

**BRUNDEE SWAMP NATURE RESERVE AND  
SALTWATER SWAMP NATURE RESERVE**

**PLAN OF MANAGEMENT**

**NSW National Parks and Wildlife Service**

**Part of the Department of Environment and Climate Change**

**July 2008**

**This plan of management was adopted by the Minister for Climate Change and the Environment on 21<sup>st</sup> July 2008.**

### **Acknowledgements**

This Plan of Management is based on a draft plan prepared by staff of the South Coast Region of the National Parks and Wildlife Service.

Valuable information and comments were provided by Department specialists, the South Coast Region Advisory Committee and other community members.

Cover photograph of a green and golden bell frog.

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For additional information or enquiries on these reserves or this plan, please contact the NPWS South Coast Region Office at 55 Graham Street Nowra or by phone on (02) 4423 2170.

## FOREWORD

Brundee Swamp and Saltwater Swamp Nature Reserves are located on the south coast of New South Wales, within the Shoalhaven Local Government Area. Brundee Swamp Nature Reserve is approximately six kilometres southeast of Nowra and covers an area of 230 hectares. The area of wetland known as Brundee Swamp extends beyond the boundaries of the reserve, particularly to the north. Saltwater Swamp Nature Reserve is approximately nine kilometres southeast of Nowra and covers an area of 215 hectares. Saltwater Swamp also extends beyond the boundaries of the reserve. At their closest point, the reserves are 600 metres apart.

Although the ecology of both reserves has been modified by drainage works and other disturbances, they contain wetland vegetation communities that are listed under the Threatened Species Conservation Act and retain high fauna habitat values. Thirty-two bird species have been observed within the reserves, including eleven waterbirds. The endangered green and golden bell frog has also been recorded, and the reserves are likely to play an important role in the conservation of this species because of their natural vegetation cover.

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 Brundee Swamp and Saltwater Swamp Nature Reserves was placed on public exhibition from 10<sup>th</sup> February until 15<sup>th</sup> May 2006. The submissions received were carefully considered before adopting this plan.

This plan contains a number of actions to achieve “Better environmental outcomes for native vegetation, biodiversity, land, rivers, and coastal waterways” (Priority E4 in the State Plan) including working with other authorities to maintain natural tidal flows and flood regimes, research into the impacts of wetland vegetation changes on habitat values, control of introduced plants and animals, and fire management strategies and fire frequency guidelines.

This plan of management establishes the scheme of operations for Brundee Swamp and Saltwater Swamp Nature Reserves. In accordance with section 73B of the *National Parks and Wildlife Act 1974*, this plan of management is hereby adopted.

**Verity Firth**  
**Minister for Climate Change and the Environment**

## 1. NATURE RESERVES IN NEW SOUTH WALES

### 1.1 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 matters to be considered in the preparation of a plan of management are listed in Section 72AA of the NPW Act. NPWS policies relate to nature conservation, cultural heritage conservation, recreation, commercial use, research and information provision.

Other legislation, agreements and charters may also apply to management of the area. In particular, the *Environmental Planning and Assessment Act 1979* (EPA Act) requires assessment and mitigation of the environmental impacts of any works proposed in this plan.

The plan of management is a statutory document under the NPW Act. Once the Minister has adopted a plan, the plan must be carried out and no operations may be undertaken within Brundee Swamp Nature Reserve and Saltwater Swamp Nature Reserve except in accordance with the plan. The plan will also apply to any future additions to the two nature reserves. Should management strategies or works be proposed in the future that are not consistent with the plan, an amendment to the plan will be required.

#### **Regional Forest Agreements**

Brundee Swamp and Saltwater Swamp Nature Reserves are covered by the Southern Regional Forest Agreement. Regional Forest Agreements (RFAs) are one of the principle means of implementing the National Forest Policy Statement of 1992. Under this Statement, Commonwealth, State and Territory governments agreed to work towards a shared vision for Australia's forests. Joint comprehensive regional assessments were undertaken of the natural, cultural, economic and social values of forests. The assessments formed the basis for negotiation of RFAs providing for, amongst other things, ecologically sustainable forest management.

### 1.2 MANAGEMENT PURPOSES AND PRINCIPLES

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, nature reserves are managed to:

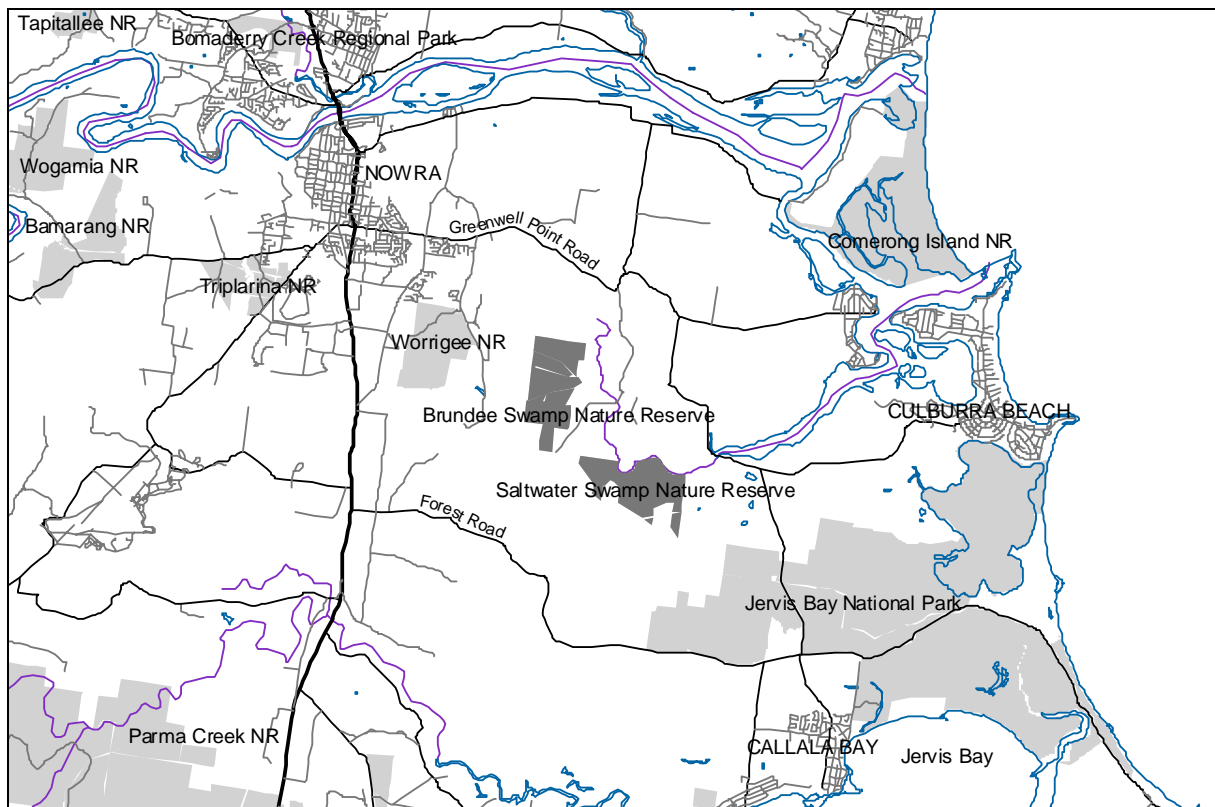
- conserve biodiversity, maintain ecosystem function, protect geological and geomorphological features and natural phenomena;
- conserve places, objects, features and landscapes of cultural value;
- promote public appreciation, enjoyment and understanding of the nature reserve's natural and cultural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

