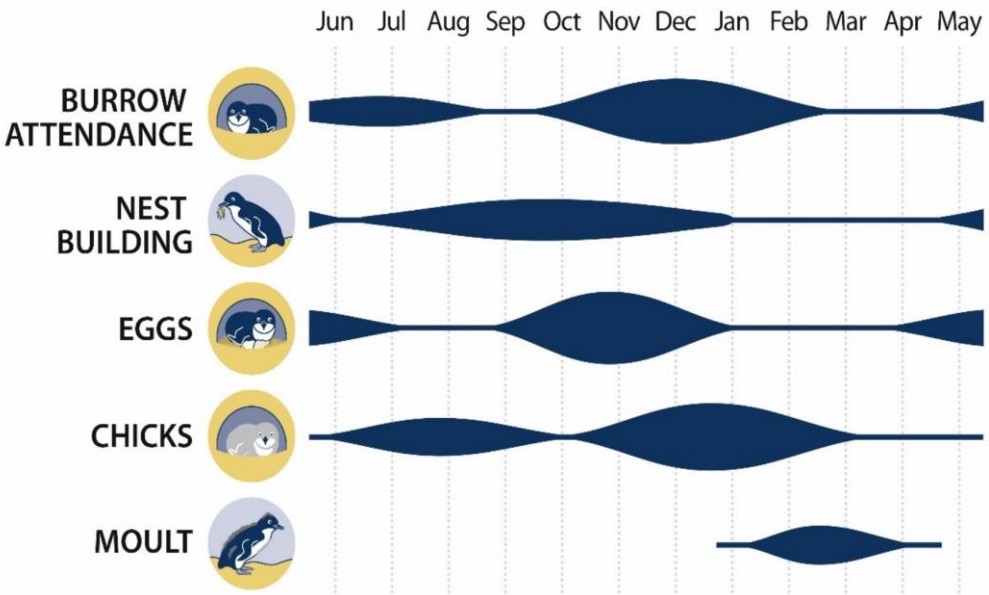


Figure 2: *General annual life cycle of Little Penguins showing continuous presence of penguins ashore throughout the year. This diagram has been adjusted from a Phillip Island diagram highlighting that the breeding cycle may commence earlier in the year in addition to during the summer months.*

3.3 Timing of works in Little Penguin habitat

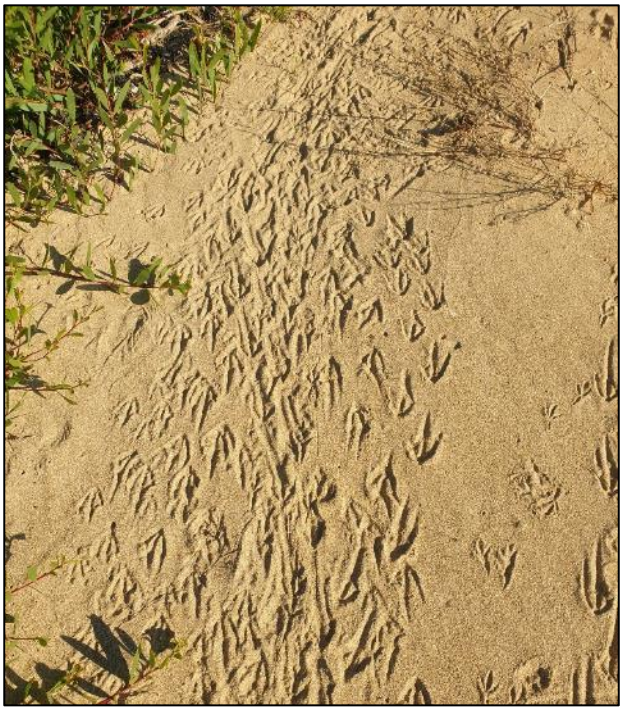
Works in areas containing penguins are best undertaken outside the breeding and moulting seasons—that is, generally from May to August. However, as there is increasing geographic and timing variability in Little Penguins breeding in Tasmania, it is critical to inspect the site carefully before any works program begins. At any time during the non-breeding season there may be as many as 10% of the birds present in the colony. Winter breeding is also becoming a more frequent occurrence. For instance, chicks were recorded in July 2019 along the north-west coast, indicating eggs had been laid as early as late May 2019 (PF Marker unpubl. data); similarly, eggs were laid in June 2022 at Low Head (EJ Woehler, unpubl. data).

Current monitoring efforts around the state are recording Little Penguins ashore from May to August more frequently than in the past, so a careful approach is now required for working in penguin habitat at any time of the year. From May to August, it may be possible to work in small areas at a time after inspecting to ensure penguins are absent. Works during the main breeding and moulting seasons (September to March) should be avoided as much as possible to minimise disturbance to penguins.

3.4 Indicators of Little Penguins' presence

The presence of Little Penguins can be identified by indicators (Figure 3), comprising:

- penguin footprints in the sand,
- penguin splashes or guano (white faecal streaks 3–5 cm long) on rocky areas and near the entrances of burrows,
- burrows in the substrate,
- penguin feathers that can be seen at entrances to burrows, especially during the moult stage,
- well-worn runways in the vegetation, and
- penguin vocalisations.



a) Little Penguin footprints

c) Little Penguin burrow in substrate

b) White splashes from Little Penguin guano.

d) Little Penguin moult feathers at concrete igloo

Figure 3: *The presence of Little Penguins can be identified by these indicators.*

4 Planning for coastal works in Little Penguin habitat

4.1 Scoping site, land tenure and permissions

Best practice outcomes are achieved if planning and preparation are done thoroughly before commencing any works in penguin habitat. The objectives of best practice planning are to:

1. Identify the land manager(s) of the site,
2. Identify if penguins are present on the site,
3. Identify if Aboriginal Heritage/Indigenous cultural sites and values are present in the coastal zone,
4. Identify if other stakeholders' groups are involved in site management, and if so, engage with them.

1. Identify the land manager(s) of the site

It is important to ensure all the required permissions are obtained before commencing any ground works on site. Ensure all land managers are informed/involved in the planning process. Ensure all stakeholder and community groups are informed (and involved if required or interested). A good resource to check is Chapter 1 of *Tasmanian Coastal Works Manual* (Page and Thorp 2010) for a detailed description of what working on the coast entails.

Checklist	Actions
Land tenure	• Use LIST map to identify the land manager(s) of the site.
Coastal Reserve	• Contact Tasmania Parks & Wildlife Service (PWS).
Unallocated Crown Land	• Contact NRE Tas Property Services.
Leased and/or managed by Council	• Contact local council to check.

2. Identify if penguins are present on the site by the indicators below

Further information can be sourced from *Survey Methods 5.1 Presence or Absence*, which is part of the *Little Penguin* (Eudyptula minor) *Survey and Monitoring Toolkit* (Tasmanian Penguin Advisory Group: TPAG 2020). https://nre.tas.gov.au/wildlife-management/marine-conservation-program/little-penguins-in-tasmania/monitoring-and-protection/little-penguin-survey-and-monitoring-toolkit

Checklist	Actions
• Well-formed runways in the vegetation	• Look for signs of an established animal track with trampled plants or grasses, leading from the beach into vegetation. • **Do not walk through any vegetation as penguins may be present.**
• Splash (white guano)	• Look for white or grey streaks of penguin splash (poo) on the sand, rocks, vegetation, or concrete.
• Footprints in the sand	• Sunny early mornings are the best time to locate penguin tracks.
• Feathers in nest hollows	• This is a sign of a moulting penguin and more likely to be observed between February and April.
• Vocalisations	• These are more likely to be heard at night, after dusk and before dawn.
• If it is a known penguin colony	• Identify any data/reports on penguin numbers for the site.

