



Environment,  
Climate Change  
& Water



## NSW Wetlands Policy

Cover photos – main photo: Wet red gum forest – D. Love, Sydney Catchment Authority.  
Other photos, left to right: Green tree frog – W. Johnson; Vegetation following delivery of environmental water at Yanga National Park, in the summer of 2009–2010 – J. Maguire, DECCW; Lowbidgee Wetland – J. Maguire, DECCW.

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# Foreword

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Wetlands provide a range of values, functions and services that benefit both the natural environment and human society. As many wetlands in NSW are under increasing pressure from human activity and climatic changes, it is even more important to protect those that remain.

Natural resource management has progressed on a number of fronts since 1996, when the NSW Government released the State's first *NSW Wetlands Management Policy*. This policy has achieved much in relation to wetland conservation including:

- the development of guidelines on the wise use and management of wetlands for use by the community and government agency staff
- an increase in the area of wetlands formally protected through the protected area network or under conservation agreements and international conventions
- the formal recognition of wetlands in legislation, planning instruments, management plans and strategies.

Consequently, the *NSW Wetlands Management Policy* of 1996 has been updated in this document to reflect developments in natural resource management and planning that affect wetlands.

This policy recognises the shared goals of government and the community in promoting the sustainable conservation, management and wise use of wetlands in NSW and the need for all stakeholders to work together to protect wetland ecosystems and their catchments.

**Frank Sartor MP**  
**Minister for Climate Change and the Environment**

# 1 Introduction



Wetlands provide valuable habitat for several eucalypt species, including river red gums.  
Photo: W. Johnson

Wetlands are dynamic living entities, and an important part of the natural environment. All wetlands are integral to landscape processes such as nutrient cycling, detention and slow release of flood water, and trapping of sediments. Wetlands form a vital component of regional and national biodiversity by providing habitat for a wide range of animals and plants.

Healthy wetlands provide services to regional communities such as nurseries for recreational and commercial fisheries, opportunities for tourism, and support for sustainable timber production, grazing and apiculture. Rivers and swamps also provide a cultural focus for many regional communities, including Aboriginal communities.

Wetlands, more than any other feature in the landscape, highlight the quintessential boom and bust quality that defines the broader Australian environment.

For over a decade, the NSW Government has understood that managing these diverse and widespread ecosystems requires a whole-of-government approach. In 1996, the Government released the NSW Wetlands Management Policy, which has helped it manage activities in and around wetlands, guided its conservation and rehabilitation efforts, supported land managers who have wetlands on their property, and educated the community about the importance of wetlands for the wellbeing of the state.

The Government's approach to managing natural resources has substantially improved since 1996. New legislation has been enacted on water management and native vegetation; a framework based on standards and targets has been introduced to improve management of natural resources; regional bodies have been established and resourced to substantially increase on-ground action; and the roles of state government agencies have been amended to deal with emerging issues, such as human-induced climate change. A number of wetland species and wetland types are now included on the schedules of the *Threatened Species Conservation Act 1995* and the *Fisheries Management Act 1994*.

In light of these changes, and building on the achievements to date, it is now time for the NSW Government to reaffirm its commitment to the ongoing protection of natural wetlands as set out in this new policy.

## 1.1 What is a wetland?

**Wetlands are areas of land that are wet by surface water or groundwater, or both, for long enough periods that the plants and animals in them are adapted to, and depend on, moist conditions for at least part of their lifecycle. They include areas that are inundated cyclically, intermittently or permanently with fresh, brackish or saline water, which is generally still or slow moving except in distributary channels such as tidal creeks which may have higher peak flows.** Examples of wetlands include lakes, lagoons, estuaries, rivers, floodplains, swamps, bogs, billabongs, marshes, coral reefs and seagrass beds.

**Many wetlands are ephemeral, that is, they are not always wet. As a result, the temporary absence of water will not necessarily be used to exclude particular areas of land from the definition of 'wetland' under this policy.** This issue is especially relevant for demarcating wetlands on floodplains, where wetland extent may vary according to the size and duration of the last flood, as well as local rainfall and the degree of groundwater connectivity. Ephemeral wetlands occur on many riverine systems where temporary flood retention leads to significant flood supported ecosystems. These areas are particularly susceptible to development as they often are difficult to define on ephemeral river and creek systems.