## 2. BRUNDEE SWAMP AND SALTWATER SWAMP NATURE RESERVES

### 2.1 LOCATION, GAZETAL AND REGIONAL SETTING

Brundee Swamp and Saltwater Swamp Nature Reserves are located on the south coast of New South Wales, within the Shoalhaven Local Government Area. Both reserves were formerly Crown land and became nature reserves under the management of the NPWS in January 2001 as a result of the Southern Forest Agreement. Together with Wogamia, Bamarang, Triplarina, Worrigeer, Woollamia, Parma Creek and Comerong Island Nature Reserves, they are part of a group of conservation reserves in the Nowra area, south of the Shoalhaven River.

Brundee Swamp Nature Reserve is approximately six kilometres southeast of Nowra and covers an area of 230 hectares. The area of wetland known as Brundee Swamp extends beyond the boundaries of the reserve, particularly to the north. Saltwater Swamp Nature Reserve is approximately nine kilometres southeast of Nowra and covers an area of 215 hectares. Saltwater Swamp also extends beyond the boundaries of the reserve. At their closest point, the reserves are 600 metres apart.



Location

Both reserves are surrounded by freehold land, with the exception of part of the southern boundary of Saltwater Swamp Nature Reserve, which lies adjacent to Currumbene State Forest.

The planning area includes two roads through Saltwater Swamp Nature Reserve that are vested in the Minister for the Environment on behalf of the Crown under Part 11 of the NPW Act. These roads do not currently form part of the gazetted area of the

reserve. They were created by the *National Park Estate (Southern Region Reservations) Act 2000* (NPE Act) to ensure that essential access arrangements which existed immediately before the reserve's creation could continue. The NPE Act provides that these roads must be either added to or excluded from the reserve.

## **2.2 NATURAL AND CULTURAL HERITAGE**

### **Landform, Geology and Soils**

The two reserves are primarily low lying wetland areas situated on the upper reaches of the Crookhaven River floodplain. A considerable proportion of Brundee Swamp Nature Reserve lies below sea level at an elevation of –1 to 0 metres. Only very narrow areas on the eastern and western boundaries are above flood level. Most of Saltwater Swamp Nature Reserve lies at an elevation of 0 to 0.5 metres above sea level with the exception of the southern edge which is raised above the floodplain and rises to a height of 50 metres above sea level in the south eastern corner.

The reserves are within the southern part of the Sydney Basin. Both areas lie primarily on Quaternary alluvium, silt and clay. The geology of the western and eastern edges of Brundee Swamp Nature Reserve consists of Berry siltstone and Nowra sandstone respectively while the southern section of Saltwater Swamp Nature Reserve is on Wandrawandian Siltstone.

Soils in both reserves reflect the geology, with alluvial soils and gleyed podzolic soils on the floodplain and yellow and red podzolic soils on the elevated southern section of Saltwater Swamp Nature Reserve (CALM 1993). The floodplain soils (both on and off the reserves) are identified as having a high probability of containing acid sulfate soil materials within the soil profile (DLWC 1997) which, when exposed to oxygen, can lead to the formation of sulfuric acid. Dalmazzo and Laing (1998) suggest that acid sulfate soils may have been exposed in Brundee Swamp through soil excavation and through lowering of the water table as a result of flood mitigation works. Acid sulfate soils may have also been exposed in Saltwater Swamp through lowering of the watertable.

### **Hydrology**

The hydrology of both Brundee and Saltwater Swamps has been heavily modified since early European settlement. Water from Brundee Swamp would previously have flowed into the Crookhaven River and then into Saltwater Swamp. Brundee Swamp now drains to both the Crookhaven River and to Crookhaven Creek while Saltwater Swamp drains to the river.

A number of drains have been cut across Brundee Swamp by individual landholders and drainage trusts for agricultural and flood mitigation purposes (Dalmazzo and Laing 1998). A large drain crosses the north eastern section of the nature reserve and joins a channel that flows into the Crookhaven River. This drain carries water from the northern part of the swamp which is outside the reserve. There are also smaller drains running across the reserve from west to east and a drain along the eastern boundary. A bank built across the river at Springbank Road partially diverts drainage from Brundee Swamp into Crookhaven Creek.

The swamps were formerly tidal but the construction of downstream tidal barriers now prevents tidal flooding. Floodgates on the Brundee Swamp drainage channel at its connection with Crookhaven Creek prevent tidal water entering the channel and Brundee Swamp. Further downstream, floodgates have also been constructed on the Crookhaven River at its junction with Crookhaven Creek, preventing tidal water flowing into Saltwater Swamp (Dalmazzo and Laing 1998).

