PAMBALONG NATURE RESERVE

PLAN OF MANAGEMENT

National Parks and Wildlife Service

Part of the Department of Environment and Conservation (NSW)

May 2006

This plan of management was adopted by the Minister for the Environment on 2nd May 2006.

Acknowledgments

This plan of management is based on a draft prepared by Greg Giles and other staff of the Hunter Region of NPWS.

Valuable information and comments were provided by
- residents of the Minmi area
- members of community organisations, particularly the Hunter Bird Observers Club, National Parks Association and the Society of Frogs and Reptiles
- the specialist reports prepared on vegetation, bird fauna, and other fauna (see reference list for details)
- Angela Besant and Warren Mayers (Aboriginal sites and history)
- volunteers involved in the Richmond Vale Railway and cycleway
- members of the NPWS Regional Advisory Committee

Special thanks go to the NSW Roads and Traffic Authority who transferred the reserve to the NPWS and provided the resources to prepare and begin the implementation of this plan.

Further information
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FOREWORD

Pambalong Nature Reserve covers 34 hectares on the western side of the of the F3 freeway, approximately 20km north-west of Newcastle. The reserve was gazetted in December 2000 over former farmland acquired by the Roads and Traffic Authority during construction of the freeway.

Pambalong Nature Reserve provides critical habitat for wader and water bird species. The reserve is a freshwater wetland at the western edge of Hexham Swamp, and is an integral part of a chain of wetland reserves that includes the internationally significant Ramsar-listed Hunter Estuary Wetlands. Several threatened bird species visit the reserve, including the black-necked stork, magpie goose, freckled duck, painted snipe and comb-crested jacana. Migratory wader species listed under international treaties have also been recorded on the reserve.

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

A draft plan of management for Pambalong Nature Reserve was placed on public exhibition from 4 June until 20 September 2004. The exhibition of the draft plan attracted 50 submissions which raised 7 issues. All submissions received were carefully considered before adopting this plan.

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

Bob Debus
Minister for the Environment

CONTENTS

1. MANAGEMENT CONTEXT

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). Section 72AA of the NPW Act lists the matters to be considered in the preparation of a plan of management. The policies are compiled from 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 plan of management is a statutory document under the NPW Act. Once the Minister has adopted a plan, no operations may be undertaken within Pambalong Nature Reserve except in accordance with the plan. The plan will also apply to any future additions to Pambalong Nature Reserve. Where management strategies or works are proposed for the nature reserve or any additions that are not consistent with the plan, an amendment to the plan will be required.

1.2 MANAGEMENT PURPOSES AND PRINCIPLES

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, 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 they do not have as a management principle to provide for visitor use.

CAMBA and JAMBA

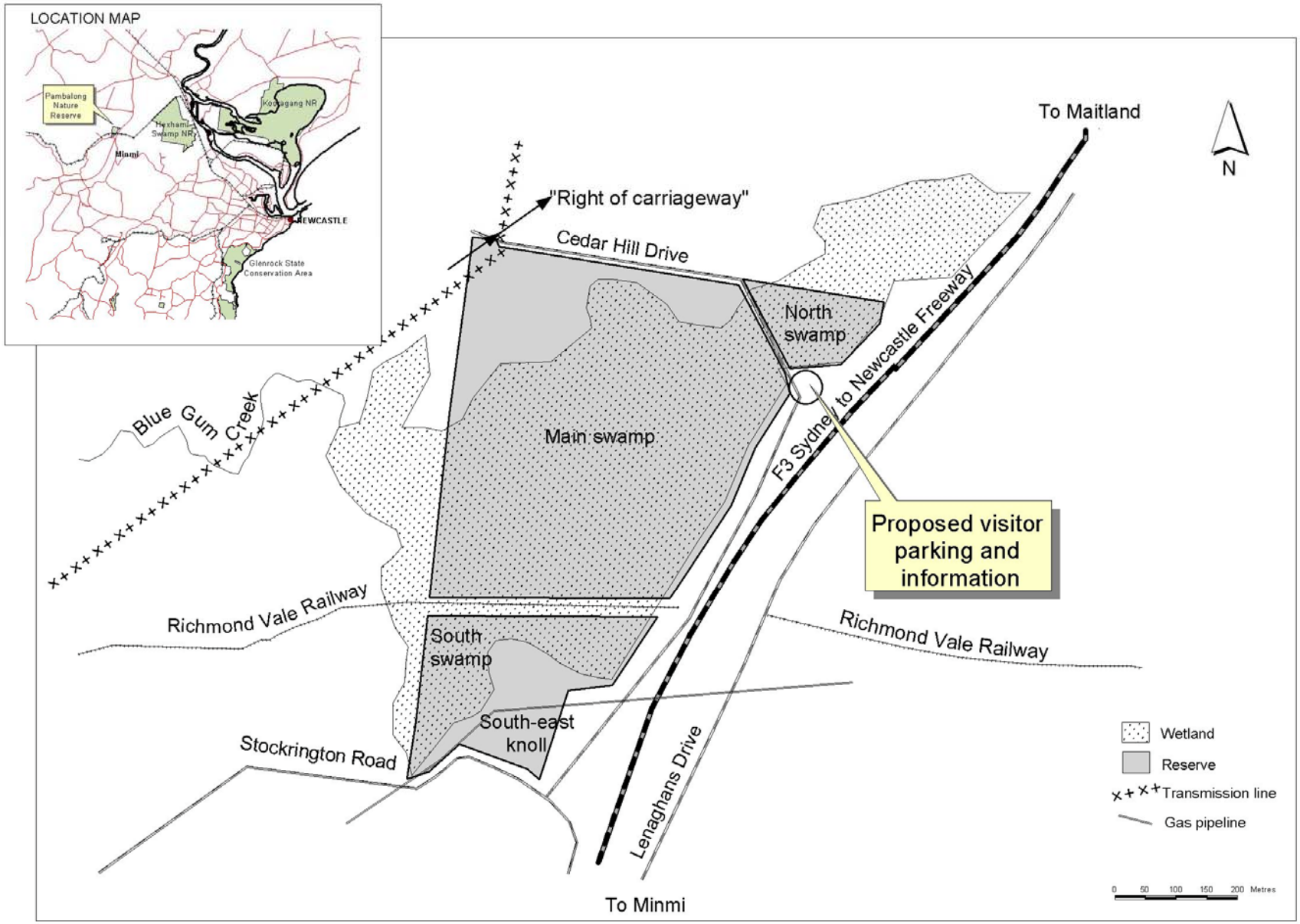
The NPWS has obligations relating to the management of the reserve under international agreements ratified by the Australian Government. These agreements are:

- 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);

The agreements with Japan and China list a species found to frequent the reserve, the Latham's snipe (*Gallinago hardwickii*) (refer to section 3.3, Native animals). A similar agreement is being negotiated with the Korean Government that will also cover this species.

2. PAMBALONG NATURE RESERVE AND LOCALITY MAP



3. PAMBALONG NATURE RESERVE

3.1 LOCATION, GAZETTAL AND REGIONAL SETTING

Pambalong Nature Reserve (referred to as 'the reserve' in this plan) covers 34.674 hectares on the western side of the of the F3 freeway, 2km north of Minmi and approximately 20km north-west of Newcastle. It is immediately adjacent to the freeway and is highly visible to passing motorists. The reserve was gazetted on 1 December 2000 over former farmland acquired by the Roads and Traffic Authority during construction of the freeway. "Pambalong" is the clan name of the Aboriginal people who lived in the area, part of the Awabakal tribe.

The reserve is a freshwater wetland at the western edge of Hexham Swamp, set in a landscape dominated by private land cleared for grazing. It is an integral part of a chain of wetland reserves, which includes Hexham Swamp Nature Reserve and Kooragang Nature Reserve that form the internationally significant Ramsar-listed Hunter Estuary Wetlands. These wetlands have experienced ongoing vegetation clearance and fragmentation since the time of European settlement. Future plans to further expand industry in the Hunter Estuary have the potential to have significant and far-reaching effects on water bird species through the removal and fragmentation of remaining habitat areas. Given these plans for industrial expansion and the historical impacts to wetlands in the Hunter Estuary, Pambalong Nature Reserve could be considered as critical water bird habitat.

3.2 LANDSCAPE CONTEXT

Natural and cultural heritage and on-going use are strongly inter-related and together form the landscape of an area. Much of the Australian environment has been influenced by past Aboriginal and non-Aboriginal land use practices, and the activities of modern day Australians continue to influence bushland through recreational use, cultural practices, the presence of introduced plants and animals and in some cases air and water pollution.

The geology, landform, climate and plant and animal communities of the area, plus its location, have determined how Pambalong Nature Reserve has been used by humans. The reserve protects areas of open water and marshy wetlands, paperbark and casuarina swamp forest, as well as lands which have been cleared for grazing. The wetlands were a rich food source for Aboriginal people and the high ground adjacent to this and nearby swamps contains abundant evidence of past Aboriginal occupation and use. In more recent times the land was cleared and fenced to provide well-watered pasture and a drought refuge for stock.

Early last century the Richmond Vale Railway was built across the swamp to take coal from the Northern Coalfields, including the Stockrington Colliery a few kilometres upstream from the reserve, to the Hunter River ports at Hexham and Newcastle. The railway closed when more competitive mines were opened further up the Hunter Valley.

Both Aboriginal and non-Aboriginal people place cultural values on natural areas, including aesthetic, social, spiritual, recreational and other values. Cultural 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 usefulness, natural and cultural heritage, non-human threats and on-going use are dealt with individually in this plan, but their inter-relationships are recognised.

3.3 NATURAL AND CULTURAL HERITAGE

Landform, Geology and Soils

Pambalong Nature Reserve is a freshwater wetland at the lower end of the Blue Gum Creek catchment, just before the creek enters Hexham Swamp. The entire area of the reserve lies below the 10metre contour, and most of the reserve is marshland or open water. The Blue Gum Creek catchment is relatively undisturbed and runs from the slopes of Mount Sugarloaf, approximately 8km south-west of the reserve, north-east to Pambalong Swamp and Hexham Swamp. The catchment is still largely forested and provides bushland views of ridges and mountains from the reserve. Historic information and recent experience shows the swamp dries out during extended dry periods.

Soils are of the “Hexham Swamp” landscape, a broad estuarine plain that maintains a permanent watertable that is no more than 60cm below the surface and rises to the surface during wet seasons. The soil is silty clay with a high organic content. There are small areas of the “Wyong” landscape and the residual “Rivermead” landscape that make up a knoll and the raised terraces around the edge of the swamp (Mattei, 1995).

The alluvial soils sit on extensive Quaternary sediments that have been deposited on the Hunter River delta. Permian rocks of the Sydney Basin underlie the alluvial soils, most likely of the Tomago or Newcastle coal measures. There is some outcropping of badly weathered fine-grained sedimentary rock on the south-eastern knoll.

Potential acid sulfate soils are present in most of the wetland areas of the reserve and their disturbance should be avoided or subject to assessment during a Review of Environmental Factors (REF) for any activity, such as archaeological investigation, fencing or provision of signage.