3. Aboriginal Heritage/Indigenous cultural sites and values

Aboriginal Heritage sites are protected by law, and it is illegal to disturb or destroy cultural sites. The *Aboriginal Heritage Act 1975* is the primary legislation for the protection of Aboriginal cultural heritage in Tasmania. Works must not harm relics through acts including to destroy, damage, deface, conceal or otherwise interfere with relics. Refer to Aboriginal Heritage Tasmania for Aboriginal Heritage Standards and Procedures. Any works that could interfere with or impact on an Aboriginal Heritage Site requires a permit, and an Aboriginal Heritage Assessment may be required.

Contact Aboriginal Heritage Tasmania on 1300 487 045 for advice.

4. Identifying other stakeholder groups

It is important to identify other stakeholder groups involved in the management of the site. For further information on identifying local community groups in the area that are assisting in the management of the site and engaging with them, contact:

Landcare Tasmania: https://www.landcaretas.org.au

Wildcare Inc. Tasmania: memberservices@wildcaretas.org.au

NRM (Natural Resource Management) organisations:

- Cradle Coast NRM admin@cradlecoast.com
- NRM North admin@nrmnorth.org.au
- NRM South admin@nrmsouth.org.au

If you have interest or concerns about your local penguin population or if you need to report unusual penguin mortality or incidents please contact the **Marine Conservation Program (MCP), Department of Natural Resources and Environment Tasmania (NRE Tas).**

Phone: 0427 942 537

Email: whales@nre.tas.gov.au

Stakeholders	Examples	Notes
Community groups	• Landcare groups • Wildcare groups • Traditional owners	• Many coastal communities are aware of Little Penguins in their local area, and some have formed to protect them and maintain habitat.
State Government and regional agencies	• NRM agencies • PWS • NRE Tas	• These organisations have contact with local community groups and support their activities. • Further information can add value to undertake conservation activities in penguin colonies.

4.2 Proposed works/development in Little Penguin habitat

The following protocols must be adopted by anyone intending to undertake any form of works in the coastal zone in Tasmania that will result in impacts to Little Penguins. It is recommended that all activities are conducted between May and July to minimise the risk of disturbing breeding/nesting Little Penguins, however, approved and permitted management actions may be required if breeding or moulting birds are detected during this period. Please note that all works relating to the translocation of Little Penguins and/or the decommissioning of Little Penguin burrows require that a permit be taken under the *Nature Conservation (Wildlife) Regulations 2021* (NC Regs), a site-specific Little Penguin Management Plan be created and surveillance of works must be undertaken by an NRE Tas-approved Little Penguin biologist.

The process as identified by NRE Tas is as follows:

1. The proponent engages an environmental consultant to conduct a natural values survey of the proposed works/development site that includes a presence/absence survey for Little Penguins and their burrows.
2. If there are no Little Penguins observed but Little Penguin habitat (no burrows observed) is present, and the development is proceeding outside of the breeding season, it is recommended that a Little Penguin Management Plan be developed to manage unanticipated Little Penguin interactions.
3. If no Little Penguins and no suitable habitat is detected in the works site, it is recommended that the work site be fenced off and materials left overnight to prevent penguins accessing the site for shelter or to nest. Each morning before the commencement of works, the works site and materials should be inspected for Little Penguin presence.

4. If Little Penguin activity and/or Little Penguin burrows are detected in the works area, NRE Tas permits will be required to disturb wildlife and/or take products of wildlife for any approved relocation of penguins and/or decommissioning of burrows.
5. To inform a permit application, an NRE Tas-approved Little Penguin biologist should undertake a follow-up survey of the penguin colony and burrow activity to determine the number of burrows to be impacted by the activity. The follow-up survey is required to inform a site-specific Little Penguin Management Plan (also to be approved by NRE Tas).
6. The proponent will submit a permit application along with the Little Penguin Management Plan attached to NRE TAS, Conservation Assessments (CAS) for approval.

5 Management of Little Penguin habitat

Little Penguins are known to nest in a wide variety of habitat, whether it consists of vegetation (native and/or introduced species) or artificial infrastructure (under buildings, pipes, sea walls etc.). Penguins use voids where they can raise their chicks and moult (Woehler 2015). Some colonies are more remote and farther from urban development in Tasmania (e.g. offshore islands), but many are in peri-urban or urban areas along the eastern and northern coasts of Tasmania (Stevenson and Woehler 2007, Woehler *et al.* 2014).

Conservation actions to assist the long-term survival of Little Penguins and their habitat require improving habitat and mitigating, minimising or eliminating identified threats. Natural resource managers such as PWS, NRE Tas, local councils, Aboriginal communities, local Landcare, Coastcare and Wildcare groups, and NRM agencies all contribute to conservation and management of the species. The current priority management objectives for Little Penguin habitats are:

- Where possible, penguin habitats should be enhanced.
- Provide suitable nesting opportunities if appropriate.
- Identified threats should be mitigated, minimised or eliminated if possible—e.g. habitat disturbance and modification, human disturbance (e.g. ensure designated beach access routes are used to reduce the incidence of trampling burrows), dog attacks.
- Nesting sites to be protected where possible.
- Remove or control exotic and invasive plant species where possible without destabilising steep slopes and/or increasing the risk of coastal erosion.

5.1 Habitat management planning

Current best-practice habitat management planning for Little Penguins can be characterised by the following:

- The development of a detailed site-specific habitat management plan.
- To the greatest extent possible, works should be planned and undertaken during the least sensitive times in the penguin's life cycle, and, during the non-breeding season. This season may vary inter-annually, but the peak breeding and moulting seasons between September and March should be avoided. Undertaking works at other times of the year will require caution as penguins are now known to be present in their colonies throughout the entire year at some locations.
- The identification of site-specific sensitive areas and relevant threats to penguins and habitat.
- The development of site-specific strategies to protect sensitive habitat and mitigate, minimise and/or eliminate threats to penguins.
- Ensure everyone involved in the proposal is aware of, and implements all the constraints identified, including but not limited to timing, duration and extent of works on site.
- The involvement of an NRE Tas-approved penguin biologist to undertake detailed mapping of the site, including penguin colony extents, runways, landing sites and proposed areas of works. The mapping is to

inform the site-specific penguin management plan to be approved by NRE Tas before works commence on site.

Two aspects of Little Penguin habitat management are considered here: rehabilitation and revegetation. They are treated separately as they have slightly different protocols.

5.2 Rehabilitation

Rehabilitation involves restoring habitats that have been degraded or modified by previous construction and/or site maintenance activities (e.g.: erosion control works, reclamation, road works and vegetation removal). These activities often result in compacted soil with rocks and rubble remaining. The cavities that are created may provide suitable nesting opportunities for penguins.

Rehabilitation aims to maintain existing penguin habitat and to improve the vegetation cover, creating additional nesting opportunities for Little Penguins. It is important to limit disturbance and modification in and around colonies, allow regeneration of native plants (if the site permits), and remove weeds as they emerge.

