NSW GOVERNMENT
Environment, Climate Change & Water
National Parks & Wildlife Service

John Gould Nature Reserve and Boondelbah Nature Reserve

Plan of Management

JOHN GOULD NATURE RESERVE

AND

BOONDELBAH NATURE RESERVE

PLAN OF MANAGEMENT

NSW National Parks and Wildlife Service

Part of the Department of Environment, Climate Change and Water

May 2010

This plan of management was adopted by the Minister for Climate Change and the Environment on 18th May 2010.

Acknowledgments

The NPWS acknowledges that this reserve is in the traditional country of the Worimi people.

This plan of management was prepared by staff of the Hunter Region of the NSW National Parks and Wildlife Service (NPWS), part of the Department of Environment, Climate Change and Water.

Valuable information and comments were provided by:
- The Regional Advisory Committee;
- DECC specialists, in particular Nicholas Carlile (Threatened Fauna Ecology Unit), who has spent significant time on John Gould and Boondelbah Nature Reserves conducting Gould's Petrel research;
- Jamie Tarrant of the Worimi community.

Cover photograph of Gould's Petrel by Nicholas Carlile.

For additional information or inquiries about this reserve or this plan of management, contact the NPWS Hunter Coast Area Office, 12b Teramby Road Nelson Bay, or by telephone on 49848200.

ISBN 978 1 74232 802 7

DECCW 2010/495

FOREWORD

John Gould Nature Reserve and Boondelbah Nature Reserve are islands located offshore from Port Stephens, within the Port Stephens - Great Lakes Marine Park. The islands cover 36 hectares in total.

Cabbage Tree Island was gazetted in 1954 as John Gould Faunal Reserve. It was the first faunal reserve in NSW and was established specifically to protect the breeding site of the endangered Gould's Petrel. Boondelbah Nature Reserve was gazetted in 1960. It is currently the site of a translocation project involving Gould's Petrel, to assist in securing their population.

The nature reserves also provide habitat for other threatened species and migratory birds protected under international treaties, protect an area of endangered littoral rainforest, and have Aboriginal heritage values.

The New South Wales *National Parks and Wildlife Act 1974* requires that a plan of management be prepared for each nature reserve. A plan of management is a legal document that outlines how an area will be managed in the years ahead.

A draft plan of management for John Gould Nature Reserve and Boondelbah Nature Reserve was placed on public exhibition from 28th November 2008 until 23rd March 2009. The submissions received were carefully considered before adopting this plan.

The plan contains a number of actions to achieve the State Plan priority to "Protect our native vegetation, biodiversity, land, rivers and coastal waterways", including implementing the recovery plan for Gould's Petrel, control of weeds such as prickly pear and bitou bush, and encouragement of continuing research and monitoring.

This plan of management establishes the scheme of operations for John Gould Nature Reserve and Boondelbah Nature Reserve. In accordance with Section 73B of the *National Parks and Wildlife Act 1974*, this plan of management is hereby adopted.

Frank Sartor MP
Minister for Climate Change and the Environment

1. JOHN GOULD NATURE RESERVE AND BOONDELBAH NATURE RESERVE

John Gould Nature Reserve encompasses Cabbage Tree Island, named after its distinctive cabbage tree palms *Livistona australis*. It is located 1.4 kilometres offshore from Port Stephens and covers an area of 26.3 hectares. The island measures approximately 1000 metres (1 kilometre) in length and 480 metres in width, and rises abruptly to an elevation of 123 metres above sea level. The longest axis is aligned north-south.

Cabbage Tree Island was gazetted in 1954 as John Gould Faunal Reserve. It was the first faunal reserve in NSW and was established specifically to protect the breeding site of the endangered Gould's Petrel, *Pterodroma leucoptera leucoptera.* Both the Gould's Petrel and John Gould Nature Reserve are named after the famous English naturalist who first described the Gould's Petrel from a specimen sent to him in London. Under the *National Parks and Wildlife Act 1967,* all faunal reserves became nature reserves.

Boondelbah Nature Reserve is an island situated 1.4 kilometres south of Cabbage Tree Island and is shaped in the form of a mesa, with steep cliffs falling away from a broad flat plain. The island covers 9.3 hectares, and is 650 metres in length and 425 metres in width.

Boondelbah Island was gazetted as a fauna reserve in January 1960. Boondelbah Nature Reserve is important secondary habitat for the Gould's Petrel. It is currently the site of a translocation project involving Gould's Petrel, to assist in securing their population.

Both islands are located within the Port Stephens – Great Lakes Marine Park. Under the Marine Park zoning, the waters to the north, east and south of Cabbage Tree Island are a Sanctuary Zone, while the protected western side of the island is classed as a Habitat Protection Zone (fishing for bait only). The waters surrounding Boondelbah Island also fall within the Habitat Protection Zone. Detailed information on the Marine Park is available from the Marine Parks Authority.

John Gould and Boondelbah Nature Reserves are prominent off-shore islands located within the boundaries of the Worimi Nation, and can be seen from the townships of Hawks Nest to the north and Fingal Bay to the south of Port Stephens. The islands are two of seven located along the coast from Port Stephens to Seal Rocks. This section of coastline consists of long sandy beaches between isolated rocky headlands.

It is thought that about ten thousand years ago Cabbage Tree Island, Boondelbah Island and the nearby Little Island were hills on a wide coastal plain through which the Karuah and Myall Rivers meandered toward the distant coastline. At the end of the last ice age the sea levels rose and flooded the coastal plain and the wide river valleys. This isolated the seaward rocky outcrops from the mainland, creating the present-day islands (Carlile 1999).

2. MANAGEMENT CONTEXT

2.1 Legislative and Policy Framework

The management of nature reserves in NSW is in the context of a legislative and policy framework, primarily the *National Parks and Wildlife Act 1974* (NPW Act), the NPW Regulation, the *Threatened Species Conservation Act 1995* (TSC Act) and the policies of the National Parks and Wildlife Service (NPWS). The policies are based on the legislative background and internationally accepted principles of park management. They relate to nature conservation, Aboriginal and historic heritage conservation, recreation, commercial use, research and communication.

Other legislation, international agreements and charters may also apply to management of the area. In particular, the *Environmental Planning and Assessment Act 1979* (EPA Act) requires the assessment and mitigation of the environmental impacts of any works proposed in this plan. The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) also applies in relation to actions that may impact on migratory species and threatened species listed under that Act.

A plan of management is a statutory document under the NPW Act. Once the Minister has adopted a plan, no operations may be undertaken within John Gould and Boondelbah Nature Reserves except in accordance with the plan. The plan will also apply to any future additions to the nature reserves. If management strategies or works are proposed for the reserves that are not consistent with the plan, an amendment to the plan will be required.