Under this policy, areas of the floodplain that pond with water after the passage of major floods peaks are included in the definition of a wetland. Areas of the floodplain which drain naturally and continuously following a major flood and do not have distinctive wetland plants or soils, are excluded from the definition of 'wetland' for the purposes of this policy.

**To determine the wetland's location and extent during dry phases, vegetation type, soil properties including seed and egg banks and historical records of inundation or palaeo-ecological surveys can be used.** For example, flood-dependent vegetation such as red gum, black box and coolibah can be used to identify wetlands in many inland valleys of NSW. Soil properties can also be used to delineate wetland boundaries as prolonged saturation produces anoxic conditions (conditions where soils are lacking in oxygen) in the upper layers of wetland soils and substrate, which can persist even when the wetland is dry. Historical satellite imagery, such as Landsat, can be used to demarcate broad wetland boundaries for NSW when it is in flood (see Kingsford et al 2004, Thomas et al in press).

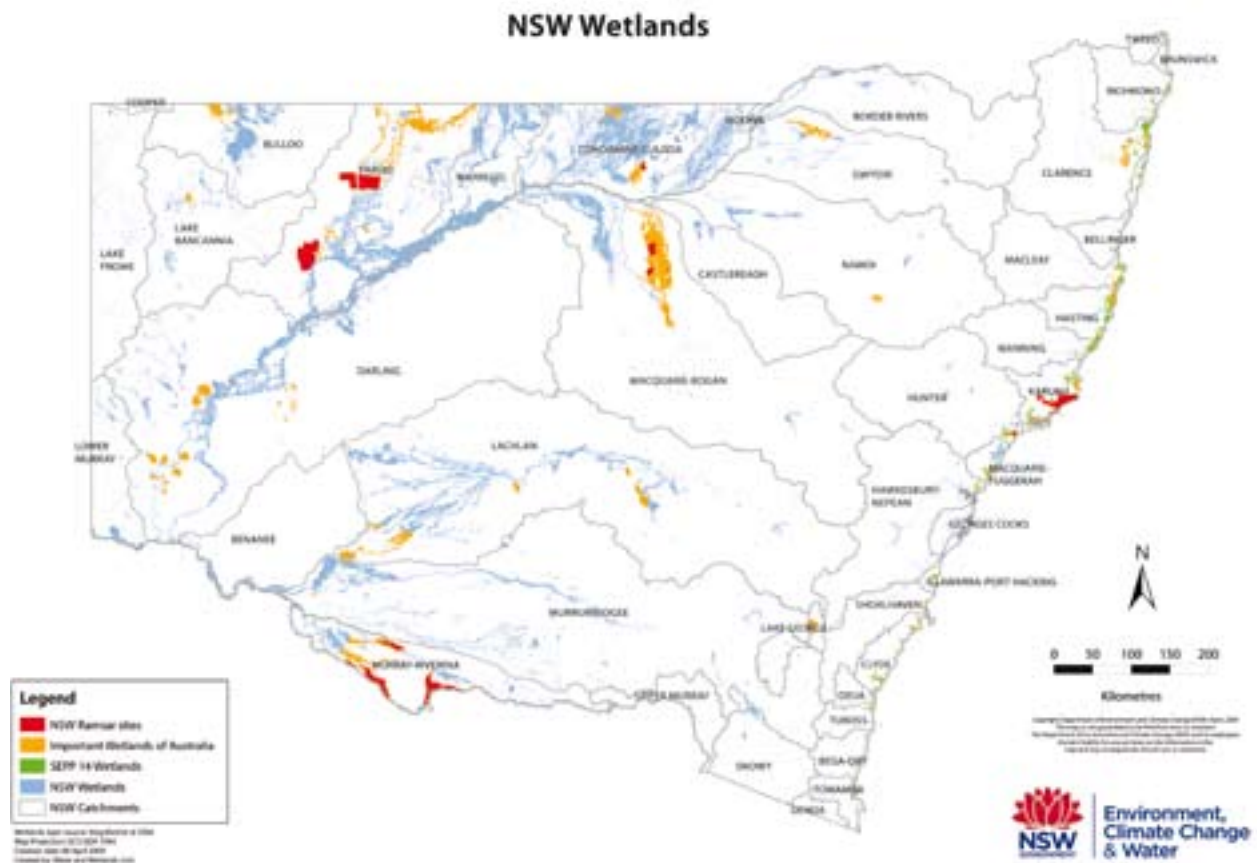
The management of wetlands that rely on groundwater is addressed in the *The NSW State Groundwater Dependent Ecosystems Policy* (DLWC 2002b).