The primary water source for the wetlands is now freshwater from local runoff and both swamps are intermittently flooded. The frequency and duration of flooding are not known but are likely to vary considerably. Brundee Swamp, being lower, is wet more often than Saltwater Swamp. During large floods, the tidal gates are overtopped, allowing some saline water into the wetland systems. The presence of saltmarsh elements (see below) indicates that there is still some saline influence, although this may be residual.

Natural channels cross the wetlands of both reserves, and Saltwater Swamp Nature Reserve appears to have a number of oxbows from former creek lines.

### **Native Vegetation**

The majority of both reserves is covered by freshwater wetland communities, with the community type largely determined by the degree of flooding. The communities are:

- reedland, consisting of common reed (*Phragmites australis*) in the most frequently inundated areas;
- sedgeland/herbland, dominated by sea rush (*Juncus kraussii*) with some saltmarsh elements, in low lying but less frequently inundated areas,
- paperbark shrubland, dominated by swamp paperbark (*Melaleuca ericifolia*), in low lying but slightly higher areas; and
- swamp oak forest, dominated by swamp oak (*Casuarina glauca*), in higher areas that are less frequently inundated than the other communities. Prickly-leaved paperbark (*Melaleuca styphelioides*) occurs as a co-dominant with the swamp oak in some areas.

Most of Brundee Swamp Nature Reserve is sedgeland/herbland, with patches of paperbark shrubland and small areas of swamp oak forest along the edges. The current mix of vegetation has been influenced by flood management works and grazing prior to dedication of the reserve. Since cattle have been removed there has been considerable growth of young swamp paperbark and swamp oak across the sedgeland, although recent drought is also likely to have had an influence. It is possible that shrub and tree species will become significantly more prevalent in areas that are currently sedgeland/herbland, with implications for waterbird habitat, as discussed below.

Saltwater Swamp Nature Reserve is covered primarily by swamp oak forest, in varying densities. There are small areas of paperbark shrubland along drainage lines, sedgeland/herbland at the western end and reedland along the Crookhaven River.

The wetland vegetation communities fall within two endangered ecological communities listed under the Threatened Species Conservation Act. These are Coastal Saltmarsh and Swamp Oak Floodplain Forest (includes areas of reedland, sedgeland/herbland and paperbark shrubland). Saltwater Swamp Nature Reserve contains a significant area of Swamp Oak Floodplain Forest.

There is a thin strip of coastal sand swamp forest along the southern edges of the wetland vegetation in both reserves. This community is dominated by swamp mahogany (*Eucalyptus robusta*) and corresponds with the endangered ecological community Swamp Sclerophyll Forest on Coastal Floodplains. It has a diverse understorey and grass/fern/herb ground cover.

Dry open forest occurs on elevated terrain along the southern edge of Saltwater Swamp Nature Reserve. It is a medium forest containing a mixture of several tree species including spotted gum (*Corymbia maculata*), white stringybark (*E. globoidea*), woollybutt (*E. longifolia*) grey gum (*E. punctata*) and black she-oak (*Allocasuarina littoralis*). The community has a sparse shrubby understorey and a grassy ground cover.

A moist spotted gum forest occurs on high ground on the northwestern edge of Brundee Swamp Nature Reserve. This community has a diverse understorey including blackthorn (*Bursaria spinosa*) and *Notelaea longifolia*, with a soft grass ground cover.

### **Native Animals**

The ecology of both reserves has been modified by drainage works and other disturbances but they retain high fauna habitat values. Thirty-two bird species have been observed within the reserves including eleven waterbirds, such as the clamorous reed-warbler (*Acrocephalus stentoreus*), little pied cormorant (*Phalacrocorax melanoleucos*) and white-faced heron (*Egretta novaehollandiae*). It is likely that many other waterbirds use the wetlands when conditions are suitable. The black swan (*Cygnus atratus*) breeds in the Crookhaven River adjacent to Saltwater Swamp Nature Reserve. Other animals recorded are the swamp wallaby (*Wallabia bicolor*), seven amphibians including Bibron's toadlet (*Pseudophryne bibronii*) and the bleating tree frog (*Litoria dentata*), and three reptile species, the eastern snake-necked turtle (*Chelodina longicollis*), eastern blue-tongued lizard (*Tiliqua scincoides*) and red-bellied black snake (*Pseudechis porphyriacus*).

Two species listed under the Threatened Species Conservation Act have been recorded within Brundee Swamp Nature Reserve; the endangered green and golden bell frog (*Litoria aurea*) and the vulnerable Australasian bittern (*Botaurus poiciloptilus*). Both species may also occur within Saltwater Swamp Nature Reserve. The draft recovery plan for the green and golden bell frog (Department of Environment and Conservation, 2005) has identified the Crookhaven River floodplain as one of the most significant areas for the species in NSW. The reserves are likely to play an important role in its conservation because of their natural vegetation cover.

The vulnerable yellow-bellied glider (*Petaurus australis*) and glossy black-cockatoo (*Calyptorhynchus lathamii*) have been recorded in forest close to the southern edge of Saltwater Swamp Nature Reserve and are likely to use the reserve.



The reserves have been modelled (NPWS 2001) as also having significant suitable habitat for the threatened regent honeyeater (*Xanthomyza phrygia*), swift parrot (*Lathamus discolor*), masked owl (*Tyto novaehollandiae*), giant burrowing frog (*Heleioporus australiacus*) and smoky mouse (*Pseudomys fumeus*), and for the regionally significant little red flying fox (*Pteropus scapulatus*). Saltwater Swamp Nature Reserve may also provide significant habitat for the greater broad-nosed bat (*Scoteanax rueppellii*) and sooty owl (*Tyto tenebricosa*).