The swamp depends on freshwater from the creek to maintain and replenish the wetland. It can dry out completely (most recently in November/December 2002) and at other times it can flood sufficiently to prevent access along Cedar Hill Drive and Stockrington Road. No information on water quality was located during the preparation of this plan, but the health of the wetland vegetation and fauna indicates water quality is at least sufficient to maintain the current ecosystem. Information from local residents suggested sedimentation in the wetland increased during mining operations in the area, however sediment loads in the creek have declined again with the cessation of mining.

The construction of the F3 freeway has altered local flows into the eastern side of the wetland, but the increased volumes from the freeway embankment are insignificant compared to the flows from Blue Gum Creek. Downstream flows out of the Pambalong Swamp into Hexham Swamp were modified by the construction of Lenaghans Drive more than 70 years ago, with further modifications to the channel during freeway construction. The effect of these modifications has not been studied.

Prior to its gazettal as a Nature Reserve the wetland was listed under State Environmental Planing Policy 14 (SEPP 14), which controls developments at or near coastal wetlands.

Native Plants

Plant communities that depend on the wetland, including rushes, sedges and melaleuca woodland, dominate the reserve. These communities are generally in good condition. The fringing woodlands are in poor condition due to past clearing and grazing. About half the area of the reserve is open water or fringing wetland vegetation. Conservation of the wetland vegetation communities is a high priority in the reserve because of their regional significance and the habitat they provide for waterbirds and waders (refer to "Native Animals").

The nature and extent of the various wetland plant communities varies with water level, especially the fringing sedge and rush communities. There is evidence, such as die-back in the melaleuca trees in the south swamp, that changes to the vegetation communities have also been caused by past alterations such as the construction of the railway embankment and the two roads.

A vegetation survey conducted by EcoLogical Australia (February 2003) identified seven plant communities, of which only two ("spotted gum–ironbark forest" and "introduced grassland") are not dependent on the wetland. The survey did not find any rare or threatened species as listed on the Register of Threatened Australian Plants (ROTAP) or under the TSC Act. However, regionally significant species and communities were identified:

- *Cyperus odoratus* (a sedge) is at the northern extent of its range and is considered rare north of Wyong.
- *Melaleuca linariifolia* (a woody shrub or small tree) is regionally significant as its extent has been severely reduced by saturation of its habitat from increased urban run-off (Sainty 2000).
- *Enydra fluctuans* (a water plant) is common on the site but is not common outside the Newcastle area (Sainty 2000).
- *Pseudoraphis spinescens* (a grass) grows only in the Wyong area and is otherwise uncommon in the region (Sainty 2000).
- The wetland vegetation communities that include paperbark sedgeland, swamp meadow, spikerush sedgeland, paperbark woodland and standing water are all considered regionally significant by the Lower Hunter and Central Coast Regional Environment Management Strategy (LHCCREMS) remnant vegetation assessment. They have been reduced in extent by and are under threat from wetland reclamation and hydrological changes. Freshwater wetlands are also considered by LHCCREMS to play a key ecological function in maintaining healthy aquatic systems.

There are several weed species in the reserve that pose a threat to the native vegetation (refer to Section 3.7).

Details of the plant communities, plant species and management recommendations, together with a map showing the location and extent of the vegetation communities within the reserve, are contained in the EcoLogical Australia (2003) report.

Native Animals

The reserve contains a range of freshwater wetland habitats – open water, reed beds, mud flats, emergent and fringing melaleuca forest, open woodlands and pasture. This variety in such a relatively small area ensures a wide variety of fauna species in the reserve. Several threatened species visit the site including the endangered black-necked stork (*Ephippiorhynchus asiaticus*) and the vulnerable magpie goose (*Anseranas semipalmata*), freckled duck (*Stictonetta naevosa*), painted snipe (*Rostratula benghalensis*) and comb-crested jacana (*Jacana gallinacea*).

Latham's snipe (*Gallinago hardwickii*) breeds in Japan and migrates to Australia for our summer. The species has an important place in shorebird conservation in the East Asia-Australia Flyway, as concern for its status at the time was a significant factor in development of the JAMBA. This species is also listed under CAMBA (refer to section 1.2) and the Commonwealth *Environment Planning and Biodiversity Conservation Act 1999* (EPBC Act). The world population of Latham's snipe is estimated at 36,000 and the several hundred who, in some seasons, roost and feed at Pambalong Nature Reserve represent up to 1% of the Australian population (Straw, 2000). Due to the destruction of Latham's snipe habitat throughout the Hunter, particular attention should be paid to retaining its habitat within the reserve.

Several other migratory wader species listed under the EPBC Act, the JAMBA and CAMBA treaties and the Bonn Convention have also been recorded on the site. These species are the marsh sandpiper (*Tringa stagnatilis*), common greenshank (*Tringa nebularia*), wood sandpiper (*Tringa glareola*), sharp-tailed sandpiper (*Calidris acuminata*), and the curlew sandpiper (*Calidris ferruginea*).

Pambalong Nature Reserve is an integral part of the Hunter Estuary wetlands and could be considered as providing critical habitat for wader and water bird species at a regional, state, national and international level. As such the health of the reserve must be closely monitored. Such monitoring should include weed control, water quality and vegetation management.

The emergent melaleuca forest provides a roosting site for several species of egrets and ibis, where up to 1000 birds have been observed. The open water provides habitat for ducks and swans, and they use this area for moulting. Few species seem to use the area for breeding, although swans and some duck species have been observed nesting and raising chicks (Straw, 2000). Nearly 150 species of bird were observed or were expected to occur within the reserve (Straw 2000).