Many Coastal Reserves are narrow and, as sea levels rise, coastal erosion is likely to increase. This may limit the area penguins will have available for nesting at these locations.

The following table outlines some staged actions.

Stage	Actions
Planning	• A rehabilitation plan should incorporate and implement a multi-year program for vegetation and weed management and identify local land managers and opportunities for partnerships to assist with implementation. • The plan should also incorporate flexibility around the variability in the timing of Little Penguin breeding seasons and timing for works. • Where possible, the rehabilitation plan should identify funding opportunities for community involvement following initial works on site.
Mapping	• Compile a map that identifies all relevant natural and anthropogenic features that are present, including the distribution of flora (native and introduced). • Map all nesting sites, penguin runways and public beach access routes.
Vegetation management	• See Sections 5.3 and 5.4 regarding management of native species, and Section 5.5 regarding management of invasive species.

5.3 Revegetation

The goal of revegetation is to enhance nesting habitat and provide additional nesting opportunities for Little Penguins. Revegetation aims to restore native vegetation and habitat to rebuild the soil and enhance biodiversity. This can be achieved by replanting or direct seeding and replacing weeds and other invasive species with native local-provenance species to enhance nesting opportunities, and potentially help mitigate, minimise or eliminate threats on site.

Vegetation plays an important role in providing nesting cover for Little Penguins, and vegetation around the nest site acts as insulation to help protect the birds from heat stress. Thinning or removing the upper canopy within a colony can increase temperatures inside nest sites and potentially reduce breeding success. Removing vegetation such as African Boxthorn (*Lycium ferocissimum*) within a colony may expose Little Penguins to greater risks from introduced predators and from human disturbance and interference.

Stage	Actions
Planning	• A revegetation plan should incorporate and implement a staged, multi-year program, as the removal and replacement of vegetation in penguin colonies may take many years, depending on the area involved and the complexity of the vegetation community to be managed. • Where possible, the rehabilitation plan should identify funding opportunities for community involvement following initial works on site. • Select plant species used by Little Penguins (Section 5.4).
Mapping	• Compile a map that identifies all relevant natural and anthropogenic features that are present, including the distribution of flora (native and introduced). • Map all rare and threatened plants identified on site and establish protocols to protect them during all works on site and following works completion. • Map all penguin nesting sites and runways, and public beach access routes. Establish protocols to protect runways during all works on site and following the completion of works.
Vegetation management	• Replant native local-provenance species in conjunction with simultaneous weed species removal to ensure a staged process. Native plants must be given several years to establish between subsequent stages of weed removal and native plantings. • Establish planting schedules for May-August, which are normally the wetter months, so that newly planted plants require minimum watering. However, watering may be required during dry winters and the following summer. • If penguins are present, no weeding or planting should be undertaken within 2 m of active nests at any time of the year. • The use of local-provenance seedlings will improve their chances of survival. • Plant native plant species as used by breeding Little Penguins in the area.
Planting guidelines	• Aim for a diversity of local-provenance native plant species. • Bushy grasses and shrubs will provide greater cover and protection for penguins. • Plant to shade and camouflage nest sites. • Plants should be closely spaced (0.5 m apart). • Plant close to existing burrow sites during the non-breeding season. • Use plant protection (tree guards) to protect seedlings from browsing animals. In areas of high populations of browsing animals, alternative plant protection (wire mesh, taller/stronger plant guards or other browsing control methods) may need to be used. • Develop a timetable to monitor success or failure of seedlings and identify options for future replacement of unsuccessful plantings.
Other considerations	• Where possible, identify the options for reducing the number of pedestrian access tracks through or adjacent to the penguin habitat to maintain its integrity. • Where possible and required, protect colonies from introduced predators (e.g. fencing to deter entry by dogs). • Where required, identify options to prevent penguins accessing transport infrastructure (roads or rail). • Where possible, identify options for planting a native vegetation buffer beyond the colony to deter disturbance to penguins.

5.4 Native coastal plants

Native plants provide breeding and moulting habitats and shelter for Little Penguins. The following table provides details for **selected** native coastal plants often found in penguin habitats in Tasmania. See McLeod and Gray (2005) for further information on growing native plants.

Common and scientific names	Comments	Images
SHRUBS		
Coastal Saltbush *(Rhagodia candolleana)*	• A hardy plant that provides excellent shelter and habitat for penguins. • Berries can be used to grow seedlings. • Cuttings of hardened tips strike easily.	 Photo by Anna Wind
Bower Spinach, Ice Plant *(Tetragonia implexicoma)* and **New Zealand Spinach** *(T. tetragonoides)*	• Both provide excellent penguin habitat, but *T. implexicoma* is more common in Tasmania. • *T. tetragoniodes* has larger leaves and smaller flowers than *T. implexicoma.* • Easily propagated by cuttings.	 *Tetragonia tetragoniodes* photo by Philip Collier via iNaturalist  *Tetragonia implexicoma* photo by Anna Wind
White Correa *(Correa alba)*	• Provides excellent penguin habitat. • Seeds can be difficult to germinate but cuttings are fairly easy to propagate.	 Photo by Anna Wind

Common and scientific names	Comments	Images
Velvet Correa *(Correa backhouseana)*	• Provides good penguin habitat. • Generally propagated by cuttings.	 Photo by Iona Flett
Coastal Beard Heath, Currant Bush *(Leucopogon parviflorus)* **Spiked Beard Heath,** *(L. australis)*	• Both provide good penguin habitat. • *L. parviflorus* is more stocky, dense and taller. • *L. australis* has a narrow leaf and is generally slightly shorter.	 Photo by Anna Wind
LARGER SHRUBS AND TREES		
Coastal Boobialla (*Myoporum insulare)*	• Provides suitable penguin habitat; plant intermittently amongst other penguin-preferred species.	 Photo by Anna Wind
GROUND COVERS		
Sagg *(Lomandra longifolia)*	• A hardy tussock that provides excellent penguin shelter and habitat.	 Photo by Anna Wind
Coastal Tussock Grass *(Poa poiformis)* and **Tussock Grass** *(P. labillardierei)*	• Both tussock grasses provide good penguin habitat. • It is hard to distinguish between the two species. • *P. poiformis* has smooth leaves whereas *P. labillardierei* has very slightly serrated leaves and is rough to the touch.	 Photo by Anna Wind

Common and scientific names	Comments	Images
Flax Lily *(Dianella revoluta)* and **Blue Berry, Forest Flax Lily, Tasman Flax Lily** *(Dianella tasmanica)*	• Both provide good penguin habitat. • *D. revoluta* is generally smaller with straight and upright leaves. • *D. tasmanica* has arching foliage and grows wider. • May be propagated by seed or by division.	 *Dianella revoluta* photo by Patrice Baxter via iNaturalist  *Dianella tasmanica* photo by nesbitj via iNaturalist

5.5 Invasive weed control

Weed invasion is one of the greatest threats to dry coastal vegetation in Tasmania (Kirkpatrick *et al.* 1999, Rudman 2003). Weeds are opportunistic and aggressive, displace native vegetation and degrade habitat. They can change the diversity and balance of ecological communities. While some weed species may be used as nesting habitat by Little Penguins (such as African Boxthorn), most weeds threaten the survival of native plants and compete for space, nutrients and sunlight. After they are established, weeds can be spread farther by birds and other animals ingesting and distributing seeds, by wind or water movement naturally transferring parts of the plants, or by humans accidentally or deliberately carrying seeds to new locations.