The wetlands provide habitat for frogs and waterbirds, with large flocks of birds present following flooding. The most valuable areas for waterbirds and the endangered green and golden bell frog are the sedgeland/herbland and reedland, although patches of shrubs and trees are also useful and open water areas are extremely important for waterbirds. Any reduction in the frequency or duration of flooding, or expansion of swamp oak and swamp paperbark into the sedgeland/herbland, could detrimentally affect the reserve's habitat values for these species.

The wetland areas of both reserves extend beyond their boundaries and wetlands on neighbouring lands are important to the total ecosystem and the maintenance of waterbird and frog habitat. The reserves can not be managed in isolation from the rest of the sub-catchment. As wetland vegetation communities and fauna habitat are sensitive to changes in hydrological regimes, any changes to the drainage systems within or outside the reserves would be likely to impact on the ecology and habitat values of the reserves.

### **Aboriginal Heritage**

The reserves occur within the area of the Dharawal Aboriginal language group, although the Dhurga language was also common. There are no Aboriginal sites or places recorded within either reserve, however a number of sites are recorded in the general vicinity. These include open camp sites, middens, a rock shelter with an occupation deposit, axe grinding grooves and burial sites.

It is highly likely that both Brundee Swamp and Saltwater Swamp were traditionally important as food resources to Aboriginal people of the area. It is known that the area to the west and north west of Brundee Swamp Nature Reserve was used by the local Aboriginal community during the early 19<sup>th</sup> century. People came to the area to catch eels, turtles and fish, trap rabbits, pick blackberries and search for beehives and bush medicine. An area to the north of nearby Worrigea Nature Reserve was a camp used by local Aboriginal people (Waters 2005).

### **Historic Heritage**

As stated above, both Brundee and Saltwater Swamps have been heavily modified since early European settlement by construction of drains and tidal barriers, mostly off-reserve. The large drainage channel across the north east of Brundee Swamp Nature Reserve was dug to connect older drains to the Crookhaven River, probably in the late 1960s – early 70s (Dalmazzo and Laing, 1998) but the age of the smaller drains is not known. The drains may be of local historic interest.

Prior to its dedication as a nature reserve, permissive occupancies were granted to adjoining landowners for the purpose of grazing cattle in the area of Brundee Swamp Nature Reserve. Fences remain in the reserve from this activity but are in poor condition. It is likely that Saltwater Swamp Nature Reserve has received little agricultural use, although parts of the north western area may have been cleared or grazed.

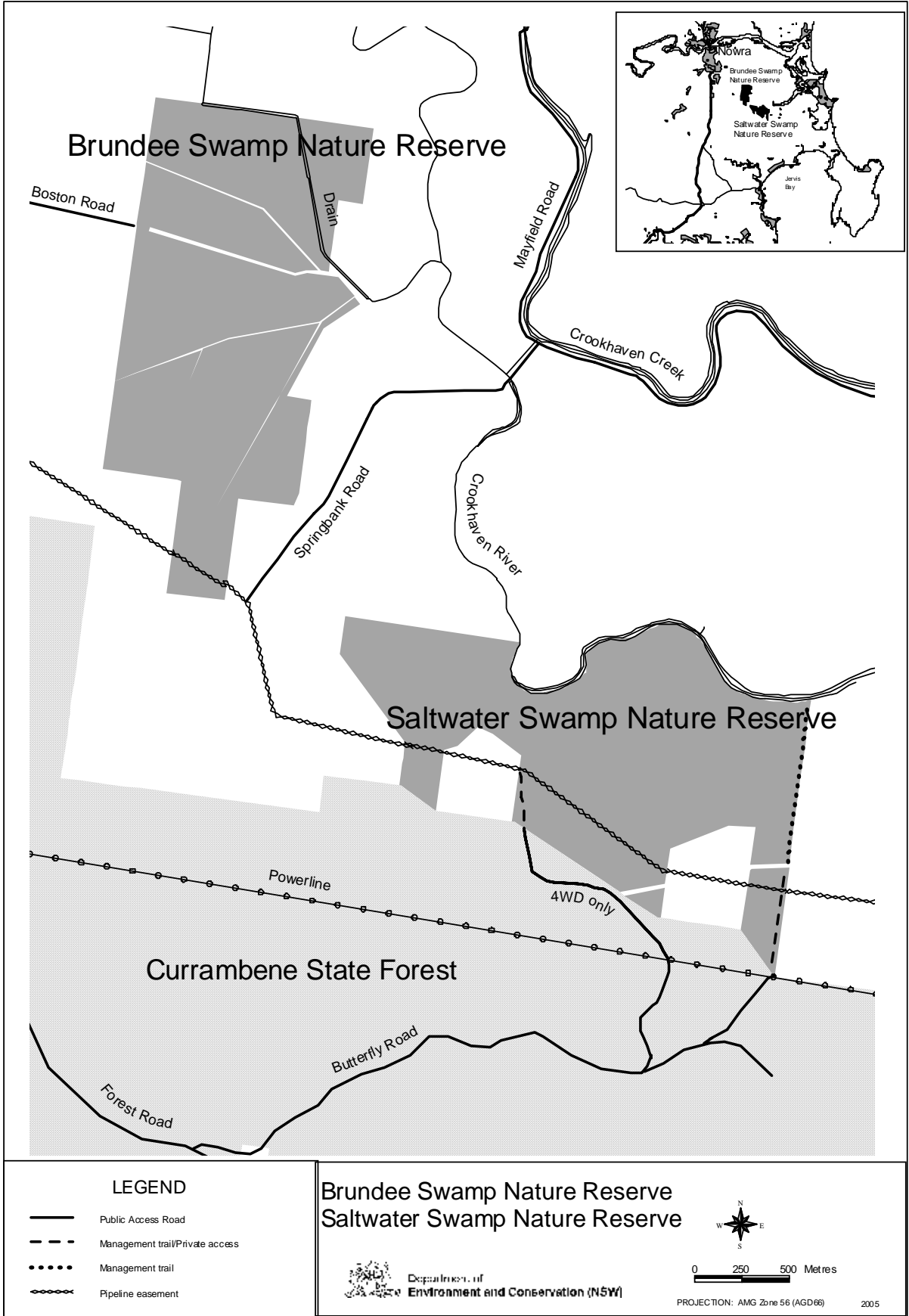
A disused tramway embankment crosses Saltwater Swamp Nature Reserve at its narrowest point, between the adjacent private property, known locally as Mill Hill, and the Crookhaven River. An early 1900s map and anecdotal evidence indicate that the tramway was built to transport timber to the Crookhaven River from a timber mill at the site during the late 19<sup>th</sup> century. It was probably taken by boat to markets in Sydney or elsewhere. No sleepers or rails remain and there are substantial trees growing on the embankment.