Marine-dominated systems, such as estuarine areas beyond the seagrass zone, coastal beaches and intertidal rocky shores, and marine areas, are not covered by this policy.

## 1.2 Wetland type, area and distribution

Typical wetland habitats in NSW include marshes and meadows, lagoons and swamps, upland peat bogs, lakes and rivers, forests and woodlands which are flood dependent; springs, salt pans and clay pans; and saltmarsh, mangrove and seagrass meadows in estuaries and near shore environments.

NSW has approximately 4.5 million hectares of mapped wetlands, which constitute 6% of the state's area (Kingsford et al 2004). This figure is based on the greatest inundated extent occurring between 1984 and 1993 for inland wetlands, and the 1994 inundation extent for coastal wetlands. Upland wetlands and coastal wetlands less than one hectare were not mapped, and are not included in this figure, but they are covered by this policy as they have high intrinsic value and provide a range of ecosystem services. In some areas they are also potentially under threat from mining and extractive industries.



Wetlands constitute over six percent of the land area of NSW. Source: Kingsford 2004.

## 2 What does this policy intend to achieve?



Many wetlands, including Lowbidgee Wetlands, are protected in national parks and reserves.  
Photo: J. Maguire, DECCW

### 2.1 Protect and sustainably manage a statewide network of wetlands

Consistent with the priority on natural resources management in the NSW State Plan (NSW Government 2009 – visit <http://more.nsw.gov.au/stateplan>) to deliver better outcomes for native vegetation, biodiversity, land, rivers and coastal waterways, this policy aims to provide for the protection, ecologically sustainable use and management of NSW wetlands.

The policy covers all wetlands in the state, including those that are mapped and the many that are yet to be formally identified in recognition of their critical importance in the ecological and hydrological systems of the state's catchments. For further definition of the scope of the policy, see section 1.

#### 2.1.1 Set priorities for wetland programs

The State Plan, which this policy is aligned with, includes a target for improving the condition of important wetlands: 'That by 2015, there is an improvement in the condition of important wetlands, and the extent of those wetlands is maintained'.

The Natural Resources Commission of NSW has defined 'important wetlands' as being those listed under the Ramsar Convention or in the *Directory of important wetlands of Australia* (Natural Resources Commission 2005). At present, 187 sites in NSW are on these lists.



Other significant wetlands in NSW include those mapped under *State environmental planning policy no. 14 – Coastal wetlands* (SEPP 14) and others listed as endangered ecological communities under the *Threatened Species Conservation Act 1995*. Numerous other wetlands also provide significant ecosystem services and are valued by local communities.

In recognition of the State Plan wetland target, and to maintain an extensive and diverse statewide network of wetlands, this policy proposes to focus on sites of:

- international importance, that is, Ramsar sites
- national importance, that is, sites listed in the *Directory of important wetlands of Australia*
- regional significance, for example, sites identified by regional organisations dealing with natural resource management in consultation with their communities.

Opportunities to support local wetlands in partnership with land holders should also be considered and identified in investment or management plans. Wetlands on private property can provide significant gains for biodiversity and improve land productivity, particularly where complexes of smaller wetlands exist within a local landscape.

By targeting conservation and rehabilitation efforts at sites of international, regional and national significance, while strategically supporting local wetlands, a statewide network of wetlands of varying size, type, value and function can be achieved.

### 2.1.2 Support integrated water management in the Murray Darling Basin

Delivering a viable statewide network of wetlands requires that degraded wetlands and floodplains in the Murray–Darling Basin are returned to an ecologically sustainable state. Establishment of the Murray Darling Basin Authority means that a single agency is now responsible for planning for the integrated management of water resources across the whole basin. This is a crucial step in protecting and restoring the basin's wetlands.