2.2 Management Purposes and Principles

2.2.1 Nature Reserves

Nature reserves are reserved under the NPW Act to protect and conserve areas containing outstanding, unique or representative ecosystems, species, communities or natural phenomena.

Under the Act (section 30J), nature reserves are managed to:

- conserve biodiversity, maintain ecosystem functions, and protect geological and geomorphological features and natural phenomena;
- conserve places, objects, features and landscapes of cultural value;
- promote public appreciation, enjoyment and understanding of the reserve's natural and cultural values; and
- provide for appropriate research and monitoring.

Nature reserves differ from national parks in that as a management principle they do not provide for visitor use.

2.2.2 CAMBA and JAMBA

The NPWS has obligations relating to the management of the reserves under international agreements ratified by the Australian Government. These agreements are:

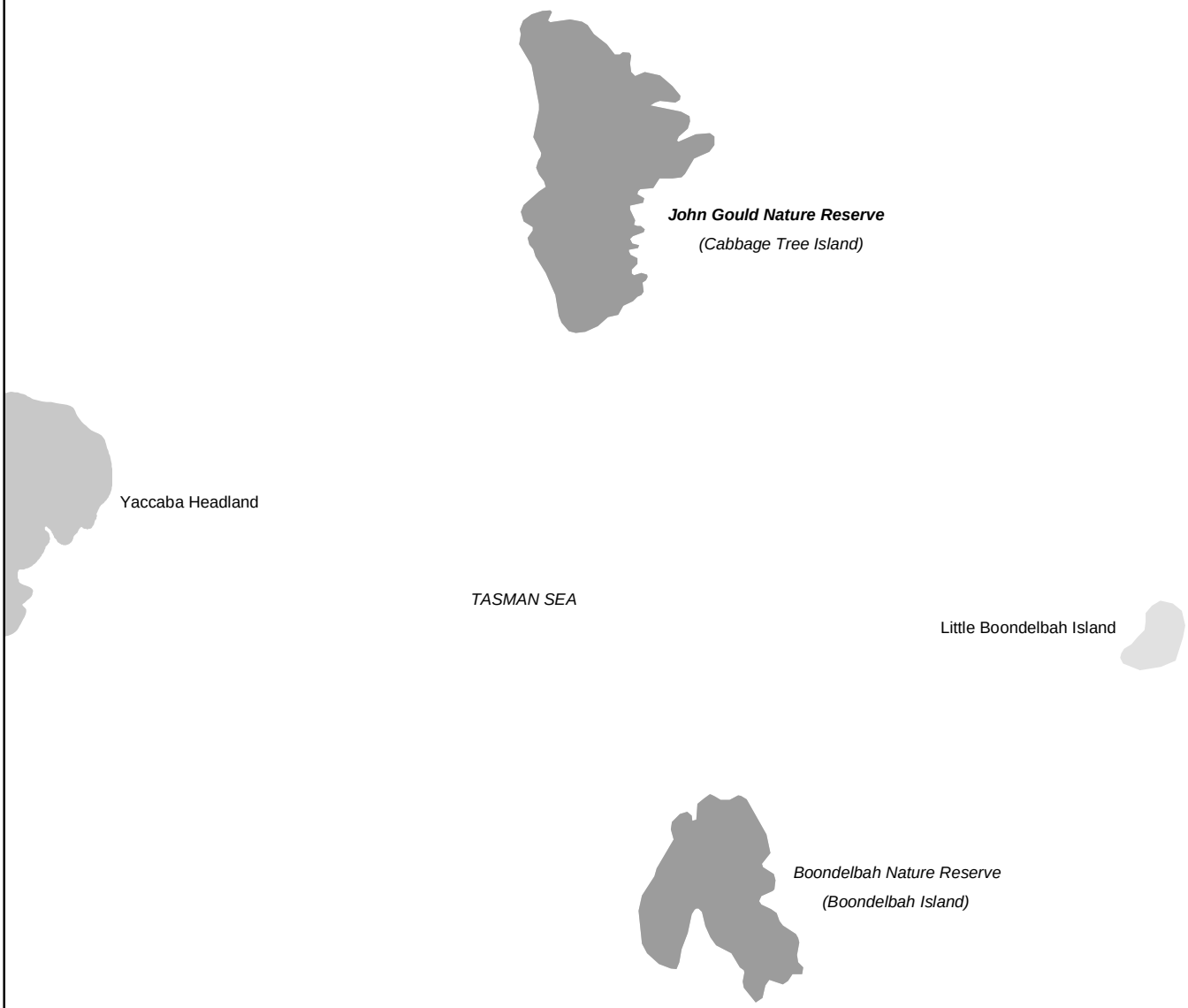
- The Agreement between the Government of Australia and the Government of Japan for the Protection of Migratory Birds and Birds in Danger of Extinction and their Environment (JAMBA); and
- The Agreement between the Peoples Republic of China and the Government of Australia for the Protection of Migratory Birds and their Environment (CAMBA).

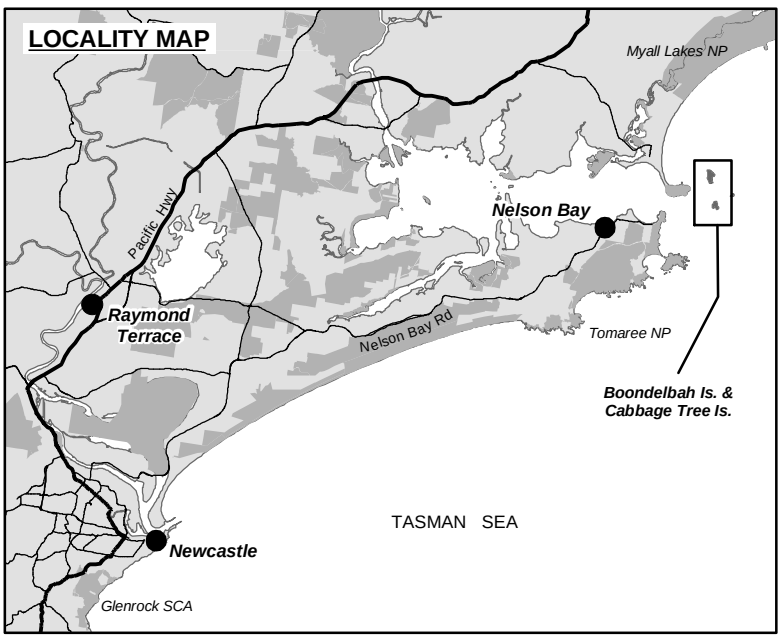
These agreements list a number of species that frequent John Gould and Boondelbah Nature Reserves (refer to 3.3 Native Fauna).