### **2.3 EXISTING CONDITION AND ISSUES**

While the reserves have been modified by drainage and grazing, both have healthy native vegetation communities and are in good condition overall, with only minor weed and pest animal incursions.

As discussed above, maintenance of the wetland vegetation communities and habitat values is dependent on adequate inundation and is influenced by drainage and flood management activities off-reserve. In addition, the small size of the reserves makes them vulnerable to edge effects such as incursion of weeds, predators and stock, and complicates fire management.

Management issues are considered in section 3 and include water management and water quality, weed control, fire management, visitor use, private property access and access for public purposes.



**Brundee Swamp Nature Reserve**

**Saltwater Swamp Nature Reserve**

**Currambene State Forest**

Boston Road

Drain

Springbank Road

Mayfield Road

Crookhaven Creek

Crookhaven River

Powerline

AWD only

Butterfly Road

Forest Road

**LEGEND**

- Public Access Road
- - - Management trail/Private access
- Management trail
- - - Pipeline easement

**Brundee Swamp Nature Reserve  
Saltwater Swamp Nature Reserve**



Department of  
**Environment and Conservation (NSW)**



0 250 500 Metres

PROJECTION: AMG Zone 56 (AGD66)

2005

### 3. MANAGEMENT ISSUES AND STRATEGIES

Current Situation	Desired Outcomes	Strategies	Priority
<p><b>Soil conservation</b></p> <p>The reserves are generally well vegetated and no significant erosion is occurring. Trail bike and 4WD activity in the eastern part of Saltwater Swamp NR, however, has resulted in the formation of an area of exposed soil, which could lead to sheet erosion.</p> <p>Any exposed acid sulfate soils in the floodplain could affect water quality in the reserves and surrounding waterways. Assessment is needed of the extent of the problem and the need for any remedial and preventative actions.</p>	<p>Soil erosion is minimised.</p> <p>Exposure of acid sulfate soils is avoided.</p>	<p>Undertake all works in a manner that minimises erosion.</p> <p>Block access to the exposed area affected by vehicle use in Saltwater Swamp NR and undertake rehabilitation.</p> <p>Support mapping of exposed and potential acid sulfate soils within the reserves and adjacent floodplain areas by relevant authorities. Support or undertake any actions required to address or prevent exposure of acid sulfate soils, consistent with maintenance of the wetland ecosystems.</p>	<p>As required</p> <p>High</p> <p>High</p>
<p><b>Water management</b></p> <p>The health of the reserves' wetlands and their associated fauna populations depends on receipt of water of adequate quantity and quality. This is affected by flood management works across the floodplain system and could also be affected by construction of dams or water diversion works within the catchment. At present there is insufficient knowledge of the hydrology of the reserves and their water needs.</p> <p>A draft Natural Resource Management Plan for the Shoalhaven River Estuary has been developed by the Shoalhaven River Natural Resource and Floodplain Management Committee (Shoalhaven NRFMC). This plan includes the Crookhaven River and its catchment and contains actions for reducing the environmental impacts of floodplain infrastructure including possible increases in tidal inundation.</p>	<p>Flooding regime and water quality are adequate to maintain healthy wetland systems and fauna populations in the reserves.</p>	<p>Undertake research as needed to improve understanding of the hydrology of the reserves and the water requirements of the wetland systems.</p> <p>Work with Shoalhaven City Council, Shoalhaven River NRFMC, the Dept. Primary Industries and other authorities regarding water management infrastructure, with the aim of ensuring that tidal flows and flood water retention are managed to maintain or improve wetland habitat values and wildlife breeding events in the reserves.</p> <p>Investigate the function of the small drains running across Brundee Swamp NR. Seek to add the drainage reserves to the nature reserve if no longer needed.</p> <p>Undertake all works in a manner that minimises water pollution.</p> <p>Seek additional information where required on water quality</p>	<p>Medium</p> <p>High</p> <p>Medium</p> <p>Medium</p>

<p>The small drains running across Brundee Swamp NR primarily drain the reserve and may no longer be needed. Crown reserves for the purpose of drainage are located over the drains.</p> <p>Water quality monitoring by Shoalhaven City Council in Crookhaven Creek shows relatively high faecal coliform and low dissolved oxygen levels. This is likely to be a result of poor flushing combined with runoff from adjacent rural residential and agricultural land. The relatively low water quality in the creek could indicate impacts in the reserves.</p>		<p>within the reserves and liaise with neighbours and relevant authorities to maintain or improve water quality in the catchments.</p>	
<p><b>Native plant and animal conservation</b></p> <p>The reserves conserve wetland vegetation that is listed under the TSC Act and provide habitat for threatened fauna species. A vegetation survey has been carried out in the reserves (DEC 2006) but there is limited knowledge of the animal species present.</p> <p>Under the TSC Act, strategies for promoting the recovery of threatened species and endangered ecological communities have been set out in a state-wide Species Priorities Action Statement (PAS). Individual recovery plans may also be prepared to consider management needs in more detail. The PAS and a draft recovery plan for the green and golden bell frog recommend a number of actions including cooperative management and monitoring across neighbouring tenures for key populations. A management plan is currently being prepared for the Crookhaven Floodplain population.</p> <p>As discussed in section 2.2 the current growth of trees and shrubs in Brundee Swamp NR may lead to loss of saltmarsh and sedgeland and reduced habitat value for waterbirds. An increase in tidal</p>	<p>All native plant and animal species and communities are conserved.</p> <p>Significant vegetation communities are protected.</p> <p>Habitat for threatened species is maintained/restored.</p>	<p>Undertake fauna survey, particularly for threatened species. Support any proposals by the Department of Primary Industries to undertaken survey for aquatic species in the reserves.</p> <p>Monitor wetland vegetation changes and research the likely impacts on habitat values. Develop a vegetation management strategy if warranted that aims to conserve a mosaic of wetland communities and maintain waterbird habitat.</p> <p>Implement priority conservation measures for threatened species and endangered ecological communities set out in the Priorities Action Statement and any relevant recovery plans and population management plans prepared.</p> <p>Work with neighbours, Shoalhaven City Council and the Southern Rivers Catchment Management Authority to encourage conservation of remnant native vegetation in the vicinity of the reserves through establishment of voluntary conservation agreements or similar mechanisms.</p>	<p>Medium</p> <p>Medium</p> <p>As required</p> <p>Medium</p>