This policy will provide a good foundation for key planning processes that are under way such as the development of the Basin Plan and its associated Environmental Watering Plan. The adoption of the principles outlined below will assist in identifying priority sites for investment, improving management of environmental water, directing large-scale rehabilitation programs, and ensuring outcomes for wetlands are included in all aspects of planning and management.

### 2.1.3 Complement the statutory framework

A number of Acts contain provisions to regulate activities that affect wetland values, primarily through planning and impact assessment. For simplicity, threats to wetland values may occur from activities that affect:

- aquatic habitat, including habitat for threatened species
- native vegetation
- the flow regime into and out of wetlands
- areas of national environmental significance.

Various Acts may be relevant to these circumstances. For example, the protection of threatened species habitat may be supported by at least six pieces of state and Commonwealth legislation, including the:

- *Environmental Planning and Assessment Act 1979*
- *National Parks and Wildlife Act 1974*
- *Local Government Act 1993*
- *Threatened Species Conservation Act 1995*
- *Fisheries Management Act 1994*
- *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth).

In relation to areas of national environmental significance, a number of Commonwealth Acts may be relevant such as the:

- *Environment Protection and Biodiversity Conservation Act 1999*
- *Heritage Act 1977*.

The purpose of this policy is to complement relevant legislation by:

- providing a more explicit definition of wetlands, including recognition of their dry phases, to assist the application of legislation to wetlands
- aiding decision making when interpreting the provisions of legislation
- providing direction where legislation lacks a consistent approach.

## 2.2 Wetland management in NSW – past

For around 40,000 years, Aboriginal land management practices meant that the natural world catered for human wellbeing and ecological function. All wetlands are significant in Aboriginal culture. Wetlands were used for ceremonies, for teaching and recreation, and as sources of food.

Since non-Aboriginal settlement, many wetlands have been destroyed, degraded or altered. Finlayson and Rea (1999) estimated that approximately 50% of wetlands have been lost since 1788. In highly populated areas of Australia, this figure may be as high as 70% for certain wetland types, such as those of high value to waterbirds (Goodrick 1970).

In NSW, similar reductions in wetland extent have been measured both inland and on the coast. For example, 50% of freshwater wetlands in Sydney have been lost (Adam and Stricker 1993). The Gwydir River wetlands have declined in area by 75% (Keyte 1992) and the Macquarie Marshes by 40–50% (Kingsford and Thomas 1995). For these and many other NSW wetlands, the major causes of decline have been:

- river regulation, and surface water and groundwater extractions, that have reduced the timing and volumes of water reaching wetlands
- water diversion works including floodplain drainage and flood mitigation works that have changed the nature of, and isolated, wetlands
- catchment-scale disturbance that has affected the quality of water and ecosystem functioning
- native vegetation clearing
- pest animals and weeds that have outcompeted native wetland species and altered habitats
- natural drought combined with other disturbances to hydrology, resulting in extended droughts.

Many wetlands have been irreversibly destroyed since 1788 and many that remain are degraded or altered. With improved management and stewardship, there is a high chance of rehabilitating many of these remaining wetlands.

### 2.2.1 Wetland management in NSW – progress since release of the NSW Wetlands Management Policy (1996)

To halt and, where possible, reverse the trend of wetland decline, and to restore the quality of the state's wetlands, the NSW Government released the NSW Wetlands Management Policy (1996). Based on the concepts of ecologically sustainable development and total catchment management, the policy provided guidance on wise use, best management practice and rehabilitation of wetlands, with a particular focus on land holders who were viewed as having primary responsibility for wetland management. It also provided consistent criteria by which the impact of activities approved under legislation such as the *Environmental Planning and Assessment Act 1979* and the *Fisheries Management Act 1994*, could be assessed.

Since then, progress has included the enactment of the *Water Management Act 2000*, which provides for the protection and restoration of water sources, their associated ecosystems, ecological processes and biological diversity. The Act further includes a specific principle (section 5), stating that 'water sources, floodplains and dependent ecosystems (including groundwater and wetlands) should be protected and restored and, where possible, land should not be degraded'. The intent of the Act is being implemented initially through water sharing plans. *The NSW State Groundwater Dependent Ecosystems Policy* (DLWC 2002b) was developed to ensure that the principles outlined in the *Water Management Act 2000* were implemented in groundwater ecosystems, which include wetlands.