Thirty-two Weeds of National Significance (WONS) have been identified in Australia based on their invasiveness, potential for spread and environmental, social and economic impacts (https://weeds.org.au/). Individual landowners and land managers are responsible for managing declared weeds including WONS. It is important to manage weeds within contemporary policy, legislative and planning frameworks. Guidance and advice is available from Authorised Weeds Officers and Biosecurity Tasmania (part of NRE Tas). The State Government is responsible for overall legislation and management; and declared plant pests are listed under the *Biosecurity Regulations 2022*. Declared plant pests (including Declared Weeds) pose an elevated security risk. Further information can be found at:

- Department of Natural Resources and Environment Tasmania https://nre.tas.gov.au/invasive-species/weeds
- Weeds Australia (Centre for Invasive Species Solutions) www.weeds.org.au
- A Guide to Environmental and Agricultural Weeds of Tasmania https://talkwith.tasnetworks.com.au/farmers-hub/widgets/348643/documents

Important points to consider when managing coastal weeds for Little Penguin protection are detailed below.

Stage	Actions
Planning	• Develop a detailed, long-term weed management plan for the site. This may require a consultant or natural resource management professional experienced in coastal weed management and eradication. • A long-term site rehabilitation plan is required when established weeds are providing nesting habitat for penguins (Sutter and Downe 2000). • Weed removal must be gradual to ensure sufficient Little Penguin nesting habitat is retained throughout the removal phase (see Sections 6.2 and 6.3). • Eradicate new and emerging weeds before they spread and become a bigger problem. Early intervention is the most cost-effective action.
Management	• Rank weeds (high, medium or low risk) as per their current status. Some weeds are listed as WONS, some are "declared weeds" under the *Tasmanian Weed Management Act 1999*, and some may be mentioned in Local Government or PWS management plans for reserves. • A higher priority of action is required to control declared weeds because land managers have a responsibility to remove them from their properties. • Manage weeds according to their level of invasiveness, problematic potential and how badly they impede nesting by penguins. Control of African Boxthorn (*Lycium ferocissimum*), Gorse (*Ulex europaeus*), Kikuyu Grass (*Cenchrus clandestinus*), should be a higher priority as they can threaten penguin habitats. • Ensure correct species identification is made as some weeds and native plants can look similar. • Soil disturbance often provides the opportunity for weeds to invade a newly disturbed area. Keep soil disturbance to a minimum. • Aim to encourage native plants in adjacent areas. • Coast Wattle (*Acacia longifolia* var. *sophorae*) is native but can dominate coastal dune scrub and may be considered an environmental weed due to its over-abundance (Sutter and Downe 2000). It may sometimes be necessary to prune or remove some native species like Coast Wattle or dense growth of other species in order to ensure access for penguins. Coast Wattle is not recommended for replanting in penguin habitat.
Education	• Weed invasions from domestic gardens can reduce penguin habitat. This may be from people dumping garden waste, or by seeds spread by birds and the wind. Information should be provided to nearby residents on the impacts of dumping garden waste.

A number of weed management methods are available and are briefly described here.

Method	Actions
Hand control (pulling)	• Wherever possible, hand-pulling of small seedlings is recommended. • Contain and suppress other established weeds (e.g., if feasible, collect seed heads, bag and dispose before they mature and germinate). • If removing large bushes, cut and retain stem and roots *in situ* to stabilise the soil and prevent/minimise erosion. Seek advice to ensure the targeted weed species is not one that will establish from cut stems *in situ*. • If feasible, leave some branches *in situ* for climbing plants (such as *Tetragonia*) to grow over—this can provide cover and create additional habitat for penguins.
Mulching and smothering	• Covering the ground with a layer of organic material suppresses or kills weeds by providing a barrier between the seedlings and sunlight.

Method	Actions
Slashing	• Where possible, slash weeds to reduce fire risk outside of the penguins' breeding and moulting seasons. If penguins are present, no slashing should occur within 2 m of active nests.
Herbicides	• Spraying of herbicides should be discouraged in the management of vegetation in and around penguin colonies as they may persist within the soil and may be harmful to nesting penguins. Herbicides should not be used in sandy soils. If herbicides do need to be used, the "cut and paste" method is recommended. Always seek professional advice on the use of chemicals and check the label and the safety data sheet (formerly material safety data sheet) for the chemicals to be used.
Biological control	• Biological control is the practice of managing a weed by the deliberate introduction of one or more natural enemies (bio-control agents). The processes for importing animal biological control agents are conducted by the Department of Agriculture, Fisheries and Forestry. Contact the land manager, Biosecurity Tasmania or the regional NRM organisation for more site-specific or local information.

Selected common weeds that can be found in Little Penguin habitats are shown here. Weeds of National Significance are highlighted.

Common and scientific names	Comments	Images
African Boxthorn (*Lycium ferocissimum*) WONS *A Declared Plant Pest in Tasmania.*	Regarded as one of the worst weeds in Australia because of its invasiveness, potential for spread and environmental impacts. However, its impenetrable thickets act as a haven for small native birds and animals, notably penguins, and may provide protection from dog attacks, but may also harbour cats. It is recommended that any removal of Boxthorn takes into consideration the potential removal of protection for penguin burrows (Lee and Booth 2003). Once established, it is difficult to eradicate.	 Photo by Anna Wind
Blackberry (*Rubus fruticosus aggregate*) WONS *A Declared Plant Pest in Tasmania.*	Can exclude access for potential burrows.	 Photo by Anna Wind
Boneseed (*Chrysanthemoides monilifera*) WONS *A Declared Plant Pest in Tasmania*	Has a shallow root system. It does not bind the substrate in a way that allows the suitable formation of burrows.	 Photo by Alan Melville, via iNaturalist

Common and scientific names	Comments	Images
Bridal Creeper (*Asparagus asparagoides*) WONS *A Declared Plant Pest in Tasmania*	Introduced from South Africa, and a common garden plant. Difficult to control, asparagus weeds grow quickly and produce dense, vigorous thickets of foliage that climb over and smother native herbs and shrubs. They displace native plants. Currently known to be in a limited number of sites in Tasmania.	 Photo by Philip Collier, via iNaturalist
Brooms, English Broom (*Cytisus scoparius*) and **Montpellier Broom or Canary Broom** (*Genista monspessulana*) WONS *Declared Plant Pests in Tasmania*	Brooms are significant environmental weeds that invade native vegetation, causing substantial environmental damage and capable of completely transforming invaded habitats.	 *Cystisus scoparius* photo by Jon Sullivan, via iNaturalist
Cape Ivy (*Delairea odorata*) No listing	A common coastal weed used by penguins for nesting. It is fast growing and smothers and kills native plants by blocking out sunlight.	 Photo by Anna Wind
Kikuyu Grass (*Cenchrus clandestinus*) and **Couch Grass** (*Coyodon dactylon*) and **Buffalo Grass** (*Stenotaphrum secundatum*) No listing	A tropical grass species introduced from Africa. Rapid growing, aggressive and can block penguin burrows. Grass species such as Kikuyu have a particularly detrimental effect on burrowing bird species as the birds are unable to penetrate the tight root mass or walk through the dense tangle. There were instances where penguins have been caught in the roots at Phillip Island (Park PIN 2018).	 Kikuyu Grass photo by Matthew Baker, Tasmanian Herbarium