The swamp and surrounding bushland also support a large frog population. The five species identified by White (2000) are all species commonly found on the eastern coast. Specific attempts to locate the endangered green and golden bell frog (*Litoria aurea*) and wallum froglet (*Crinia tinnula*) did not find any on the site, although green and golden bell frogs do occur in nearby freshwater wetlands on the eastern edge of the Hexham Swamp.

Only a small number of mammal species were recorded, with none of them considered significant, although the presence of the brown antechinus (*Antechinus stuartii*) in the melaleuca thickets is unusual. Other mammals observed in the reserve included bush rats (*Rattus fuscipes*), a sugar glider (*Petaurus breviceps*) and five bat species. Details of the survey can be found in White (2000).

Despite its proximity to the freeway, there is some potential for the reserve to act as a habitat corridor and refuge. Movement of fauna is possible to the west of the freeway, where the catchment is forested and relatively undeveloped. Movement to the east, to and from Hexham Swamp, is likely to be restricted, except for bird species, which are generally able to cross the freeway safely. There may be some fauna movement under the freeway using the culverts and the railway tunnel, but this has not been observed.

Aboriginal Heritage

The area along the western margins of the Hexham Swamp and extending westward to Mount Sugarloaf was the country of the Pambalong Clan of the Awabakal tribe (Gunson, 1975). There is a rich assemblage of objects from Aboriginal occupation in many locations around the margins of Hexham Swamp. A nearby site at Woods Gully, surveyed in 1996, contained the highest artefact density then recorded in the Hunter Valley, with 25,000 items found in the course of the study (Sue Effenberger, cited in Kuskie and Kamminga 2000).

In general, sites rich in objects from Aboriginal occupation have been found on high, dry ground adjoining the swamp margins. An open campsite was recorded in the reserve in 1979 during investigations for the construction of the Sydney-Newcastle gas pipeline. A visit to the same area in June 2003 by NPWS officers and an archaeologist failed to locate the recorded site, which may have been covered with spoil during the construction of the F3. The 2003 survey also located some stone flakes from tool-making or sharpening within the reserve. Based on the evidence from similar sites nearby, such as Woods Gully, other parts of the reserve are also expected to contain Aboriginal artefacts.

Aboriginal communities have an association and connection to the land. The land and water biodiversity values 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 nature are inseparable from each other and need to be managed in an integrated manner across the landscape.

Pambalong Nature Reserve offers the opportunity to understand Aboriginal occupation and land use within a landscape context. Hexham Swamp provided a rich and varied food source for the Aboriginal people who lived on its margins, and Pambalong Swamp is one of the few areas on the margin of the swamp that has not been significantly disturbed by urban development.

The Richmond Vale Railway line (refer to Non-Aboriginal Heritage, below) marks the boundary between the Mindaribba Local Aboriginal Land Council area (north of the line) and the Awabakal Local Aboriginal Land Council area (south of the line).

Non-Aboriginal Heritage

The historic Richmond Vale Railway (or South Maitland Railway) and associated easement divides the Southern Swamp from the Main Swamp. The railway is currently owned and managed by Coal & Allied Pty Limited. The double-line railway tracks and sleepers are still in place. The railway continues east under the freeway to Hexham and

west along the Stockrington Valley to Richmond Vale but is closed at the boundary of the Pambalong Nature Reserve by a fence at the eastern end and gate at the western end. The railway to Richmond Vale was completed in 1907 and ceased operation with the closure of Stockrington Colliery in 1984 (refer also to section 3.4).

The embankments and track are lightly vegetated with weeds, native grass and shrub re-growth and are in good condition. Weeds along the railway are spreading into the reserve, requiring joint management by the railway's owners and NPWS to prevent their further spread.

Local residents report that the western edge of the knoll was quarried to provide road gravel for the construction of Lenaghans Drive (Ron Perry, pers. com.). This was a relief-work project during the Great Depression. No other significant items of non-Aboriginal heritage are evident on the site, although cleared vegetation and fences provide information about more recent land use for grazing.

3.4 ACCESS AND PUBLIC USE

The reserve is accessed from the north off the F3 freeway by Lenaghans Drive, then Stockrington Road, or from the south via Newcastle Link Road east of the F3 freeway, via Woodford Street and Lenaghans Drive. Access from the west of the freeway is by Seahampton Road off George Booth Drive, then Stockrington Road. From Stockrington Road, Cedar Hill Drive runs north to a proposed visitor parking area (see the map). No visitor facilities currently exist in the reserve.

The numerous and diverse waterbirds and waders that use the reserve attract a small number of bird observers. The Hunter Bird Observers Club carries out regular monitoring of birds in the reserve, including an annual census of Latham's snipe. There are few other visitors to the reserve.

The Richmond Vale Railway line and associated easement offers potential access through the reserve, but is currently closed at the reserve's east and west boundaries. There are proposals from community organisations to develop the line as a cycleway and pedestrian corridor from Minmi and Hexham through to Mt Sugarloaf and Pelaw Main, however no firm plans were available at the time of preparation of this plan of management. Other sections of the railway are subject to unauthorised use by trail bike riders and there is the potential for this use to spread onto the section that crosses the reserve.

3.5 OTHER USES

The Sydney–Newcastle gas pipeline crosses the knoll on a pre-existing easement in the south-eastern corner of the reserve (see the map). The pipeline is managed by Agility, the pipeline division of AGL. The management of the pipeline requires access through the reserve, although this can be by foot for most purposes. The easement is 24 metres wide, but it is only the central strip that needs to be kept clear of vegetation such as trees that might restrict access. Current practice is to slash this strip to about 500mm height. The easement has not been formalised under the NPW Act.

An electricity transmission line runs across the north-western corner of the reserve, also on a pre-existing easement (see the map). Transgrid is responsible for management of

this transmission line and conditions for access to the lines and maintenance of the easement are covered under an Agreement between the NPWS and Transgrid (2002). The easement has not been formalised under the NPW Act.