Many of the intended outcomes of the NSW Wetlands Management Policy have been realised. For example, river flow objectives were developed for every NSW catchment, and environmental flow contingencies were allocated for many inland dams. Guidance to land holders was provided in the form of technical guidelines (*Wetland management technical manual: wetland classification* (DLWC 1997)) and management guidelines (*Managing wetlands on your property – inland NSW: guidelines* (McKeon, Richardson and Dunn 2002)). Financial support was also provided – the NSW Government granted nearly one million dollars to community-based groups for wetland rehabilitation.

Some programs have been initiated to rehabilitate and protect wetlands in NSW, including NSW RiverBank which was the first program established in Australia for the specific purpose of purchasing water for the environment. Other programs recovering water for the environment through purchase and infrastructure works include the Living Murray Initiative, the Rivers Environmental Restoration Program and the Wetland Recovery Program (now complete). These programs, variously, are being delivered in partnership with the Commonwealth and other state governments in the Murray–Darling Basin, and include funding for:

- research to help maximise the benefits of environmental water use
- infrastructure works to improve the quality, quantity and timing of environmental flows
- partnerships for the management of environmental water on private land.

Additionally, the NSW Government has incorporated many significant wetlands in the national reserve system. Important wetlands such as the Macquarie Marshes, Lowbidgee Wetlands, Booligal Wetlands, Lake Wollumboola and the Paroo River Wetlands are partly or wholly protected in national parks and nature reserves. The reserve network is complemented by private land conservation agreements including listings under the Ramsar Convention in the Gwydir, Hunter, Macquarie and Murrumbidgee regions, and by wildlife refuges and conservation agreements throughout NSW.

Changes in water availability have become a very significant issue for wetland management since 2002. A lengthy, record-breaking drought has prevailed in large parts of NSW. Although policies were put in place to increase environmental flows, most obviously through water sharing plans which commenced in 2004, the drought has limited these environmental flows and in some valleys water sharing plans have been suspended due to critical water shortages. Impacts on wetlands have been extreme, particularly in the Murray–Darling Basin. Wetland biodiversity has been severely affected, with waterbird populations plummeting, and extensive areas of iconic plant communities such as river red gums dying. Annual aerial surveys of waterbirds in eastern Australia have shown that the number and breeding of waterbirds has declined significantly since 1983 (Porter et al 2006) and the diversity of breeding species in 2006 and 2007 were the lowest on record (Porter et al 2007).

The status of wetlands was succinctly captured in *New South Wales State of the Environment 2006* (SoE report) (DECC 2006): inland wetlands have continued to decline due to river regulation, poor management, drought and the impact of invasive species – the issues that had threatened wetlands since non-Aboriginal settlement. Coastal wetlands have also been under intense pressure from population growth and urban development. The SoE report warned that human-induced climate change and associated sea-level rise would soon become serious threats to wetland extent and condition.

## 2.3 Wetland management in NSW – present

The drought of 2002–2009 has exposed the scarcity and variability of water resources in NSW, and brought some inland wetlands to the brink of extinction, which has led to a reassessment of wetland management in NSW (DECCW 2009). Persistent threats to wetlands remain, new threats such as climate change are emerging, and some management actions – be they legislation, planning or on-ground action – need to be more strategically applied to produce lasting outcomes.

The Government is tackling these threats by adopting a broad suite of principles to guide management of, and investment in and around, wetlands (see section 4). These principles apply to all wetlands. Issues affecting inland, coastal and upland wetlands are discussed in sections 2.3.1, 2.3.2 and 2.3.3 respectively.

The NSW Government's planning system provides for ongoing wetland protection at the state, regional and local planning levels. *State environmental planning policy no. 14 – Coastal wetlands* limits development of wetlands along the NSW coast (except in the Sydney Greater Metropolitan Area) that have been mapped since the early 1980s. Regional strategies have been prepared for all high growth areas, to recognise the value of natural resources and focus future development around existing centres. Some regional strategies also attempt to minimise the cumulative impacts of upstream development on wetlands. Where greenfield sites are identified, mechanisms are in place for councils to provide adequate protection through their local environmental plans (LEPs).