Common and scientific names	Comments	Images
Gorse (*Ulex europaeus*) WONS *A Declared Plant Pest in Tasmania*	Gorse is a persistent agricultural weed that also invades coastal reserves. Like African Boxthorn, penguins and other native mammals may use gorse infestations as habitat, therefore a staged removal is recommended.	 Photo by Alan Melville, via iNaturalist
Marram Grass (*Ammophila arenaria*) No listing	Marram Grass may impede access to burrows, although in some locations it provides nesting habitat. Controlling Marram Grass has proven to be very difficult. Most management efforts identify the best control method is to prevent expansion through maintaining healthy native vegetation condition and to control isolated or new populations (Rudman 2003).	 Photo by Anna Wind
Mirror Bush (*Coprosma repens*) No listing	A common environmental weed introduced from New Zealand, which can provide protective cover for penguins and under which penguins may nest. However, mirror bush is increasingly being recognised as a serious environmental weed in Tasmania with thickets reducing seabird breeding habitat.	 Photo by Anna Wind
Radiata Pine (*Pinus radiata*) No listing	Prevents native seed regeneration and growth of seedlings, forms dense stands that shade or crowd out native trees.	 Photo by Jeannie Mooney via iNaturalist

Common and scientific names	Comments	Images
Sea Spurge (*Euphorbia paralias*) No listing	A small Mediterranean herb with a toxic milky sap. Highly invasive in coastal areas and can develop dense populations. Recent advances in bio-control show promise.	 Photo by Iona Flett
Sweet Briar (*Rosa rubiginosa*) No listing	Often invades disturbed coastal areas and bushland. A troublesome weed that mainly spreads by the dispersal of seed.	 Photo by Ramit Singal, via iNaturalist

5.6 Providing alternative nesting opportunities

Little Penguin nest sites can be a below-ground burrow in the substrate, amongst boulders in coastal sea walls (Woehler 2015), or above ground level under vegetation and other natural features. They will also nest under human structures. Nest sites within the substrate are dug into the sand, soil or cavities among rocks along the coast; some penguins also use caves (Klomp *et al.* 1991, Marker 2016). Here, the term "nest site" will refer to all burrow types used by Little Penguins in Tasmania.

Modification and alienation of the landscape by urban encroachment and a broad spectrum of other human activities has decreased the extent of suitable, natural coastal habitat for nest sites. In some situations, birds can make use of buildings and other man-made structures (drains, pipes etc.). The loss of nesting habitat and a series of dog attacks on penguins statewide has resulted in an increasing focus on the use of artificial nest sites and nest boxes as a conservation and management tool to mitigate the loss of natural habitat and breeding penguins.

A variety of alternative nesting boxes have been used in Tasmania, and all have proved to be taken up by penguins in a short space of time (Burnie: PF Marker unpubl. data, and at Low Head, Derwent Estuary and Bicheno: EJ Woehler unpubl. data, Lee and Booth 2005, Kalmari 2014, Woehler *et al.* 2021). The New Zealand Department of Conservation (DOC) nest box design (Appendix 1) has been adopted widely throughout Tasmania, using marine ply

for the construction material with additional ventilation holes in the side and back panels to enhance ventilation. The concrete igloo design (Appendix 2) has also been used, predominantly following the *MV Iron Baron* oil spill at Low Head in 1995 (Goldsworthy *et al.* 1998). Minor variations in the design and construction material have been used on the north-west and east coasts, and around the Derwent Estuary (Lee and Booth 2005).

Ventilation and air circulation through the burrows are important for all nest box and igloo designs to ensure that the penguins do not overheat during the summer months. The efficacy of these artificial nest boxes was compared to natural nest sites on Phillip Island over a 25-year study. The study showed that the breeding productivity was similar for all types of burrows in most years, but when breeding performance was low in poor years, breeding productivity was slightly greater in the artificial burrows (Sutherland *et al.* 2014).

In general, the provision of artificial nest boxes should be considered as one component of a short- to long-term management strategy for a colony, rather than as a permanent solution. Nest boxes may provide alternative and/or supplementary nest sites during revegetation and rehabilitation efforts or contribute to a colony's population recovery following a dog attack. Nest boxes can be used as temporary nest or moult sites if penguins require relocation due to an imminent threat.

Note that the installation of artificial nest boxes in an existing penguin colony requires advice and approval from NRE Tas and may also require approval if the installation is part of a development mitigation strategy/plan proposal.

5.6.1 Rationale for the installation of artificial burrows

Artificial burrows are an effective tool to increase nesting opportunities for penguins. Some aspects to be considered:

- Artificial concrete burrows (igloos) are more resistant to human disturbance due to their weight (approaching 30 kg).
- Nest boxes and artificial concrete burrows (igloos) should be placed on higher ground, away from drainage areas and to avoid inundation during high rainfall periods (Marker 2016).
- All artificial burrows must be positioned out of direct exposure to sunlight, with vegetation cover to provide insulation against high temperature extremes (Marker 2016).
- Installation of nest boxes and artificial concrete burrows (igloos) must only be undertaken following advice from a penguin biologist.
- Artificial burrows should be installed intermittently in the colony, positioned at least 2 m from each other.
- Allow a buffer of at least 2 m from major runways to avoid territorial disputes among penguins.

5.6.2 Types of burrows

The following table summarises when each type of alternative burrow may be suitable. An important feature that needs to be incorporated is ensuring adequate ventilation, e.g., by adding air holes to wood or concrete burrows.

Burrow type	Construction material(s)	Indications for use	Images
Vegetation burrows	Use naturally occurring materials to establish additional nesting opportunities, e.g. logs and fallen branches.	• Where vegetation is being pruned (eg shrubs or small trees), then the small branches can be loosely layered or stacked to form a shelter that penguins may use. • *Tetragonia* spp. can be planted alongside, which will eventually grow over the branches and form a void.	
Rock burrows	Rock piles, broken concrete slabs (in artificial land fill sites) and other debris offer good nesting sites, especially when climbing plants grow over them to create nesting habitat. **Do not remove rocks or other materials from the beach for this purpose.**	• Using rubble or rocks present on a site can provide material for reuse as burrows. • These can be cemented together and have proven useful in some areas as alternative burrows.	
Artificial concrete burrows (igloos)	A mixture of concrete and peat in various combinations.	• These can be used near public paths but must be under vegetation to avoid over-heating during the summer months, and must contain sufficient ventilation holes.	
Wooden boxes	Wooden (marine ply) nest boxes have been used extensively around Tasmania.	• Easy to deploy. Also important to cover with vegetation for weather/heat protection.	 Nest box at Low Head. Photo by Eric J Woehler

5.7 Seawalls

There are many coastal areas where erosion has resulted in the need for seawalls/revetment zones to be built or replaced. Rock armour as an outer layer has provided voids for penguins to utilise for nesting on Bruny Island (Woehler 2015), and along the TasRail corridor in north-west coastal areas when repair has been required (Marker 2020, 2022a, 2022b).

When rock armour is used, it is recommended to integrate large boulders (0.45 m to 1.3 m) into the design and to place stone loosely, not compacted, into place. This retains voids that penguins in the area may use as burrows.