A local landholder uses the transmission line easement to move stock to and from their paddocks, and a “right of carriageway” has been established as a condition on the Land Title to give them continued access to this route.

3.6 MANAGEMENT OPERATIONS

There are no permanent management trails within the reserve. Management access to the reserve occurs from the public access points (refer to section 3.4), as well as along the Richmond Vale Railway line easement (refer to Non-Aboriginal Heritage) which is gated and locked.

3.7 THREATS TO RESERVE VALUES

The reserve is small and its boundary length is large in proportion to its area. This makes it particularly vulnerable to “edge effects” from weeds, grazing animals, feral pests and litter that enter the reserve from areas outside the boundary. It is also vulnerable to potential changes to both water flows and quality that are likely to result from continuing development higher up the Blue Gum Creek catchment.

Pest species

There are several weed species in the reserve that pose a threat to the native vegetation. Water hyacinth (*Eichornia crassipes*) can spread rapidly and cover large areas of open water, preventing access by water birds and choking out sunlight to other aquatic plants. The species can re-establish from seed, which may remain viable for up to 20 years. The hyacinth may also be entering the reserve from higher up the catchment, or may be borne in on water birds from neighbouring properties along Lenaghans Drive where the species is also known to occur. Control measures must involve neighbours, Newcastle City Council and Cessnock City Council. Some small areas of alligator weed *(Alternanthera philoxeroides)* have been located and their spread represents a major threat to other species. It is a declared noxious weed and eradication measures are required. Understorey weeds such as lantana (*Lantana camara*) threaten the small area of dry woodland on the knoll. In addition, there are many pasture weeds present, including noxious weeds such as blackberry. These do not present such an urgent threat to the wetland communities, however legislation requires that noxious weeds be controlled.

Rubbish dumping has occurred in and adjacent to the reserve due to the ease of vehicle access. This impacts on amenity and has the potential to introduce weed species and to impact on native fauna. The NPWS Hunter Region Pest Management Strategy (2002a) has identified control of water hyacinth at Pambalong Nature Reserve as a “high priority” and an active program has been operating in the reserve since 2002. The Strategy also identifies alligator weed, crofton weed, noogoora burr, lantana and blackberry, all of which occur in Pambalong Nature Reserve, as “high priority” weeds, although at this stage there are no specific control programs for these species in the reserve.

Some naturally occurring species may present a problem if they become too abundant. Water couch (*Paspalum distichum*) already forms thick mats on the swamp margins, preventing use of some areas by waders and ground-roosting birds such as Latham's snipe. Typha (*Typha orientalis*) and phragmites (*Phragmites australis*) have the potential to spread into areas of open water, restricting the habitat of species such as ducks and swans. If these native plant species threaten the habitat value of the reserve, they may require control.

In some cases the pasture grasslands seem to be providing roosting and feeding areas for Latham's snipe and other waders. In other areas the rapid growth of grasses such as kikuyu and couch has created dense mats unsuitable for bird habitat, and management of these areas to protect bird roosts may be required.

Foxes were seen every night during the mammal survey. Field observation and scat analysis indicated they were preying on long-necked tortoises, water birds including swans and moor hens, and eggs. They were seen penetrating well into the shallow water around the edges of the swamp (White, 2000). The NPWS Hunter Region Pest Management Strategy (2002a) rates control of foxes as a high priority and NPWS already has an active control program operating in the adjacent Hexham and Kooragang Nature Reserves. Feral pigs have been reported in the nearby Hexham Swamp, but there is no evidence of their presence in Pambalong Swamp.

In the past, grazing on parts of the land now within the reserve had an adverse impact on native vegetation, including forest re-growth. Both grazing pressure and trampling may affect native fauna habitat and nesting sites, encourage the spread of weed species and increase sedimentation and nutrient loads. Grazing of the wetland's fringe continues on privately owned land adjacent to the reserve. While this keeps down rampant grass it may still contribute to the spread of weeds and increase nutrient loads into the wetland, particularly if fencing is not maintained and stock are able to enter the reserve.

Modification of surrounding land

Run-off or spills from the freeway may harm vegetation and wildlife. The effects of run-off on vegetation on the eastern side of the wetland should be monitored and a plan developed with the RTA to contain spills.

A sealed road on a corridor managed by Newcastle City Council bisects the reserve, however traffic use is low as it only provides access for local residents.

There are two current exploration licences for coal, covering areas adjacent to the western edge of the reserve. The impacts of any future exploration or coal mining on the reserve must be closely monitored. The reserve title runs through to the core of the earth. As such, coal mining or methane gas extraction below the reserve is not permitted under the NPW Act. Any coal mining in areas adjacent to the reserve or upstream of the reserve has the potential to detrimentally effect water bird habitat if it were to re-direct water flow prior to it entering the reserve. This must be closely monitored and a plan developed with the Department of Mineral Resources and/or mining companies to ensure this impact does not occur.

Fire

Fire is a natural feature of many environments and is essential to the survival of some plant communities. It is one of the continuing physical factors influencing the Australian environment. However, inappropriate fire regimes have been identified as a key threatening process affecting the biological diversity of NSW as frequent fire can lead to loss of particular plant and animal species and communities. Fire could also damage cultural features, fences and threaten neighbouring land.

There have been no recorded wildfires within the reserve, although anecdotal evidence describes a fire in the 1940's. The wetland vegetation of Pambalong Nature Reserve is sensitive to fire and while unlikely to be easily lit in moist conditions, drier climatic conditions may dry the vegetation of the reserve. Sealed roads and pasture buffers surrounding the reserve limit the likelihood of fire spreading into the reserve.