2.3 Management Directions

John Gould and Boondelbah Nature Reserves will be managed to achieve the following:

- Protection and recovery of the endangered Gould's Petrel and its breeding habitat, in order to sustain a viable breeding population of the species;
- Protection of habitat for other threatened species and for migratory bird species covered by the CAMBA and JAMBA agreements;
- Protection of the endangered Littoral Rainforest on John Gould Nature Reserve; and
- Recognition and protection of Aboriginal heritage values in cooperation with the local Aboriginal community.





Map 1

John Gould NatureReserve & Boondelbah Island Nature Reserve

Legend

Nature Reserve

N
W E
S

0 50 100 200 300 400 500
Metres

3. VALUES OF THE RESERVE

The location, landforms and plant and animal communities of an area have determined how it has been used and valued. Both Aboriginal and non-Aboriginal people place values of natural areas, including social, spiritual, recreational and aesthetic values. These values may be attached to the landscape as a whole or to individual components, for example to plant and animal species used by Aboriginal people. This plan of management aims to conserve both natural and cultural values. For reasons of clarity and document usefulness, natural heritage, cultural heritage, threats and on-going use are dealt with individually, but their inter-relationships are recognised.

3.1 Landform, Geology and Soils

John Gould Nature Reserve is a remnant outcrop of granitic toscanite and basalt formed by tectonic activity around 65 million years ago. Basaltic dykes running east – west dissect the island (Fullagar 1976).

The eastern aspect of the island is very exposed and falls steeply to the sea. A pinnacle, Cathedral Rock, is located on the north-eastern side and there are some small rocky islets off the southern end and another to the north.

The western aspect is inclined at about 30 degrees, and contains two gullies composed of rock scree sparsely interspersed with patches of shallow loamy soil (Priddel *et al* 1995).

Boondelbah Nature Reserve consists of steep cliffs of granitic toscanite, elevating on all sides to 55 metres. These cliffs are highly fractured along vertical bedding planes and several basaltic dykes dissect the island. The main north-south dyke is heavily eroded at the southern end, forming a deep bay and a natural arch (Morris 1975).

Siliceous soils on the southern and eastern parts of Boondelbah Nature Reserve give way to more humic and waterlogged soils in seepage areas (Morris 1975).

There are no creeks or fresh water sources on the reserves.

Both reserves occur at the southern-most limit of the North Coast Bioregion. The North Coast Bioregion runs up the east coast of NSW from just north of Newcastle to just inside the Queensland border occupying 11.7% of NSW (NPWS 2003). It covers northern NSW from the shoreline to the Great Escarpment and is geologically one of the most diverse areas in NSW.

3.2 Native Plants

The vegetation on John Gould Nature Reserve is comprised mostly of sub-tropical rainforest. Other vegetation associations include mat-rush *Lomandra longifolia* tussock grasslands and heath land.

The two prominent gullies on the western side are dominated by Cabbage Tree Palm *Livistona australis*. John Gould Nature Reserve is the only forested offshore island in

NSW coastal waters (Floyd and Dodkin 1978). The Littoral Rainforest it supports is the most southerly offshore rainforest in Australia and is listed as an Endangered Ecological Community under the TSC Act.

More than 150 species of plants occur on the island; most are indigenous rainforest species, but a few introduced weeds are also present (Carlile 1999) (refer to 4. Threats to Reserve Values). A detailed flora species list for John Gould Nature Reserve has been compiled based on surveys in 1986-88 and 1992-93 (Carlile 1999).

The vegetation of Boondelbah Nature Reserve is dominated by Mat-rush *Lomandra longifolia* tussock grasslands in drier areas, while Knobby Club-rush *Isolepis nodosa* dominates waterlogged sites. Ridges are dominated by the Blue Flax Lily *Dianella caerulea*. Scattered, wind-sheared trees of Deciduous Fig *Ficus superba* var. *henneana*, Tuckeroo *Cupaniopsis anacardioides* and Soft Corkwood *Duboisia myoporoides* occur along ridges in the central valley and on the north and west cliff faces (Carlile 1999).

No threatened plant species have been recorded within John Gould or Boondelbah Nature Reserves.

3.3 Native Fauna

More than 100 bird species have been recorded on and around John Gould and Boondelbah Nature Reserves, many of which are listed under the TSC Act, the EPBC Act, JAMBA and CAMBA (see table below).

Table 1. Significant bird species recorded in John Gould and Boondelbah Nature Reserves

Common Name	Scientific Name	Legal Status
Gould's Petrel	*Pterodroma leucoptera leucoptera*	Endangered* [a]
Little Tern	*Sterna albifrons*	Endangered* [#] ^
Sooty Oystercatcher	*Haematopus fuliginosus*	Vulnerable*
Pied Oystercatcher	*Haematopus longirostis*	Vulnerable*
Wedge-tailed Shearwater	*Puffinus pacificus*	Migratory species ^
Sooty Shearwater	*Puffinus griseus*	Migratory species ^ [#]
Short-tailed Shearwater	*Puffinus tenuirostris*	Migratory species ^
Lesser Frigatebird	*Fregata ariel*	Migratory species ^ [#]
Eastern Reef Egret	*Egretta sacra*	Migratory species [#]
White-bellied Sea Eagle	*Haliaeetus leucogaster*	Migratory species [#]
Common Noddy	*Anous stolidus*	Migratory species ^ [#]
Fork-tailed Swift	*Apus pacificus*	Migratory species ^ [#]
Barking Owl	*Ninox connivens*	Vulnerable*
Powerful Owl	*Ninox strenua*	Vulnerable*
Rose-crowned Fruit dove	*Ptilinopus regina*	Vulnerable*

* Status under TSC Act, [a] species also listed as endangered under the EPBC Act, ^ migratory species listed under JAMBA, [#] migratory species listed under CAMBA.

The endangered seabird, Gould's Petrel, comes ashore only to breed, and generally does so only on John Gould Nature Reserve. In 1996, however, a few birds were discovered breeding on nearby Boondelbah Nature Reserve. Apart from these two islands, Gould's Petrels breed at no other locality in the world. When management commenced in 1992, there were less than 250 breeding pairs of Gould's Petrel nesting on Cabbage Tree Island. The 2006 and 2007 surveys indicated 1042 nesting pairs, with a total population estimate of 2500, however Gould's Petrel remains Australia's rarest endemic seabird.