Planting of native vegetation could be done on top of these revetment zones. *Tetragonia* spp. are proving to be good coverage over the rocks on the higher slopes allowing cover for penguins inside the rock burrows.

5.8 Fencing

Little Penguins can nest at least 1 km inland, including in urban areas such as Bicheno (Woehler *et al.* 2014). Fencing is a management option that can be used where there is a risk to penguins from vehicular and/or rail traffic, from demolition/construction activities or from revegetation/rehabilitation efforts adjacent to, or within, an active colony.

Ideally, fencing should be installed before the onset of breeding, otherwise breeding penguins will be trapped inside the exclusion area (Woehler 2016). Should fencing be required to exclude penguins from an area during the breeding season or for longer period(s) of time, one-way exits comprising ramps of soil and timber to 500 mm through fencing will be required to allow penguins inside the fenced area to exit but prevent their re-entry (Figure 4). Additional efforts will be required to monitor and ensure penguins do not re-enter elsewhere.

Figure 4: *One-way exit ramp through fencing to prevent Little Penguins accessing colony.*

Figure 5: *Roadside fencing to prevent Little Penguins accessing the road surface in 2018. A camera trap to record penguin behaviour along the fence line is visible. ©Eric J Woehler.*

Fencing was used to direct Little Penguins into under-road culverts on Bruny Island when the Bruny Island Main Road was upgraded and sealed between July and November 2017. As part of the upgrade, four circular 750 mm diameter concrete culverts were placed under the newly sealed section of road at the Neck specifically to facilitate

Little Penguins' access to the colony at the Neck eastward of the sealed road. An additional three circular 375 mm diameter under-road culverts were also placed for drainage purposes. All culverts were approximately 10 m in length.

In addition to the penguin culverts along Bruny Main Road, penguin fencing was erected on both sides of the road for approximately 800 m to prevent Little Penguins gaining access to the road (Figure 5). The 1 m high fences were installed along the roadside shoulder at a greater elevation than the culverts to direct the penguins to the culverts (Woehler *et al.* 2018, Woehler and Scoleri 2019). Fencing had previously been used to direct Little Penguins to a single under-road culvert at Eaglehawk Neck (EJ Woehler, unpubl. data) and is proposed for the redevelopment of parking facilities at the Gulch, Bicheno (https://gsbc.tas.gov.au/wp-content/uploads/2016/09/Drawings-for-proposed-Bicheno-Gulch-Redevelopment-P3-221212.pdf).

Where construction is expected to take more than a few days, and equipment and materials are to be stored on site, fencing around all equipment and construction materials is essential to prevent Little Penguins accessing the areas overnight. Mounds of soil and sand are attractive as potential breeding and moulting sites. Where possible, consider minimising the volumes of construction materials on site if stockpiles cannot be fenced off.

Until recently, a 600 mm high fence was thought to be sufficient to prevent penguins crossing the fencing, but vegetation can easily grow over the fence and allow penguins to cross the fence by climbing the vegetation. A 600 mm fence has been used extensively along the Bass Highway and the chicken wire material has fallen into disrepair in many instances, especially when regular maintenance is lacking. The following images show the vegetation coverage over a low fence that makes it a poor long-term solution (Figure 6).

***Figure 6**: Short 600 mm fence with vegetation growing over and providing access to penguins.*

New fencing installed in 2024 along the Coastal Pathway in north-west Tasmania, has been used to the recommended 1200 mm height, to protect the penguins and the coastal habitat, as well as providing safety for users of the pathway (Marker 2022). This height is an improvement in areas of high public use and will require less frequent maintenance.

The height of fencing to be installed depends on a few factors:

- Ease and safety of installation and maintenance,
- Habitat type and threat type(s), and
- Required longevity of fence.

The following gives a guide on the type of fence material, height and when it should be used.

Type of fence	Height	When they should be used	Image
Temporary either silt and sediment fence ('filter"- see photo) or close cross mesh (especially on beaches). Short-term (days–months) duration.	600 mm above ground, with 100 mm dug into the ground.	Work zones to protect penguins entering the area.	
Permanent close cross mesh wire fence.	Between 300 and 900 mm, with 100 mm dug into the ground and with the wire mesh bent towards the seaside.	Along railway lines (north-west coast only).	
Permanent sturdy close cross mesh wire fence.	1200 mm with a) 100 mm dug into the ground or b) fastened to a pathway if present.	Along pathways that are heavily frequented by humans.	 a) b) 

5.9 Construction work

Construction zone

Construction will involve the use of vehicles, machinery, tools and materials throughout the period, and it is assumed that works will only occur during the day. A daily pre-start check to confirm the absence of penguins in and around all machinery and materials left onsite overnight must be completed by an authorised NRE Tas approved penguin biologist or a trained person, before any on-site activities begin.

The following gives an outline of protocols around materials and machinery:

- Fence off works material, particularly overnight.
- Every day, before work begins, a check must be undertaken for penguins' presence in and around any machinery and material left on site overnight.
- The site and boundary must be checked daily for any new penguin footprints entering the works site.
- If footprints or splash are detected, a greater effort must be made to check the work site more thoroughly as penguin(s) may be present.
- Any material left nearby or onshore should be fenced off to prevent its use for nesting, moulting, sheltering or overnight resting sites.
- Silt fencing or chicken wire that has small mesh to prevent penguins getting through is recommended. The barrier mesh should be wide enough to allow c.100 mm to be dug into the sand or bent inwards and fixed in the ground with tent pegs or steel star pickets (or similar) to prevent penguins burrowing under the barrier, and c.600 mm above the ground. The barrier mesh will need to be staked at regular intervals to stay upright and prevent its collapse. The barrier mesh will prevent penguins accessing the construction zone overnight.
- Any non-breeding penguin(s) found could be located to good coverage of vegetation close by. Any breeding penguin(s) found will need to be relocated to an artificial burrow in adjacent vegetation away from the works area before daily activity begins. This will require further advice from an NRE approved penguin biologist and CAS.
- In relation to any penguin management, all daily actions should be recorded.

5.10 Nocturnal Illumination

Illumination of coastal sites may be required for safety and security reasons during construction, restoration/rehabilitation or other coastal activities. If additional nocturnal lighting is required, the illumination extent and intensity should be kept to a minimum, red or sodium (yellow-orange) lighting should be used, and any illumination of any colony and foreshore areas minimised to the greatest extent possible.

Penguins are less sensitive to red light, and its use would reduce the potential for light spill hindering the use of foreshore areas by penguins and their return to the colony. White light spill onto adjacent areas will discourage the nightly return of penguins to their burrows. Whether a known active penguin colony or not, all options for minimising light spill onto the foreshore to minimise any adverse impacts of light spill during construction should be considered.

If the development proposal includes nocturnal artificial lighting CAS recommends the inclusion of the following document National Light Pollution Guidelines for Ecological Communities .

6 Threats to Little Penguins

Threats to Little Penguin colonies can vary depending on the size and location of the colony in Tasmania. Identifying the impacts that these threats may have on the long-term viability of the colony in question needs to take place as part of the planning process and should also be incorporated into the rehabilitation and revegetation aspects. There have been records of colony decline in some parts of Tasmania, particularly in the south east (Stevenson and Woehler 2007). Identifying and managing threats is an important part of the works in penguin habitats to encourage the long-term viability of the colony.