There have already been innovative solutions to improve planning provisions for wetlands under threat from development, such as where wetlands on the NSW Coast have been rezoned as environmental protection zones. These positive planning outcomes are recognised as a model for future land use planning and local planning mechanisms will be encouraged to protect, conserve and rehabilitate wetlands. A new LEP template has been issued which provides councils with four environmental protection zones to choose from, as well as the option of applying overlays (maps showing specific features for protection or development that may be constrained) to any zone. This policy encourages the continued development of consistent wetland mapping layers and planning provisions in LEPs.

### 2.3.1 Inland wetlands



Environmental water is being directed to Gwydir Wetlands. Photo: J. Spencer

Inland wetlands include floodplain lakes and lagoons, reed swamps, woodlands and arid wetlands. For many of these wetlands, implementing environmental flows through the water planning framework was intended to halt and reverse wetland decline. The water sharing plans gazetted since 2004 have given environmental flows a legislative base, setting aside water for the environment (planned environmental water), allowing for adaptive environmental water licences, and establishing advisory groups to identify important ecological assets and guide environmental water management.

Due to the lengthy drought of 2002–2009, however, the full benefits are yet to be seen as water allocations have been low and some water sharing plans have been suspended. Other approaches are under way, such as using engineering solutions to recover water that would otherwise be lost through inefficient infrastructure, and purchasing water on the market to increase environmental water entitlement. For example, the NSW RiverBank program is purchasing water on the open market from willing sellers to increase environmental flows that are additional to those established in water sharing plans. Water recovery efforts are being targeted to support the Macquarie Marshes and Gwydir Wetlands as well as important wetlands on the Lachlan and Murrumbidgee floodplains, such as within Yanga National Park.

A cooperative approach to water management across states will be vital for returning degraded wetlands to a healthier state. Through the Murray Darling Basin Authority, the Commonwealth, with the agreement of relevant jurisdictions including NSW, has become responsible for planning the integrated and sustainable management of water resources of the Murray–Darling Basin. The Commonwealth is working to produce the first Basin Plan in 2011, which will set sustainable limits on water extraction from surface water and groundwater systems. The NSW Government anticipates that this plan will be instrumental in returning degraded wetlands to a healthy state.

To complement the Basin Plan, the NSW Government needs to ensure compliance with water use rules and related legislation, and sustainably manage floodplain harvesting. To help achieve this latter aim, the NSW Government is finalising a Floodplain Harvesting Policy to ensure that such harvesting is appropriately licensed and meets the requirements of the National Water Initiative.

A major challenge is to identify the water requirements of priority wetlands and monitor the delivery and effectiveness of such water. NSW has invested significantly in the purchase of environmental water and the experience that will be obtained through its delivery will help to set future directions in wetland management.

Wetland management on private land has been improved by developing comprehensive guidelines, by educating landholders about best practice wetland management and by tailoring a range of management actions to individual wetlands. Incentive programs such as those run by Industry and Investment NSW and catchment management authorities are strengthening conservation of wetlands on private lands.

In some regions, water scarcity and past decisions about land use mean that wetland health is more likely to improve when substantial resources are directed to areas of greatest conservation significance, whilst recognising the benefits for biodiversity of connectivity between wetlands. The NSW Government has been implementing the Wetland Recovery Program to deliver targeted wetland conservation outcomes. This program involves a suite of projects whose aim is to restore the Macquarie Marshes and Gwydir Wetlands. Water recovery, weed control, grazing management and targeted research projects are helping to address the ecological stress these two wetlands are experiencing. The Wetland Recovery Program is providing examples of best practice projects that can be implemented on other significant wetlands in NSW.

A more recent threat to inland wetlands is potential acid sulfate soils (DECCW 2009). River regulation has led to the accumulation of sulfidic sediments in some Murray–Darling Basin wetlands. These sediments pose little threat when they are undisturbed and covered by water, although the large-scale drying of wetlands during the drought has exposed these sulfide-rich sediments to air, with the potential to generate sulphuric acid. When re-moistened, many of these wetland soils may release sulfuric acid into the waterways. Efforts are under way to locate wetlands in the Murray–Darling Basin which have potential acid sulfate soils and identify ways in which their drying periods can be managed to minimise the potentially catastrophic release of acids into inland waters.