The petrels are present on John Gould Nature Reserve between October and May of each year. The core breeding habitat for the petrel is contained within two hectares on John Gould Nature Reserve, in the western gullies, with additional nests located in areas fringing the gullies or in small rock screes around the periphery of the island. They come ashore in October to begin courtship and mating. Eggs are laid in November, and hatching takes place during late December and early January. Each pair lays only a single egg in a nest, hidden from view among rocks or under fallen palm leaves. If the egg is lost it is not replaced. Over 100 artificial nesting boxes have been erected in the breeding gullies to increase nesting sites and to replace existing nesting sites that may have collapsed. Adults with young return to the island every few days to feed their growing offspring. The young depart the island during late March to early May. It is not known where the adults or young go once they leave the island. Gould's Petrels are known to live for 30 years or more (Carlile pers. comm. 2006).

In 1996, several Gould's Petrel adults and chicks were found on Boondelbah Nature Reserve, identifying the island as an important secondary breeding site. In 1998, following a major research program, 100 breeding boxes were installed on Boondelbah Nature Reserve, and 100 chicks translocated from John Gould Nature Reserve in March 1999. Of these 100 chicks, 95% subsequently fledged and left the island in April. A further translocation of 100 chicks took place in 2000 with 100% fledging success. Up to date 14 translocated birds have returned to the Island to breed, attracting other adults with them. Further return of translocated birds to breed on Boondelbah Nature Reserve will ensure a viable population of petrels on both islands (Priddel *et al* 2006).

The ongoing future management of the Gould's Petrel population is now covered by the Gould's Petrel Recovery Plan (DEC 2006a). The Department of Environment, Climate Change and Water (DECCW) is responsible for managing the species and its habitat in accordance with the Recovery Plan**.** The Declaration of Critical Habitat for the Gould's Petrel (DEC 2006b) over Cabbage Tree Island also ensures that any development proposals will be rigorously assessed and will involve DECCW in the planning and decision making process. Due to the small size, rugged topography and lack of visitor infrastructure on the island, no development is proposed, but the declaration of critical habitat provides a strong legislative protection for the islands.

Cabbage Tree Island is also important habitat for a number of other breeding seabirds including the Little Penguin *Eudyptula minor* and Wedge-tailed Shearwater *Puffinus pacificus.* The Sooty Shearwater *Puffinus griseus* and Short tailed shearwater *Puffinus tenuirostris* have also been recorded, but in lower numbers. The breeding population of Little Penguins on John Gould and Boondelbah Nature Reserves is at the species' northern extent.

Boondelbah Nature Reserve forms important breeding habitat for Wedge-tailed Shearwaters *Puffinus pacificus,* White-faced Storm-petrels *Pelagodroma marina*, Sooty Shearwaters *Puffinus griseus* and Little Penguins *Eudyptula minor.* Sixteen species of land birds have also been observed on Boondelbah Nature Reserve.

Four species of reptiles have been recorded on John Gould Nature Reserve including the Golden-crowned Snake *Cacophis squamulosus*, a small dragon *Amphibolurus muricatus*, and two skinks *Saiphos equalis* and *Lampropholis guichenoti*. These constitute the only vertebrate ground fauna on the island. Marine turtles have been recorded adjacent to the island (Carlile 1999).

Three reptiles and one amphibian have been recorded on Boondelbah Nature Reserve including the Striped Skink *Ctenotus robustus*, Garden Skink *Lampropholis guichenoti*, a blind snake *Anomalopus swansoni* and Brown-striped Frog *Limnodynastes peronii.*

The threatened Grey-headed Flying Fox *Pteropus poliocephalus* visits Cabbage Tree Island to feed on fruiting trees and small insectivorous bats. Gould's Wattled Bat *Chalinobolis gouldii* and Little Bent-wing Bat *Miniopterus australis* have been recorded in the rainforest.

A range of marine mammals has been recorded in and around the islands. Fur seals (unconfirmed but most likely the threatened Australian Fur-seal *Arctocephalus pusillus*) have been observed hauled out on the northern end of the island. The Bottlenose Dolphin *Tursiops truncatus*, the Long-beaked Bottlenose Dolphin *Tursiops aduncus*, the threatened Humpback whale *Megaptera novaeangliae* and the threatened Dugong *Dugong dugon* have all been sighted in the surrounding waters.

No evidence of any mammal has been recorded on Boondelbah Nature Reserve**.**

The islands support a diverse array of invertebrate fauna, including countless species of insects and spiders, many of which have been collected but are yet to be formally identified.

3.4 Aboriginal Heritage

Aboriginal communities have an association and connection to the land. The land and water within a landscape are central to Aboriginal spirituality and contribute to Aboriginal identity. Aboriginal communities associate natural resources with the use and enjoyment of foods and medicines, caring for the land, passing on cultural knowledge and strengthening social bonds. Aboriginal heritage and connection to nature are inseparable from each other and need to be managed in an integrated manner across the landscape.

The Aboriginal people living in the Port Stephens area prior to European settlement were members of the Worimi tribe. Worimi people still live in the local area today.

The Worimi people were the first to make use of the islands, probably even before they were severed from the mainland. The Worimi were capable users of watercraft and built canoes from bark stripped from local trees. The island provided the Worimi people

with an abundance of food, including rainforest fruits, seeds, tubers, bird eggs, muttonbirds (shearwaters), shellfish, and seals.

Two campsites with associated shell midden, grinding stones and tool-making objects remain as evidence of past Aboriginal occupation of Cabbage Tree Island, and suggest that that the processing of plant resources may have been a significant activity. Pieces of chert, a sedimentary rock not naturally occurring on the island, were most likely carried or traded from as far south as Merewether near Newcastle for tool making purposes. The sites are adequately protected in their natural state, requiring no site conservation management actions.

The Worimi community has suggested that further survey work is required to investigate the extent of the midden and artefacts at each of the campsites.

3.5 Historic Heritage

The first recorded European visit to Cabbage Tree Island occurred about 1840. During this visit a few of the petrels on the island were collected and sent to the eminent 19th Century naturalist, John Gould, who was living in London at the time. Gould reported that

> *"It* [*Gould's Petrel, then called the White-winged Petrel*] *breeds in great numbers on Cabbage-tree Island, at the mouth of Port Stephen's Harbour, New South Wales, and is very abundant in all parts of the ocean between that locality and New Zealand."* (Priddel *et al*. 1995).

European rabbits were released onto Cabbage Tree Island in 1906 as part of a series of experiments being conducted on nearby Broughton Island. The aim of this research was to find a biological control for rabbits. The release on John Gould Nature Reserve was to determine whether rabbits infected with a pox virus would survive. To the detriment of the island's flora and fauna, the infected rabbits did survive and their presence over a ninety-year period has altered the island's vegetation by removing the understorey layer and stopping regeneration of many plants.