6.1 Sensitive times to disturbance

It is important to note that Little Penguins are vulnerable during several stages of their life cycle, i.e.:

- During egg incubation, when any major disturbance can result in adult birds abandoning their eggs.
- During their entire breeding season, but particularly during the post guard stage, where Little Penguin chicks venture out of their burrow during the evening and may be more vulnerable to predation.
- During the moult season, when birds undergo moult for ~17 days, at which time they remain on land during the entire time and are at a disadvantage against mammal predators.

Where possible, works should be restricted during these periods.

6.2 Terrestrial impacts and recommended mitigation actions

6.2.1 Predators

Mammalian predators such as dogs and cats have been responsible for mortality events at Little Penguin colonies in Tasmania. There have been a number of dog attacks in Little Penguin colonies over the years with, for example, 170 birds killed in 2019 in a spate of incidents mostly attributed to dog attacks in West Ulverstone Beach (Uibi 2019), and a further 17 killed in West Beach colony in 2021 (James 2022). A recent paper modelling the impact of dog attacks on Little Penguin colonies does suggest that frequent and intense dog attacks markedly increased the probability of colony decline, regardless of colony size (Blamey *et al.* 2024). On the mainland coast of Tasmania, the distribution of Little Penguin colonies is commonly urban or peri-urban. This means these threats are likely to occur if appropriate actions are not put in place to manage dogs and cats within penguin colonies that are close, or within, human urbanisation areas.

Walking dogs through colonies, even on a lead, results in dogs leaving scents that can attract other dogs, including stray dogs. Apart from urinating and marking territory, dogs also have scent glands on their paws which leave scent trails that other dogs can follow (McClanahan and Rosell 2020).

The suggested actions outlined below are recommended to mitigate the potential impacts on Little Penguins.

Predator	Potential impacts	Suggested actions
Dogs	• Mortality of penguins. • Loss of future breeding adults in colony. • Decrease in size or loss of local colony.	• Education of dog owners on the potential impacts of dogs. • Signage by councils/ PWS to alert the community of sensitive wildlife areas and dog prohibited areas. • Establish no dog zones in coastal areas where significant penguin colonies are present.
Cats	• Loss of chicks. • Toxoplasmosis causing mortality of Little Penguins (Campbell *et al.* 2022).	• Education of cat owners to keep cats safe at home to prevent nuisance and predation of wildlife. • Installation of cat containment solutions e.g.: cat-proof fencing or a cat enclosure. • Implement a feral cat trapping program using authorised personnel.

6.2.2 Habitat disturbance/degradation

Current erosion along the coast in Tasmania and destabilisation of slopes along the foreshore, particularly in the north west, is inhibiting access to habitat in some places, and may inhibit burrow creation. Activities such as vegetation clearing including removal of logs, boulders and even weeds can result in a loss of penguin habitat if not carefully planned. Inappropriate land use and development can all lead to destabilisation of the dune areas where penguins nest.

Thorny bushes and thistles may inhibit penguin access to breeding locations, whereas older, more established African Boxthorn does provide shelter from larger predators (Pryor and Wells 2009).

The suggested actions outlined below are recommended to mitigate the potential impacts of habitat disturbance in terrestrial habitats of Little Penguins.

Habitat disturbance	Potential impacts	Suggested actions
Vegetation clearance	• Loss of habitat and nesting materials. • Temperature increase in burrows.	• Develop a revegetation plan. • Minimise removal of vegetation unless it presents a fire hazard.
Coastal erosion and storm surges	• Destruction and/or flooding of penguin burrows. • Difficulty in penguins accessing nesting sites. • Reduction of habitat if erosion occurs on narrow vegetated coastlines.	• Enhance dune vegetation with endemic native coastal species that bind the soil and maintain soil structure. • Revegetate degraded areas prone to erosion with quick growing coastal plants. • If seawalls are required or need replacing, rock armour should be used as the outer layer to the works to provide voids for nesting penguins.

6.2.3 Human disturbance

Little Penguins can be delayed in coming ashore if people are present on the beach where penguin colonies are located or are walking through colonies at night when penguins are generally active. This can lead to a disruption in adults caring for chicks and even nests being exposed to predators if adults remain absent after significant disturbance. A delay in feeding chicks can interfere with the breeding success of penguins (Seddon *et al.* 2008).

It is known that Little Penguins can become habituated to people in ecotourism sites, but the factors that contribute to the habituation or de-sensitisation is not fully known (Ellenberg 2017). In many sites around Tasmania, Little Penguin ecotourism has been carried out successfully over several years, where Little Penguins have been observed carrying out their activities with little sign of disturbance.

The suggested actions outlined below are recommended to mitigate the potential impacts of human activities in terrestrial habitats on Little Penguins.

Effect of human activities	Potential impacts	Suggested actions
People on the foreshore at dusk	• Delay in penguins returning to their burrows resulting in possible abandonment of chicks.	• Education of local councils/community groups/ landholders to minimise activity on foreshores at dusk.
Light pollution and light spill	• Can impact and disorientate penguins. • May prevent penguins returning to shore.	• Follow *National Light Pollution Guidelines* (DCCEEW 2023) if lighting is needed. • Follow lighting recommendations from Phillip Island Nature Park if lighting along walkways is required.
Inappropriate penguin viewing activities	• Disturbance and disruption to the life cycle of penguins.	• Viewing of penguins is recommended at designated viewing areas where guides can provide information and correct viewing protocols. • Implement appropriate viewing guidelines. • Encourage community custodians and volunteer groups in penguin guiding (training is recommended).
Road kill	• Loss of penguins from the local population.	• Use of appropriate fencing, if necessary. Note that, as ongoing fence maintenance is required, the feasibility of maintenance should be considered fence installation. • Install road signage informing that penguins crossing and to drive slowly between dusk and dawn.
Train kill	• Loss of penguins from the local population.	• Install penguin fencing along train lines where penguins breed if feasible. • Reduce the speed of trains between dusk and dawn in identified areas of penguin mortality.
Industrial/ Commercial	• Pollution of waterways. • Penguins nesting under buildings and infrastructure.	• Seek expert advice on the most appropriate mitigation measures.

6.2.4 Climate change

The ecological effects of climate change on Little Penguins are aspects that need to be considered in planning for works in penguin habitat (Dann and Chambers 2013), particularly where increasing storm surges, coastal erosion, increasing temperatures and decreasing rainfall are identified as issues that are already impacting Tasmania and its coastal zone (*Tasmania's Changing Climate* 2021).

Increased consideration will need to be given to vegetation and types of artificial burrows used in improving habitat for penguins in a changing climate.

The suggested actions outlined below are recommended to mitigate the potential impacts of climate change in terrestrial habitats on Little Penguins.

Summary of potential impacts and suggested actions to reduce identified impacts. Adapted from Dann 2013.