NPWS regards cooperative fire management as essential for the protection of life and surrounding property, as well as for protection of the natural and cultural heritage of the reserve. An important aspect of fire management for the NPWS is participation as a member of the Newcastle Bush Fire Management Committee (NBFMC) and preparation of district bushfire management plans for the area covered by this committee. NPWS also maintains cooperative arrangements with surrounding landowners and the NSW Fire Brigade, including approaches to fuel management, support for neighbours' fire management efforts and information sharing.

The NPWS is a fire authority under the *Rural Fires Act 1997* that is required to implement the provisions of district fire management plans. Management of NPWS estate is in accordance with an adopted state-wide NPWS strategy and approach to fire management planning (NPWS 2002b), with the following objectives:

- To reduce the occurrence of human-caused unplanned fires in NPWS estate.
- To suppress unplanned fires occurring in NPWS estate.
- To minimise the potential for spread of bushfires on, from or into NPWS estate.
- To protect from bushfire occurring in NPWS estate, persons and property on, or immediately adjacent to, NPWS estate. To manage bushfires to avoid the extinction of all species which are known to occur naturally within NPWS estate.
- To protect from damage by bushfires all Aboriginal sites, historic places and culturally significant features which are known to exist in NPWS estate.

A recent review of fire management throughout the Directorate by NPWS has resulted in a modified approach based on the level of complexity involved. In regard to Pambalong Nature Reserve, the NPWS considers that it is appropriate to include the specific fire management strategies for the reserve in this plan of management. Programs are also submitted to the district Bush Fire Management Committee. The NPWS approach to fire management planning (2002b) uses a system of zones that are compatible District Bushfire Management Committee (DBFMC) risk management plans.

NPWS has assessed Pambalong Nature Reserve for fire management planning purposes and has zoned the reserve as a Heritage Area Management Zone (HAMZ). The primary fire management objective within this zone is to protect plant and animal species that are known to occur naturally within the reserve, and to protect culturally

significant sites. The reserve has been designated as a HAMZ because it is not adjacent to built assets which would be exposed to a high level of bushfire risk, and does not have a history of bushfire ignitions or known areas of high bushfire potential. The HAMZ does not require intensive management and focuses on those actions appropriate to conserve biodiversity and cultural heritage of the reserve and it's wetlands.

Ecological research in fire-prone ecosystems has established some general principles about fire regimes and the conservation of biodiversity. That is, groups of plants and animals respond similarly to fire according to characteristics of their life history. Therefore it is not necessary to individually specify fire regimes for the conservation of every species. Requirements for most plant species can be summarised on the basis of vegetation communities and there is a threshold in fire regime variability that marks a critical change from high species diversity to low species diversity. The following fire regime guidelines have been identified for Pambalong Nature Reserve:

Table 1 Fire Regime Guidelines for Pambalong Nature Reserve

Vegetation type	Minimum interval	Maximum interval	Notes
Semi-mesic grassy forest	10	50	Crown fires should be avoided in the lower end of the interval range
Swamp sclerophyll forest	7	35	
Freshwater wetland	6	35	

* intervals given are tentative due to insufficient data.

Source: NPWS intranet, based on Auld & O'Connell (1991), Keith (2002), Keith et al (2002), Morrison et al (1995)

4. MANAGEMENT ISSUES AND STRATEGIES

Current Situation	Desired Outcomes	Strategies	Priority
Soil and water conservation			
Observable water quality in the reserve is satisfactory due to relatively undisturbed catchment. No water quality records are available.	There is no evidence of increased sediment loads into the reserve from soil erosion in the upper catchment.	Liaise with landholders and local authorities to maintain or improve water quality in the reserve's catchments.	Medium
Long term impact of water run-off from the F3 is unknown, as it is only a recent development.	There is no reduction in the water quality and health of watercourses in the reserve.	Monitor development proposals in the catchment to assess their potential impact on water quality.	Medium
There is limited hydrological information on the effects of roads and other landscape modifications on natural flows.	Natural flow regimes are maintained where possible and there is an increased knowledge and understanding of hydrological processes affecting the site.	Liaise with the CMA in regard to water quality and water monitoring.	Medium
Potential acid sulphate soils occur below most of the wetland areas of the reserve.		Monitor water-borne and wind blown pollutants and litter from the F3 and initiate joint management programs with EPA officers in the Department of Environment and Conservation and RTA if necessary.	Medium
		Disturbance of potential acid sulphate soils will be avoided where possible. If disturbance is unavoidable, impacts of disturbance will be minimised.	Medium