<p>inundation associated with proposed changes to flood management infrastructure could reverse this process and assist in habitat maintenance, but would need to avoid adverse changes to the current areas of swamp oak forest. It may be necessary to control tree and shrub growth through other means including occasional burning.</p> <p>Conservation of native vegetation on neighbouring land is important to the long term viability of plant and animal communities within the reserves.</p>			
<p><b>Cultural heritage</b></p> <p>It is likely that the reserves were important food resources for Aboriginal communities in the past, although the probability of archaeological sites occurring is relatively low since most of the area is wetland.</p> <p>The significance of the disused tramway across Saltwater Swamp Nature Reserve is not known but it is likely to be of at least local historic value.</p> <p>The drainage channels and fences across Brundee Swamp Nature Reserve may be of local heritage interest. The fences may, however, impede wildlife movement.</p>	<p>Cultural features are conserved and managed in accordance with their significance.</p>	<p>Undertake an archaeological survey and cultural assessment prior to all works with the potential to impact on Aboriginal and historic sites and places.</p> <p>Manage any Aboriginal sites found in consultation with relevant Aboriginal community organisations and individuals.</p> <p>Record the location of drains and fences. Record the tramway embankment through Saltwater Swamp Nature Reserve and any associated features.</p> <p>Remove wire from internal fences but retain posts and strainers.</p>	<p>As required</p> <p>As required</p> <p>Low</p> <p>Medium</p>
<p><b>Introduced species</b></p> <p>Weeds are mostly in low numbers in the reserves and the majority are short lived pasture and disturbance opportunists such as spear thistle (<i>Cirsium vulgare</i>), fleabane (<i>Conyza bonariensis</i>) and inkweed (<i>Phytolacca octandra</i>). Weeds of concern are lantana (<i>Lantana camara</i>), Jerusalem cherry (<i>Solanum pseudocapsicum</i>), bitou bush (<i>Chrysanthemoides monilifera</i>), moth vine (<i>Auraujia sericifera</i>), wild aster (<i>Aster subulatus</i>),</p>	<p>The impact of introduced species on native species and neighbouring lands is minimised.</p>	<p>Monitor the presence, extent and abundance of introduced species. If necessary develop programs for control and eradication.</p> <p>Control infestations of weeds of concern, with the aim of eradicating them from the reserves where possible.</p> <p>Control pigs when present. Control foxes if necessary to protect populations of threatened species such as breeding waterbirds.</p>	<p>Medium</p> <p>High</p> <p>High</p>

<p>kikuyu (<i>Pennisetum clandestinum</i>), fireweed (<i>Senecio madagascariensis</i>), Noogoora burr (<i>Xanthium occidentale</i>) and pampas grass (<i>Cortaderia selloana</i>) because of their ability to invade further areas. Aster, fireweed and Noogoora burr are relatively abundant in the northern areas of Brundee Swamp but the other species have limited distributions.</p> <p>Pest animals species observed or likely to occur in the reserves include rabbits, hares, feral pigs, feral dogs, feral cats, foxes, Indian mynas and mosquito fish. All are thought to be in low numbers. Mosquito fish, if present, could affect populations of the green and golden bell frog but their control is unlikely to be feasible. Proposals in the draft Shoalhaven River Estuary Natural Resource Management Plan to redesign flood management structures to improve fish passage could potentially increase the likelihood of mosquito fish in the reserves. Any control programs for foxes would need to be undertaken over a broad area to be successful and should be targeted to protection of threatened species.</p> <p>Cattle have been observed entering Brundee Swamp Nature Reserve from neighbouring properties.</p>		<p>Control introduced species in conjunction with Shoalhaven City Council, the Rural Lands Protection Board and neighbours where appropriate.</p> <p>Work with the Department of Natural Resources, Department of Primary Industries and Shoalhaven City Council to ensure that any changes to floodplain structures that block fish passage avoid introducing or increasing populations of mosquito fish in the reserves.</p> <p>Work with neighbours to ensure fencing is of a suitable standard to prevent stock entering the reserves.</p>	<p>As required</p> <p>As required</p> <p>Medium</p>
<p><b>Fire management</b></p> <p>The fire history of the reserves is not well known. Traditionally, graziers have burnt coastal wetlands to promote fresh pasture growth but it is not known whether this was the case in Brundee Swamp. Wildfire burnt much of Brundee Swamp Nature Reserve in the summer of 1980-81 while parts of Saltwater Swamp Nature Reserve burnt in 1951, 1981-82 and 1991.</p> <p>The wetland communities are vulnerable to high</p>	<p>Bushfire mitigation measures contribute to the cooperative protection of persons and property on or immediately adjacent to the reserves.</p> <p>Fire regimes are</p>	<p>Contain any wildfires within the reserves as quickly as possible to control further spread and minimise area burned.</p> <p>Do not undertake hazard reduction burning in the wetland vegetation communities unless needed to maintain the sedgeland areas (see above). Any burning should be outside fauna breeding times.</p> <p>Use prescribed burns in the eucalypt forests if needed to</p>	<p>As required</p> <p>Ongoing</p> <p>High</p>