Predicted climate change effect	Potential impacts	Suggested actions
Sea-level rise	• Possible loss of breeding habitat. • Access to colonies may be hindered on sandy beaches where steep dune banks form.	• Investigate the removal and replacement of Marram Grass with native species to hold the dune structure. • Seawalls may be necessary in some coastal sections. The use of rock armour can provide voids to create nesting sites (Woehler 2015).
Decreased rainfall (and humidity)	• Increased fire risk leading to mortality and possible habitat loss.	• Increase appropriate vegetation cover in breeding habitat to reduce evaporation of soil moisture during periods of decreased rainfall and to reduce erosion after high rainfall events. • Reduce fire risk in breeding habitat by planting fire resistant vegetation where possible.
Ambient temperature increase	• Possible increase in mortality.	• Increase appropriate vegetation cover in breeding habitat to reduce internal burrow temperatures. • Use artificial burrows with optimal micro-climate to increase the likelihood of breeding success.
Increasing Sea Surface Temperature (SST), El Nino Southern Oscillation (ENSO)	• Earlier and more productive breeding seasons in the short and medium term.	• Survey colony before any works are carried out to avoid affecting areas where penguins may have started early breeding.

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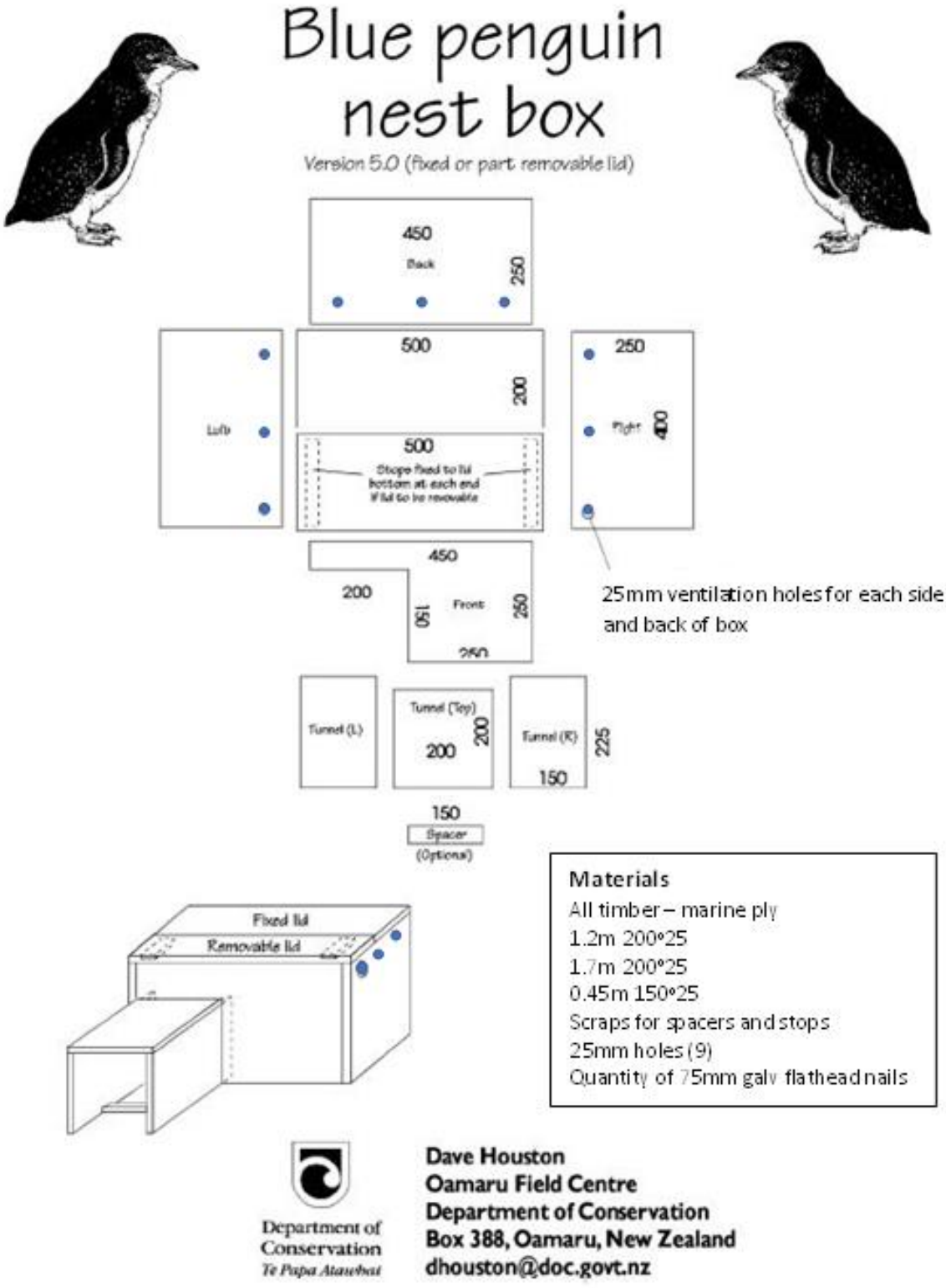
9 Appendices

9.1 Appendix 1. Wooden nest boxes

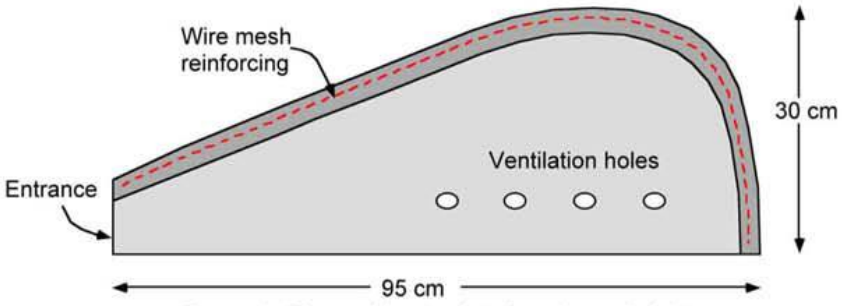
Little Penguin nest box design as used in New Zealand, with local modifications to increase the number of ventilation holes on the side and back panels. The use of marine ply will see their use approaching 20 years. **The ply must not be painted, stained, or varnished.**



9.2 Appendix 2. Concrete igloos

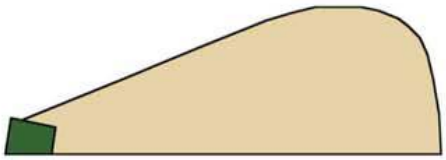
ARTIFICIAL PENGUIN BURROWS

Cross section through burrow

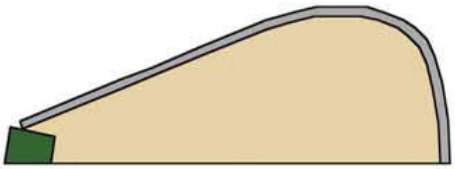


Burrow is 50 cm wide at point of maximum height

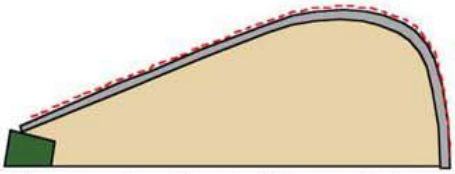
Stages in making a penguin burrow



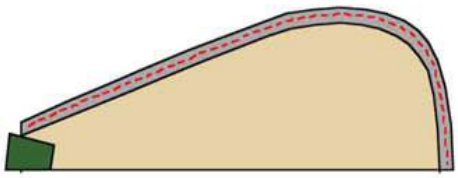
1. Make mound of sand about 90 cm long, 25 cm high and 40 cm wide (at its highest point) tapering to the entrance and place a 150mm plastic flower pot at the entrance.



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



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



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

4. 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.

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

7. 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