Current Situation	Desired Outcomes	Strategies	Priority
Native plant and animal conservation			
Changes to the vegetation communities have occurred due to past activities on and off the reserve. The reserve contains a number of regionally significant vegetation species and communities.	There is no reduction in the diversity of native plants or animals in the reserve, particularly significant species.	Initiate and support research and monitoring projects which increase knowledge of native plant and animals in the reserve, their populations, distribution and ecology, particularly bird populations and other key species such as frogs, through the University of Newcastle, Hunter Bird Observers, NPWS and other relevant organisations.	Medium
The range of freshwater habitats in the reserve is used by a variety of animal species, including several threatened water bird species and internationally significant waders. Habitat for these species in the reserve should be monitored and enhanced where possible.	Increased knowledge and understanding of ecological needs and characteristics of plants and animals in the reserve, with emphasis on bird species and especially Latham's snipe.	Establish fauna baseline data prior to any changes in habitat due to vegetation management, and monitor effects of habitat management on key species such as Latham's snipe.	Medium
Latham's snipe is a species of particular interest due to its status under international migratory species agreements.		Revegetate cleared and degraded areas not required for management purposes in order to protect and extend suitable habitat for waders and waterbirds (particularly Latham's snipe) while controlling exotic pasture growth.	High
Grazing and land clearing has altered habitat for animal species, reducing forest cover on the reserve and connectivity to nearby bushland and swamp, while increasing open grasslands.	Improved habitat and connections to adjoining environments for animal species, particularly water and wading birds.	Work with other agencies such as the Wetlands Centre, Hunter/Central Rivers CMA and Newcastle Council to integrate management of the reserve with other wetland conservation reserves and proposed reserves in the Hunter Estuary. Assist in discussions for inclusion of the reserve in the RAMSAR sites of the Lower Hunter Estuary.	Medium
There is potential for rapid spread of some native species such as water couch, typha and phragmites. This may alter the habitat value of some areas of the reserve.	Cleared and disturbed areas in the reserve that are not required for management purposes are rehabilitated.	Work with neighbours to encourage conservation, and, if possible, expansion, of remnant native vegetation in the vicinity of the reserve and to monitor the effects of grazing on the wetland margins.	Medium
		Monitor the extent and environmental impact of potential "problem natives" such as water couch, typha and phragmites.	Low

Current Situation	Desired Outcomes	Strategies	Priority
Cultural heritage			
One Aboriginal site has been recorded in the reserve, however, the wider area is known to contain a number of sites. There is the potential for Aboriginal land use and objects to be presented in their landscape context.	Cultural features are identified, conserved and managed in accordance with their significance.	Work with the local Aboriginal community, relevant LALCs and knowledge holders to identify and manage Aboriginal cultural heritage sites, places and values and to understand their place in the pre-European landscape of the Lower Hunter estuary.	Medium
It is important that the local Aboriginal community is involved in the protection of cultural values in the reserve. The reserve is bisected by the Richmond Vale Railway easement, listed as a heritage item of local significance in both the Cessnock and Newcastle Local Environment Plans.	Sites considered likely to contain Aboriginal objects are protected from disturbance. Aboriginal heritage values are protected in partnership with the local Aboriginal community.	Ensure known Aboriginal sites and potential sites are protected from disturbance by visitors or management activities on the reserve by restricting vehicle and pedestrian entry and by placing signs and facilities that are required for management purposes in areas that are already disturbed. Should any new ground disturbance be essential, precede any work by a check for cultural features. Maintenance of existing works is exempted to the extent of land previously disturbed.	High Medium
	Integrate the railway easement into the reserve's management regime.	Discuss with the owners/managers of the Richmond Vale Railway easement management requirements that include weed control and possible use by walkers and cyclists.	Medium

Current Situation	Desired Outcomes	Strategies	Priority
Visitor use			
The reserve is highly visible from the F3, however it currently experiences a low level of nature-based visitor use, limited largely to bird enthusiasts, researchers, and occasional visitors from passing local traffic. This low level of use is expected to continue.	Visitor use remains at a low level and is ecologically sustainable, in accordance with management principles.	Place signs identifying the tenure of the reserve in locations visible from the F3, however traffic will not be directed from the F3 to the reserve.	Low
		No public vehicle access will be permitted into the reserve.	High
Visitor access is restricted to vantage points around the reserve boundary. No visitor facilities exist in the reserve.	The local community and visitors understand the values of the reserve and support management programs.	Provide a parking area for approximately 3 cars on the reserve boundary with appropriate tenure, interpretive and minimal impact signs. The preferred location is shown on the map.	Medium
The railway corridor easement is currently closed to public access but has potential for unauthorised access by walkers, bike riders, horse riders and trail bikes.		Identify appropriate observation points on the reserve boundary to discourage entry into the wetland areas of the reserve and investigate their development in conjunction with the appropriate landholders.	Medium
Identification and interpretation of the reserve is limited to publications containing general information about the Lower Hunter Estuary Wetlands complex.	A safe and satisfactory experience for those who do use the reserve.	Identify and mark a pedestrian entry point and walking route leading to suitable bird observation area on the south-eastern knoll.	Medium
	Educational opportunities are provided, consistent with reserve values.	Group educational activities that are consistent with the values of the reserve may be permitted, subject to conditions on group size, activities and location as determined by the Area Manager to protect reserve values and minimise conflict with other users.	Low
	A long-term plan is developed for appropriate use and management of the railway easement.	Confer regularly with neighbours and encourage them to report illegal and inappropriate use of the reserve.	High
		Camping, horse riding, trail bikes and all water craft will not be permitted in the reserve. No visitor facilities will be provided except for the car park and walking route.	High

Current Situation	Desired Outcomes	Strategies	Priority
		Work with other stakeholders to develop a plan for appropriate future use and maintenance of the railway reserve that is compatible with the management principles for and values of the reserve. Until such a plan is developed, discourage access along the railway corridor and prevent entry from the corridor into the reserve by retaining gates and fences.	Medium