<p>fire frequency and to intense fire, particularly the swamp oak forest and paperbark shrubland, as is indicated by areas of dense swamp oak regrowth in Saltwater Swamp Nature Reserve. Reedland and sedgeland/herbland will recover from fire but frequent fire can damage the peat layer and convert reed and rush swamps into fresh meadows.</p> <p>Fire is a natural feature of the eucalypt forests within the reserves, but too frequent or regular fire, could cause loss of particular plant and animal species. Appropriate fire frequencies are set out in the Appendix.</p> <p>Fire risk is generally low in Brundee Swamp NR as it is largely surrounded by cleared land and is frequently flooded. It would, however be vulnerable during dry periods.</p> <p>Saltwater Swamp NR lies adjacent to Currumbene State Forest and is therefore more likely to be subject to fire. The private land holdings on the southern side of the reserve, and perimeter fencelines elsewhere, may need protective management where feasible.</p> <p>NPWS participates in local co-operative fire management arrangements as a member of the Shoalhaven Bush Fire Management Committee.</p>	<p>appropriate for conservation of plant and animal communities.</p>	<p>manage fuel loads and biodiversity requirements. Where appropriate, carry out fuel management in cooperation with neighbours for mutual protection.</p> <p>As far as possible use existing trails or features for containment of fires and avoid use of heavy machinery for fire suppression in wetlands. Also avoid any Aboriginal or historic sites found.</p> <p>Rehabilitate areas disturbed by fire suppression operations as soon as practical after a fire.</p> <p>Where practical and environmentally acceptable, establish and maintain a fuel reduced strip adjacent to perimeter fences in accordance with Rural Fire Service guidelines.</p> <p>Prepare operational maps for the reserves that set out life, property and natural and cultural resource protection strategies in accordance with the above.</p> <p>Maintain close contact and cooperation with neighbours, the Rural Fire Service, volunteer bush fire brigades and Forests NSW.</p> <p>Manage visitor activities to limit human caused bushfires within the reserves. This may require closing the reserves to public use during periods of extreme fire danger.</p> <p>Encourage research into the ecological effects of fire in the reserves, particularly the wetland communities.</p>	<p>As required</p> <p>As required</p> <p>Medium</p> <p>Medium</p> <p>High</p> <p>As required</p> <p>Low</p>
<p><b>Visitor use and information</b></p> <p>The reserves are small areas with significant wetland vegetation and fauna habitat, and are not appropriate for visitor use apart from bird watching and other nature study. Organised educational use would be appropriate if undertaken by small groups on foot.</p> <p>Because of the highly variable water depths and</p>	<p>Visitor use is appropriate and sustainable.</p> <p>The local community</p>	<p>Prohibit public vehicle access in both reserves, apart from access to private property on the southern side of Saltwater Swamp NR as outlined below. Erect signposting as needed.</p> <p>Permit walking access within the reserves for bird watching and nature study.</p> <p>Permit use for organised educational and research purposes.</p>	<p>High</p> <p>Ongoing</p> <p>As</p>



<p>bird populations the wetlands are not suitable for establishment of viewing facilities. Good views of Brundee Swamp Nature Reserve and its bird populations can, however, be obtained from the eastern end of Boston Road.</p>	<p>is aware of the significance of the reserves and of access limitations.</p>	<p>Access should be by foot unless approval is obtained for vehicle access where essential for a specific purpose.</p> <p>Prohibit camping, horse riding, cycling and campfires.</p> <p>Monitor visitor use and take action to ameliorate impacts where necessary.</p> <p>Undertake community information programs as needed to promote understanding of the reserves' nature conservation role and management programs being undertaken.</p>	<p>required</p> <p>High</p> <p>Low</p> <p>Medium</p>
<p><b>Private property and utility access</b></p> <p>Two roads through the southern section of Saltwater Swamp NR provide access to private property. These are the southern section of the eastern boundary road and a short road running off Snowwood Road, as shown on the map. Under the provisions of the NPE Act, access roads that form the only practical means of access to private property may continue to be used for that purpose.</p> <p>Crown road reserves cross both nature reserves and are excluded from their gazetted area. The road reserve across Brundee Swamp NR is unformed and not needed. There is a rough track along the road reserve across Saltwater Swamp NR but there is better formed alternative access.</p> <p>A water pipeline and associated vehicle trail, managed by Shoalhaven City Council, runs along the southern section of Saltwater Swamp NR and the southern tip of Brundee Swamp NR.</p> <p>Some of the agricultural drains across Brundee Swamp may need to be maintained from time to time, possibly requiring vehicle access. This is not a function that would normally be permissible in nature reserves and alternatives should first be considered.</p>	<p>Access to private property and services continues to be provided where appropriate.</p>	<p>Continue to permit private property access to the inholdings on the southern side of Saltwater Swamp Nature Reserve. Seek to include the access roads within the reserve and enter into agreements for continued access and future maintenance where appropriate.</p> <p>Seek addition of the Crown road reserves to the nature reserves once private access issues are resolved.</p> <p>Negotiate an access and maintenance agreement with Shoalhaven City Council for the water pipeline that ensures that the natural and cultural values of the reserves are not adversely affected.</p> <p>Prior to granting access consent for any proposed work on the drainage channels across Brundee Swamp NR, require investigation of the feasibility of relocating the drains outside the reserve. Any access permitted in the reserve must be undertaken in a manner that minimises damage to wetland vegetation.</p>	<p>High</p> <p>Low</p> <p>Medium</p> <p>As required</p>