Early in 1943, Cabbage Tree Island was used for war-time target practice by the military, to test the feasibility of using artillery guns from amphibious landing craft. The test failed and the concept was aborted. Ornithologists were also quick to alert the Minister for the Army of the ecological importance of the island and, in response, an order was given to cease any further tests in this area. Craters caused by the missiles are still discernible in the most northerly of the two large, palm-lined gullies. In 1997 a small fragment of shell casing approximately 100 millimetres in length was discovered between the north and south gullies on Cabbage Tree Island. In 2000 another larger piece (200 millimetres) was found on Boondelbah Island indicating that it too may have been used for target practice, though no written or oral history supports this (Carlile pers. comm. 2006)

In 1946 the Royal Australasian Ornithological Union (RAOU - now Birds Australia) changed the common name of the White-winged Petrel to Gould's Petrel because the original name was considered confusing as several similar species also had white wings.

A stainless steel replica of Captain James Cook's sextant, mounted on a brass plate with extract from Cook's log book on the day he discovered Port Stephens, was erected on Boondelbah Nature Reserve on the 200 year anniversary in 1970. The statue was unveiled by Athel D'Ombrain, an amateur naturalist who had a 50 year association with researching the petrels on John Gould Nature Reserve (Newcastle University 2004) (see 3.7 Research and Monitoring).

3.6 Education and Recreation

3.6.1 Recreation

John Gould and Boondelbah Nature Reserves occur in the high tourism area of Port Stephens. The waters surrounding the islands are regularly used by divers, recreational and commercial fishers, and recreational and commercial tour vessels. Both islands have steep rocky shores making human access difficult. The hazardous terrain, the difficulties associated with providing safe access and the desire to protect nesting seabirds all combine to limit the recreational potential of the island. No visitor facilities are provided on the reserves, and no public access is permitted.

Recreational opportunities exist nearby at Tomaree and Myall Lakes National Park, including Broughton Island.

3.6.2 Education

Substantial media interest has been generated by the recovery effort for the Gould's Petrel on John Gould and Boondelbah Nature Reserves. Newspaper articles, radio interviews, TV segments and public seminars relating to the petrels have been conducted on a regular basis since 1998. Following this media interest, there has also been an interest in the Gould's Petrel from the local community and local schools. Continued media opportunities are essential to raise awareness of the conservation significance of the Nature Reserves in relation to the petrels, other significant flora and fauna, and cultural heritage.

Information about the Gould's Petrel has been supplied to dolphin and whale watching tour boats operating in and around Port Stephens and the islands, which is used in tour commentaries and publications.

3.7 Research and Monitoring

In the 1930s a local game fisherman and amateur naturalist, Athel D'Ombrain began to take an active interest in the Gould's Petrel. He continued to have a 50-year association in researching the petrel on John Gould Nature Reserve. His initial activities concentrated on determining where the petrels bred and nested, and later he was responsible for the banding program of Gould's Petrels.

D'Ombrain continued his visits and banding activities up until the late 1960s. By this time the CSIRO Wildlife Division in Canberra had become interested in the Gould's Petrel and had commenced regular visits to the island. Peter Fullagar from the CSIRO

was the first person to attempt a census of the species. He estimated that the total number of adults was about 2000. He also determined that the breeding success of the birds was probably less than 40%. That is, from all the eggs laid each year less than 40% produced young fledglings.

In 1989, the NPWS commissioned the CSIRO to carry out a full scientific survey of the petrel to determine its conservation status. The findings were great cause for concern. Fewer than 300 pairs were incubating eggs and only one quarter of these eggs produced young. Surveys repeated in each of the subsequent two years found the same level of breeding success, but fewer birds breeding. Evidence from banding returns indicated that the population had declined by more than 20% during the past two decades (Davey 1990), and if this trend continued then the Gould's Petrel would likely be pushed to the brink of extinction sometime within the next few decades. The causes of the species' demise were unknown.

In 1992, the NPWS initiated a research program to identify the causes responsible for reproductive failure. The factors responsible for the decline of the petrel were soon determined to be entanglement with the sticky fruit from the Bird-lime Tree *Pisonia umbellifera* and predation by Pied Currawongs *Strepera graculina* and Australian Ravens *Corvus coronoides* (see 4.2 Pest Plants and 4.3 Pest Animals).

Between March and October 1997 the NPWS undertook a rabbit eradication program on John Gould Nature Reserve as part of the Gould's Petrel program. Changes in the vegetation of the island were evident within months of the rabbits being removed. Intensive monitoring of the vegetation continued over the next few years to follow the process of regeneration of the rainforest.

In the mid 1990s the NPWS found several Gould's Petrel nesting on Boondelbah Nature Reserve which allowed for the proposal to translocate more Gould's Petrel from John Gould Nature Reserve.

In 1999, the first of two translocations of Gould's Petrel young was made between John Gould Nature Reserve and Boondelbah Nature Reserve over a two year period. The process involved moving near fledged young birds from their natural nest sites on John Gould Nature Reserve to artificial nest boxes set up in a steep ravine on Boondelbah Nature Reserve. When the young birds finally leave their land base for the open sea, they associate their home with the latter island and return in due course to breed there rather at the site where they hatched. This management action will help bolster the small colony on Boondelbah Nature Reserve. In the event of a disaster befalling the John Gould Nature Reserve site the Boondelbah Nature Reserve colony will act as insurance for the species continual survival into the future. With the close proximity of the mainland to John Gould Nature Reserve, having a second colony breeding independently of the main site makes for sound management of this rare bird.

Volunteers have made a valuable contribution to the recovery program over the years. Volunteers will continue to be invited to participate in the recovery effort.

4. THREATS TO RESERVE VALUES

4.1 Soil Erosion

On John Gould Nature Reserve, researchers use two tracks to access the south and north gullies where the Gould's Petrels nest. In order to camouflage the tracks from view from the water to prevent public access and to reduce soil erosion, the tracks are left overgrown. Minor remediation works are required on the steep section of the track leading from the boat landing area to the south gully to prevent soil erosion.

4.2 Pest Plants

A number of formal and informal floristic surveys have been carried out on the two islands and these have identified a number of introduced weeds as being potentially troublesome. Most significant amongst these are Bitou Bush *Chrysanthemoides monilifera* and Prickly Pear *Opuntia stricta*.

Bitou Bush occurs in small patches over many parts of the John Gould Nature Reserve. In 1996/1997 a control program was undertaken on Bitou Bush. Aerial spraying trials were carried out in June 2006 with moderate success. Follow up spraying will be undertaken as conditions permit.

On John Gould Nature Reserve, Prickly Pear occurs on the island fringes, generally within the areas of Spiny-headed Mat-rush *Lomandra longifolia*. On Boondelbah Nature Reserve, dense stands of Prickly Pear occur across the island, including the northern ravine where it encroaches on the Gould's Petrel nest boxes. Prickly Pear has the potential to become a threat to this ecosystem, including to the animal species using it such as the Little Penguins that nest in the Spiny-headed Mat-rush.