Current Situation	Desired Outcomes	Strategies	Priority
Pest species Aquatic weeds, particularly water hyacinth, have invaded the wetland areas. A control program has reduced its extent but re-infestation continues. Some noxious and environmental weeds are a problem in cleared and remnant bushland areas. Pasture grasses, particularly couch and kikuyu, are a potential weed threat now that grazing has ceased. Foxes are known to occur in the reserve, and other feral predators such as dogs, cats, pigs and rats are common in the surrounding areas due to the rich food source provided by birds and other wetland animals. Introduced species that occur in surrounding areas are likely to occur in the reserve. Domestic stock occasionally enter the reserve from neighbouring properties. This may impact by direct grazing on vegetation in the reserve, threaten waterbird nesting sites, as well as spreading weeds and increasing nutrient loads in the wetland.	Pest species are controlled and, where possible, eradicated. The impact of introduced species on native species and neighbouring lands is minimised. Distribution of weed species does not expand beyond the current extent. Habitat suitable for water birds and waders is protected and enhanced. Control of introduced species has no harmful impact on native species.	Continue to monitor and control pest plant and animal species and, if possible, eradicate them from the reserve. Water hyacinth, alligator weed, blackberry and foxes will be a priority. Seek the cooperation of other authorities and neighbours in implementing pest plant and animal control programs, particularly in the control of aquatic weeds and in preventing up-stream release of water hyacinth into the creek system and lower catchment. Undertake control in cooperation with Maitland RLPB, Newcastle and Cessnock City Councils, Hunter and Central Coast Noxious Weeds Committee and the Hunter-Central Rivers Catchment Management Authority. Implement native vegetation regeneration programs to enhance habitat and shade out introduced grasses on the swamp margins. Where possible use regeneration methods that mimic natural processes. Use weed control techniques that minimise the potential for herbicides to impact water quality in the reserve. Where appropriate, negotiate fencing agreements with neighbours to exclude livestock from the reserve, in accordance with NPWS Boundary Fencing Policy.	High High Medium High High

Current Situation	Desired Outcomes	Strategies	Priority
Fire management			
Fire threat is low as the reserve is small and is bounded on three sides by sealed roads, acting as fire breaks. The other boundary is cleared and grazed. In normal times half the site is open water.	Life, property, natural and cultural values in and adjacent to the reserve are protected from fire.	Manage the reserve as a HAMZ, where fire is managed or excluded from most areas of the reserve to protect biodiversity. Prescribed burning will not be undertaken on the reserve unless required to maintain biodiversity (refer to Section 3.7).	High
Any fire that does start within the reserve is unlikely to threaten neighbouring land. Wetland vegetation in the reserve is vital in providing habitat and resources to animal species. It is sensitive to fire and requires protection. The reserve is designated as a Heritage Area Management Zone (HAMZ).	The fire regime is appropriate for conservation of native plant and animal communities. The potential for spread of fire on, from or into the reserve remains low.	Locate appropriate access points and sources of water for use in the event of fire. Ensure the information is shared with local fire authorities and neighbouring landholders and that local fire authorities are provided with access. Continue to participate in the Newcastle BFMC. Maintain coordinated and cooperative arrangements with Minmi and other Fire Brigades as well as Newcastle City Council.	High High

Current Situation	Desired Outcomes	Strategies	Priority
Research			
Some research has been undertaken on the ecology of bird species in the reserve, particularly Latham's snipe. Further scientific study is needed to improve understanding of the reserve's natural and cultural heritage, the processes that affect them and the requirements for management of particular species, sites or values.	Research that enhances the management information base and has minimal environmental impact is undertaken. Increased knowledge and understanding of natural and cultural values and the processes affecting the site.	Undertake or encourage appropriate research to improve knowledge and management of the natural and cultural values of the reserve (refer to "native plant and animal conservation" above) Prepare a prospectus of priority research topics to encourage and guide research by educational organisations and others in the reserve. Maintain and make accessible to researchers a file of completed research relevant to the reserve.	Medium Medium Medium

Current Situation	Desired Outcomes	Strategies	Priority
Management operations and other uses Two pre-existing easements, for an electricity transmission line and for a gas pipeline, cross the reserve (see the map). Powerlines are managed in accordance with a state-wide agreement with Transgrid. The centre of the gas pipeline easement (operated by Agility) must be kept free of tall vegetation. The reserve was gazetted over the easements and the easements have not yet been granted under the NPW Act. A 10m wide "right of carriageway" to allow stock movement exists beneath the transmission easement in the north-west corner of the reserve. A raised and sealed public road crosses the north-east corner of the reserve. The road may impact on hydrological flows in the reserve, and in turn impact vegetation communities. No management trails exist in the reserve, although the railway easement provides partial access to some parts of the reserve. Some temporary trails may be required for fire and vegetation management. Two exploration licences for coal cover areas adjacent to the western edge of the reserve. Coal mining adjacent to or upstream of the reserve has the potential to detrimentally affect water bird habitat. Rubbish has been dumped on and adjacent to the reserve.	Management facilities are kept to a minimum and adequately serve management needs and have acceptable, minimal impact on the natural and cultural features of the reserve. No new non-NPWS uses or infrastructure occurs within the reserve. Use and maintenance of the transmission line, gas pipelines and the easements occurs in accordance with formal agreements and has no adverse impacts. There are no adverse impacts from mining on the reserve. Rubbish is removed from the reserve and the likelihood of any future dumping is minimised.	Ensure all non-NPWS uses are licensed or easements granted as appropriate under the NPW Act, and proper commercial returns are obtained where possible. Authorised access for use and maintenance of the transmission line and gas pipeline will be permitted under the provision of existing or future formal agreements between NPWS, Transgrid and Agility. Monitor and manage impacts of stock movement through the north-west corner of the reserve as per the "right of carriageway". Investigate water flows under road easement to ensure no adverse impacts on the wetlands. Continue to use the existing railway easement to provide vehicle access for management activities, with permission of relevant landholders. No permanent management trails will be constructed within the reserve. Identify routes for temporary trails that may be required for management purposes. No other built structures or facilities will be provided on site except for fencing and signs. Monitor coal exploration near the reserve and liaise with the Department of Mineral Resources and/or mining companies to minimise impacts if necessary. Remove dumped rubbish from the reserve and work with Councils to remove rubbish adjacent to reserve and to police illegal dumping activities.	Medium High Medium Low High High Medium 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.

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