<p><b>Research and monitoring</b></p> <p>Scientific study is important for improving understanding of the reserves' natural and cultural heritage, the processes that affect them and the requirements for management of particular species. Some specific research topics have been mentioned above but there will be other areas of research that could provide useful information.</p> <p>Under the Southern RFA all forest managers must demonstrate ecologically sustainable forest management (ESFM). ESFM is a management principle that is applied to all ecosystem types, not just forests. Monitoring will be conducted in the reserves as part of regional measurement of ESFM performance indicators, to provide feedback on management programs and directions for future adaptive management.</p>	<p>Research enhances the management information base and has minimal environmental impact.</p> <p>Monitoring shows the level of success in managing the reserves on an ecologically sustainable basis.</p>	<p>Undertake and encourage research to improve knowledge related to management of natural and cultural heritage.</p> <p>Use the principles of Ecologically Sustainable Forest Management to guide management operations.</p> <p>Undertake ESFM monitoring in accordance with regional programs.</p> <p>Encourage bird watchers and similar groups to pass on information gathered in the reserves.</p>	<p>Low</p> <p>Ongoing</p> <p>Medium</p> <p>Ongoing</p>
<p><b>NPWS management operations</b></p> <p>Vehicle trails through Saltwater Swamp NR provide NPWS management access as well as access for the water pipeline and to private properties. The eastern boundary trail is on low-lying land and should not be used when wet.</p> <p>There are no vehicle trails in Brundee Swamp NR.</p>	<p>Management facilities adequately serve management needs and have acceptable impact.</p>	<p>Maintain trails needed for management purposes, as identified on the plan of management map, to a suitable standard. Avoid use of the eastern boundary trail when wet.</p>	<p>High</p>

**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.

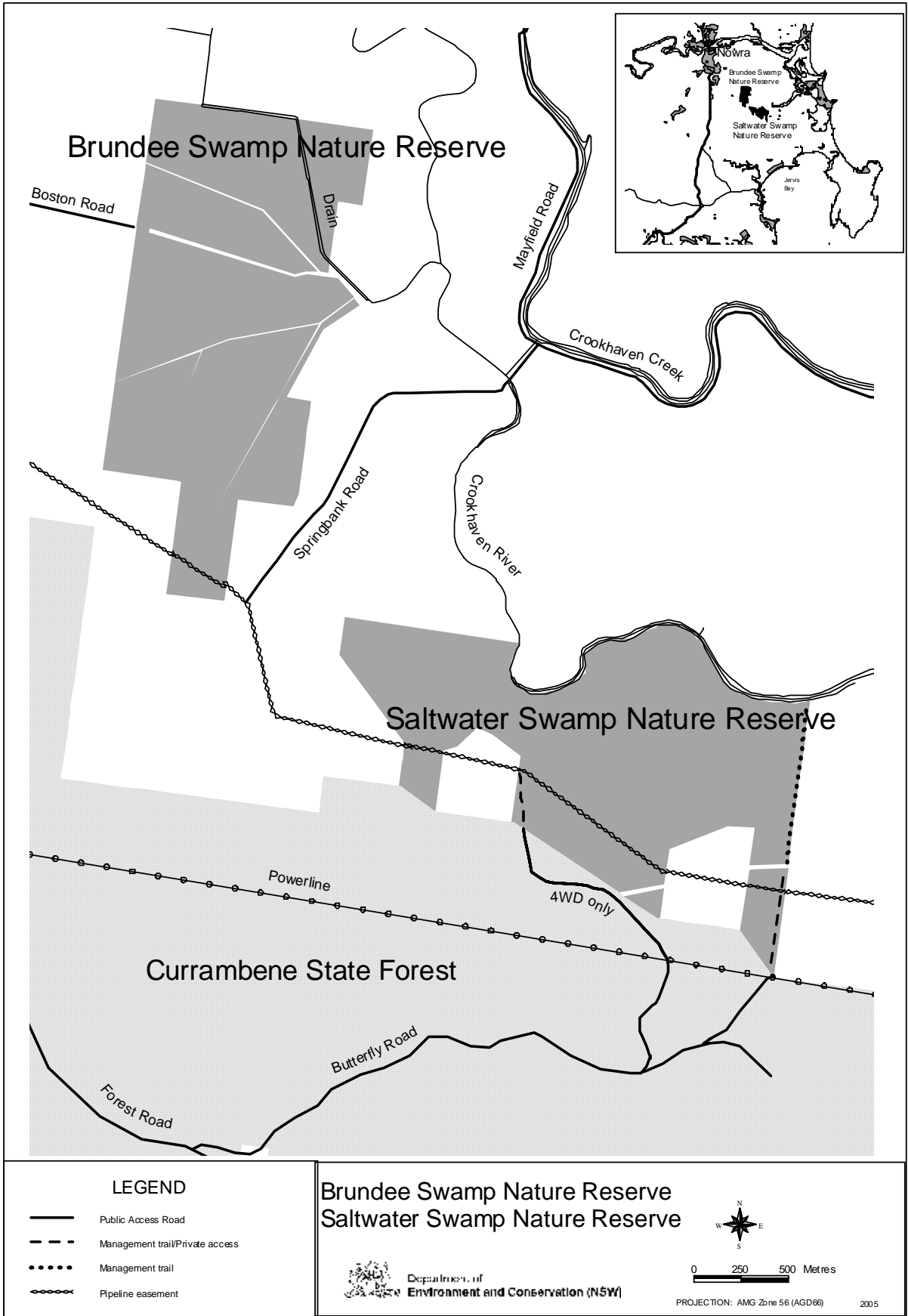
## APPENDIX – Fire frequency guidelines

The following table outlines fire regime guidelines for the vegetation types occurring in the reserves. It should be noted that the guidelines are subject to further research and judgement based on the particular species combinations.





Vegetation Type	Fire Regime
Swamp oak forest and paperbark shrubland	Fire between 7 and 35 years. A decline in biodiversity is predicted if successive fires occur less than 7 years apart, if there are no fires for more than 35 years or if fires occur at regular intervals.
Sedgeland/herbland and reedland	Fire should be excluded until fire effects have been researched.
Spotted gum forest and dry open mixed forest	Fire between 5 and 30 years. A decline in biodiversity is predicted if successive fires occur less than 5 years apart, if there are no fires for more than 30 years or if fires occur at regular intervals.

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**LEGEND**

-  Public Access Road
-  Management trail/Private access
-  Management trail
-  Pipeline easement

**Brundee Swamp Nature Reserve  
Saltwater Swamp Nature Reserve**



Department of  
**Environment and Conservation (NSW)**



0 250 500 Metres

PROJECTION: AMG Zone 56 (AGD66)

2005