To control the Prickly Pear periodic releases of the moth borer *Cactoblastis cactorum* have occurred on John Gould Nature Reserve and Boondelbah Nature Reserve on several occasions, but not since 1997. Control works, both chemical and bio-controls, will continue as conditions permit.

The native Bird-Lime Tree *Pisonia umbellifera* has been found to be one of the main factors responsible for the decline of the Gould's Petrel. Around the time that petrel chicks hatch, the Bird-lime Tree drops bundles of sticky fruit to the ground where they pose a threat to birds moving about the forest floor. The fruit is so sticky that a single fruit can cause a petrel's wing to become stuck to its body. Once incapacitated the bird slowly dies of starvation or falls prey to scavenging birds. Removal of Bird-Lime Tree from the nesting sites has significantly reduced chick mortality. Suppression of this tree in the nest sites will continue. An intact understorey will also reduce the negative effects of the Bird-lime Tree on nesting Gould's Petrels by preventing the sticky fruits finding their way to the forest floor.

4.3 Pest Animals

Rabbits *Oryctolagus cuniculus* were introduced onto Cabbage Tree Island in 1906 as part of research to find a biological control of rabbits.

Between March and October 1997 the NPWS undertook a rabbit eradication program on John Gould Nature Reserve as part of the Gould's Petrel program. The rugged terrain and the impenetrability of much of the island's vegetation made this task difficult. Rabbits were successfully eradicated from John Gould Nature Reserve by a procedure involving use of myxomatosis, rabbit calici virus and conventional poisoning. There are now no known feral animals remaining on the islands.

Presently there are no rats *Rattus rattus* on the islands, though if they were to colonise they would have a detrimental impact the island's ecology, especially ground nesting birds through the predation of eggs and chicks. The islands are too far from the mainland (over one kilometre) to have rats colonise on their own accord. However, rats could be inadvertently introduced to the islands from vessels anchoring nearby.

The most prevalent cause of Gould's Petrel mortality, however, was the attacking of nesting adults by Pied Currawongs and Australian Ravens. These native predators were systematically searching the forest floor for petrel chicks to feed their own chicks. The foraging activities of these predators within the colony also contributed to breeding failure by causing petrels on eggs to abandon their nests. The effectiveness of the predatory native birds was believed to be amplified by the change to the rainforest understorey caused by rabbits (Priddel *et al.* 2000).

Pied Currawongs and Australian Ravens are culled each year in September/October in accordance with the Gould's Petrel Recovery Plan (DEC 2006a). A small population is left to defend their territory from more currawongs and ravens moving in. This approach has been adopted in view of the serious risk posed by avian predators to the recovery of the Gould's Petrel and its relative conservation status. Control of avian predators will be undertaken as an interim measure until the understorey of the rainforest regenerates sufficiently to provide cover for the petrels.

4.4 Fire Management

Fire is a natural feature of many environments and is essential to the survival of some plant communities. However, inappropriate fire regimes can lead to loss of particular plant and animal species and communities, and high frequency fires have been listed as a key threatening process under the TSC Act.

The primary fire management objectives of the NPWS are to protect life, property and community assets from the adverse impacts of fire, whilst managing fire regimes to maintain and protect biodiversity and cultural heritage (NPWS 2005). The NPWS uses a zoning system for fire management which is compatible with the zoning used by the District Bushfire Management Committee (BFMC) in its bushfire risk management plan.

In regard to John Gould and Boondelbah Nature Reserves, Type 1 Reserve Fire Management Strategies have been prepared. The crucial point of both these strategies is that fire should be excluded from both reserves, including no prescribed burning.

There have been no recorded wildfires within either reserve. Fire scars are present on some Cabbage Tree Palms in John Gould Nature Reserve, however, it is likely that this fire may have been over one hundred years ago. The most likely source of ignition for fires on the reserve is from lightning strikes. Though possible, the risk is minimal and

would depend on a critical combination of fuel moisture content, strike location and prevailing weather conditions.

NPWS has assessed the reserves for fire management planning purposes and has zoned the reserves as a Land Management Zone. The reserves have been designated as Land Management Zones because they are not adjacent to built assets which would be exposed to a high level of bushfire risk and do not have a history of bushfire ignitions or known areas of high bushfire behaviour potential. Apart from the over-riding legislative objective of protecting life and property, the primary fire management objectives for a Land Management Zone are to conserve biodiversity and protect cultural heritage.

4.5 Aircraft disturbance

A Royal Australian Airforce (RAAF) Base is located 30 kilometres away at Williamtown. RAAF aircraft use airspace in the vicinity of John Gould and Boondelbah Nature Reserves for pilot training purposes. Noise from low flying RAAF jets over the islands cause Gould's Petrels to call from their nests. The calling alerts native avian predators to the petrels' location, making them vulnerable to predation.

The NPWS has a continuing relationship with the RAAF at Williamtown who adhere to a no fly zone around the islands during the breeding season, as specified in the Gould's Petrel Recovery Plan.

4.6 Unauthorised Public Access

Due to the ground nesting habit of the Gould's Petrel and other seabirds, unauthorised access may cause nests or birds to be unknowingly crushed or disturbed. Unauthorised access also has the potential to introduce weed and pest species to the island. To protect the conservation values of the reserves, public access is not permitted.

4.7 Climate Change

Climate change has been listed as a key threatening process under the TSC Act. Projections of future changes in climate for NSW include higher temperatures, increasing sea levels and water temperatures, elevated carbon dioxide, more intense but possibly reduced annual average rainfall, increased temperature extremes and higher evaporation. These changes are likely to lead to greater intensity, duration and frequency of fires, more severe droughts and increased regional flooding.

Climate change may significantly affect biodiversity by changing population size and distribution of species, modifying species composition, and altering the geographical extent of habitats and ecosystems. Species most at risk are those unable to migrate or adapt, particularly those with small population sizes or with slow growth rates. The potential impact of climate change is difficult to assess since it depends on the compounding effects of other pressures, particularly barriers to migration and pressure from weeds and feral animals. Programs to reduce pressures arising from such threats will help reduce the severity of the effects of climate change.

5. MANAGEMENT OPERATIONS

A permanent camp was erected in the southern gully on John Gould Nature Reserve in the early nineties to accommodate researchers on the island. The camp consists of an igloo shelter, water tank, solar panels and a kitchen area covered by a canvas tarp. The camp is to be maintained to the current state with no expansion permitted or proposed. Temporary camps were established on Boondelbah Nature Reserve during chick translocation, and may be permitted in the future depending on management requirements.

6. MANAGEMENT STRATEGIES AND ACTIONS

Current Situation	Desired Outcomes	Strategies	Priority
6.1 Native Plants			
Vegetation monitoring plots have been established in John Gould Nature Reserve (NR).	Ongoing vegetation monitoring to quantify Littoral Rainforest regeneration and structural diversity on John Gould NR.	6.1.1 Prepare a vegetation monitoring plan for John Gould NR which will determine the methods and frequency of survey required to monitor forest understorey regeneration. 6.1.2 Maintain plot pegs on John Gould NR.	Medium Medium
6.2 Native Fauna			
The endangered Gould's Petrel breeds only on John Gould and Boondelbah NRs. The Gould's Petrel Recovery Plan and recovery actions are currently being implemented. The Recovery Plan identifies a desired outcome/target of having the Gould's Petrel population stabilised and downlisting of the subspecies from endangered to vulnerable by 2011.	A viable population of Gould's Petrel.	6.2.1 Implement actions regarding the Gould's Petrel consistent with the Gould's Petrel Recovery Plan (2006) and its subsequent reviews. 6.2.2 Undertake field surveys to monitor populations of Gould's Petrel as approved by the Recovery Team. 6.2.3 Maintain nest site tags that are part of an activity approved by the Recovery Team or other authorised research. Tags that are no longer required will be removed. 6.2.4 Nest boxes in John Gould NR that are approaching the end of their useful life will be removed and not replaced. In addition, existing nest boxes in John Gould NR that have not been visited by a Gould's Petrel within a five year period will be used to replace any boxes that fall into disrepair on Boondelbah NR.	High High High Medium

Current Situation	Desired Outcomes	Strategies	Priority
6.2 Native Fauna (continued)			
Gould's Petrel have been found on Boondelbah NR identifying the island as a secondary breeding site.	To establish and maintain a translocated second colony at Boondelbah NR.	6.2.5 The 100 nest boxes on Boondelbah NR will be maintained and replaced as required, in accordance with the Gould's Petrel Recovery Plan. They may be removed if a revised recovery plan determines they can be removed.	Medium
6.3 Aboriginal Heritage			
Two campsites, shell middens, grinding stones and tool making objects have been discovered on John Gould NR. These sites have been recorded in consultation with the Worimi Community. The Worimi Community has suggested that further survey work should be undertaken at each of the campsites.	Aboriginal heritage features and values are identified and protected. Aboriginal people are involved in management of the Aboriginal cultural values in the reserves.	6.3.1 The campsites and associated artefacts on John Gould NR are left in their natural state, with no site conservation management actions undertaken 6.3.2 Undertake further survey work to investigate the extent of the midden and artefacts at each of the campsites on John Gould NR, in association with the Worimi Community. 6.3.3 Consult and involve the Worimi Local Aboriginal Land Council and other relevant Aboriginal community groups in the management of the Aboriginal heritage of the reserves.	Low Medium Medium
6.4 Historic Heritage			
The reserves have a long association with scientific research, but little else is known about their non-Aboriginal history.	Understanding the cultural significance of the park is improved.	6.4.1 Record any new historic heritage place or objects that are discovered in the reserves.	Low

Current Situation	Desired Outcomes	Strategies	Priority
6.5 Education and Recreation			
Media opportunities have raised awareness of the conservation significance of John Gould NR and Boondelbah NR.	The broader community is made aware of the conservation values of the reserves.	6.5.1 Promote the work being undertaken on the reserves in print and electronic media in accordance with the Gould's Petrel Recovery Plan. 6.5.2 Dissemination of information in accordance with Gould's Petrel Recovery Plan.	Low Low
Public access is not permitted to protect nesting seabirds, and due to the hazardous terrain and difficulties associated with providing safe access.	No unauthorised access to the reserves.	6.5.3 Restrict access to both reserves. In accordance with the Gould's Petrel Recovery Plan, access will only be permitted for scientific and conservation management purposes.	High
6.6 Research and Monitoring			
Research and monitoring undertaken of the natural heritage values of the reserves is a significant resource to researchers with the potential to contribute to a range of new research questions.	Research and monitoring continues to make a significant contribution to conservation of the Gould's Petrel and is conducted in a sustainable manner. Involvement of volunteers in the recovery program.	6.6.1 Research and monitoring by tertiary educational institutions or government agencies that produce outcomes which assist conservation management will be encouraged. 6.6.2 Contribute to annual monitoring and collection of demographic and life history data in accordance with the Gould's Petrel Recovery Plan. 6.6.3 Continued participation in research by volunteers in accordance with Gould's Petrel Recovery Plan.	High High Medium

Current Situation	Desired Outcomes	Strategies	Priority
6.7 Soil Erosion			
On John Gould NR, access to the research sites is via two unformed tracks. Minor erosion is present on the track leading from the boat landing area to the south gully.	Continued use of the two tracks on John Gould NR, with minimal impact to the landscape / soil.	6.7.1 Maintain the two unformed tracks on John Gould NR to an 'unmarked route' standard. 6.7.2 Minor remediation works to the eroded section of the unformed track on John Gould NR leading from the boat landing area to the south gully. 6.7.5 No new tracks formed on both reserves.	Medium Low High
6.8 Pest Plants			
Weeds and native vegetation may cause access difficulties to Gould's Petrel next boxes on Boondelbah NR.	Gould's Petrel have clear access to nest box entrances.	6.8.1 Undertake weed control and native vegetation control on Boondelbah NR in the vicinity of the nest boxes, in accordance with the Gould's Petrel Recovery Plan.	High
Prickly Pear poses a threat to the grasslands of both reserves and causes access difficulties to Gould's Petrel nest boxes on Boondelbah NR.	The Prickly Pear infestation is reduced and does not impact on Gould's Petrel nesting habitat.	6.8.2 Targeted control of Prickly Pear on Boondelbah NR. 6.8.3 Periodic release of *Cactoblastis cactorum* or other bio-controls at both reserves.	High Medium
Bitou Bush occurs in small patches on both reserves. Emerging plants were hand removed and treated with herbicide on John Gould NR in 1996/97.	The Bitou Bush infestation is reduced and does not further impact on the native vegetation communities of the reserves.	6.8.4 Investigation into aerial spot spraying techniques. 6.8.5 Follow up treatment required of emerging plants in John Gould NR. 6.8.6 Aerial spraying of uniform patches of Bitou Bush on John Gould NR. 6.8.7 Introduction of biological controls.	Low Medium High Medium

Current Situation	Desired Outcomes	Strategies	Priority
6.8 Pest Plants (continued)			
Other introduced weeds may become established within the reserves.	No further pest species are allowed to establish within the reserves.	6.8.8 Monitor noxious and significant environmental weeds. Treat any new outbreaks.	High
Pisonia plants are a threat to the Gould's Petrel population.	Threats to Gould's Petrel population from *Pisonia* plants are managed**.**	6.8.9 Annual removal of *Pisonia* seedlings in accordance with the Gould's Petrel Recovery Plan**.**	High
6.9 Pest Animals			
Rabbits have been successfully eradicated from John Gould NR, following introduction for scientific experimental purposes in 1906.	Permanent exclusion of rabbits to ensure regeneration of native vegetation communities.	6.9.1 Introduction of rabbits is not permitted. Treat any new outbreaks that may occur.	High
Other animal pests may become established within the reserves.	No further pest species are allowed to establish within the reserve.	6.9.2 Monitor the presence of animal pests. Treat any new outbreaks. 6.9.3 A set of guidelines will be developed to minimise the risk of transporting undesirable biological agents in vessels and equipment.	High High
Avian predators are a threat to the Gould's Petrel population.	Threats to Gould's Petrel population from avian predators are managed.	6.9.4 Control Pied Currawongs and Australian Ravens in accordance with the Gould's Petrel Recovery Plan. 6.9.5 Assessment and control of other avian predators in accordance with the Gould's Petrel Recovery Plan.	High High
6.10 Fire Management			
The reserves have a very low fire frequency regime and the current level of biodiversity is dependent on this exclusion of fire.	No net loss of biodiversity or habitat because of inappropriate fire regime.	6.10.1 No fires are permitted within the reserves for any reason. 6.10.2 Suppress all fires in the reserve as soon as possible.	High High

Current Situation	Desired Outcomes	Strategies	Priority
6.11 Aircraft disturbance			
There is a no fly zone around the islands during the breeding season as noise from jet aircraft may impact on the Gould's Petrel.	Continuation of the no fly zone around the islands encouraged.	6.11.1 Continue relationship with the RAAF at Williamtown who adhere to a no fly zone around the islands.	Medium
6.12 Unauthorised public access			
Unauthorised public access could pose a threat to the Gould's Petrel and other seabirds, and has potential to introduce weeds and pests.	Unauthorised public access is discouraged.	6.12.1 Restrict access to both reserves. In accordance with the Gould's Petrel Recovery Plan access will only be permitted for scientific and conservation purposes. 6.12.2 Install advisory signs on both reserves in accordance with the Gould's Petrel Recovery Plan.	High High
6.13 Climate Change			
Climate change has been listed as a key threatening process under the TSC Act.	Management programs increase the ability of natural systems to cope with climate change.	6.13.1 Continue existing fire, pest and weed management programs to increase the ability of native flora and fauna to cope with future disturbances, including climate change.	Medium

Current Situation	Desired Outcomes	Strategies	Priority
6.14 Management Operations			
One permanent campsite is located within John Gould NR for research and management purposes. Temporary camps were established on Boondelbah NR during translocation project.	Management facilities adequately serve management needs and have acceptable environmental impacts. No new campsites are to be established on John Gould NR.	6.14.1 Maintenance of existing lockup igloo facility and covered kitchen area on John Gould NR to be retained for management purposes 6.14.2 A limit of 8 people camping overnight for research or management purposes within John Gould NR will apply. 6.14.4 Camping required for management or research operations on Boondelbah NR will be assessed on a case by case basis by the Hunter Coast Area Manager, as to the location of the temporary campsite. No permanent or semi-permanent structures will be built to enable camping.	High High High

High priority activities are those imperative to achievement of the objectives and desired outcomes. They must be undertaken in the near future to avoid significant deterioration in natural, cultural or management resources.

Medium priority activities are those that are necessary to achieve the objectives and desired outcomes but are not urgent.

Low priority activities are desirable to achieve management objectives and desired outcomes but can wait until resources become available.

7. REFERENCES

Carlile, N. (1999) Concise History of Cabbage Tree Island and its Wildlife, Unpublished report, NPWS.

Davey, C. (1990) A report on the numbers and distribution of Gould's Petrel *Pterodroma leucoptera* breeding on the John Gould Nature Reserve, New South Wales. Report prepared for NSW National Parks and Wildlife Service. CSIRO Division of Wildlife and Ecology, Canberra. Pp. 1-19.

Department of Environment and Conservation (DEC) (NSW) (2006a). *Gould's Petrel (Pterodroma leucoptera leucoptera) Recovery Plan.* Department of Environment and Conservation (NSW), Hurstville, NSW.

Department of Environment and Conservation (DEC) (NSW) (2006b). Declaration of critical habitat for *Gould's Petrel (Pterodroma leucoptera leucoptera)* (Pursuant to sections 44 and 47 of the *Threatened Species Conservation Act 1995*). Department of Environment and Conservation (NSW), Hurstville, NSW.

Floyd, A and Dodkin, M (1978) Rainforest Report, John Gould Nature Reserve, Unpublished report, NSW NPWS.

Fullagar, P. J. (1976) Seabird Islands No. 35/1, Cabbage Tree Island, New South Wales. In The Australian Bird Bander Vol. 14, No. 4.

Morris, A. K., (1975) Seabird Islands No. 22, Cabbage Tree Island, New South Wales. In The Australian Bird Bander Vol. 14, No. 1.

Newcastle University (2004), Athel D'Ombrain Photograph catalogue and collection. Newcastle University.

NPWS (2003). *The Bioregions of New South Wales: their biodiversity, conservation and history*. NSW National Parks and Wildlife Service, Hurstville.

NPWS (2005). *Fire Management Manual.* NSW National Parks and Wildlife Service, Hurstville.

Priddel, D., Carlile, N., Davey, C. and Fullagar, P. J. (1995) The status of Gould's Petrel, Pterodroma leucoptera leucoptera, on Cabbage Tree Island, New South Wales. *Wildlife Research* 22: 601-10.

Priddel, D. Carlile, N. and Wheeler R. (2000) Rehabilitation of the breeding grounds of the Gould's petrel *Pterodroma leucoptera leucoptera* by eradication of the European rabbit *Oryctolagus cuniculus* from Cabbage Tree Island, New South Wales Australia. *Biological Conservation* 94: 115-125.

Priddel D Carlile, N Wheeler, R (2006) Establishment of a new breeding colony of Gould's petrel *Pterodroma leucoptera leucoptera* through the creation of artificial nesting habitat and the translocation of nestlings. *Biological Conservation* 128: 553-563.

Priddel, D Carlile, N (2007) Population size and breeding success of Gould's petrel *Pterodroma leucoptera leucoptera* on Cabbage Tree Island, New South Wales 1996-97 to 2005-06 Unpublished report.