### 2.3.2 Coastal wetlands

Coastal wetlands include estuarine lakes and lagoons, coastal floodplain forests, and mangrove and saltmarsh swamps. Wetlands on the coast are subject to threats such as over drainage, exposure of acid sulfate soils and intense urban development. These threats have created a landscape where many wetland ecosystems are fragmented or endangered.

For example, seven coastal wetland communities are listed in the *Threatened Species Conservation Act 1995* as endangered ecological communities, including saltmarsh, river-flat eucalypt forest and swamp sclerophyll forest. With much of the immediate threat coming from urban development (DECC 2006), there is a need to conserve these endangered ecological communities and threatened species on the coastal floodplain.

Conservation efforts may be complicated by sea-level rise, a threat exclusive to coastal wetlands. Salinisation, higher tides and floods are some processes that will start to affect low-lying coastal wetlands. The NSW Government is currently developing strategies to deal with the impacts of sea-level rise (see principles 3 and 8).

Water sharing plans for coastal rivers will benefit coastal wetlands. For example, by protecting floodplain billabongs and preventing bores from being established near groundwater dependent ecosystems (see DLWC 2002), the hydrology of many coastal wetlands will be managed more sustainably. Future research will need to examine the connection of features of coastal wetlands, such as intertidal vegetation, with groundwater systems. Environmental water is not currently being purchased in coastal catchments as overallocation is more relevant to inland areas, and water sharing plans should suffice to manage extraction that may affect high value wetlands.

The Government's emphasis for coastal wetlands is on conservation, land use planning and rehabilitation. Managing high conservation value coastal wetlands and lowlands through reservation programs and private-land conservation will be vital. Cooperation between state and local government will be essential for identifying these wetlands and for their ongoing management. Some high-value wetlands have already been secured with assistance from the NSW Environmental Trust. Further work needs to be done to more comprehensively document the location, extent and biodiversity values of valuable coastal wetlands, particularly endangered ecological communities, and then conserve them.

See the introduction to this section (section 1.3) for further land use planning information including information on *State environmental planning policy no. 14 – Coastal wetlands*.



Coastal wetland in northern NSW. Photo: R. Nicolai

### 2.3.3 Upland wetlands



Upland wetlands, such as Mt Hay Creek swamp in the Blue Mountains region, provide habitat for a wide range of plants such as this flowering buttongrass. Photo: I. Baird

The other major type of wetland in NSW is the upland wetland. This type of wetland is located in low hills or mountainous regions, such as the Monaro region and the Snowy Mountains. Areas of NSW's public reserve system, such as the steep ranges of eastern NSW and the Australian Alps which are amongst the best protected landscapes in NSW, currently protect some upland wetlands from damaging land use practices or water extraction. These reserved wetlands are vulnerable to indirect impacts. For example, glacial lakes such as the Ramsar-listed Blue Lake are threatened by warming patterns associated with climate change (see section 1.4 below). Blue Lake is being monitored to track the impacts of climate change, as are other upland swamps on the Woronora plateau in the Sydney Basin bioregion.

Upland wetlands are not well-represented in the reserve system, and have been historically reduced in area. In recognition of this, many tableland wetlands are listed as endangered ecological communities in the *Threatened Species Conservation Act 1995*. Examples include the upland wetlands of the New England Tableland Bioregion, and montane peatlands and swamps in areas such as the NSW North Coast and Sydney Basin. These wetlands will be managed by various means, including recovery planning to identify ways of managing threats, and voluntary conservation agreements to conserve remnants, where possible. Tableland wetlands will also be a priority for reserve building under the NSW National Parks Establishment Plan (DECC 2008).



Most upland wetlands are not filled by river flows, but rely on groundwater, rainfall runoff and snow-melt. Many may act like a sponge and slowly release runoff and groundwater into lowland rivers and streams. The new water management framework for NSW will benefit upland wetlands by improving the management of groundwater resources. For example, groundwater sharing plans will prevent bores being established near groundwater-dependent wetlands, ensuring that the hydrology of these systems is maintained at sustainable levels.

Rehabilitation works, such as those run by catchment management authorities and local government, are also targeting upland wetlands. Examples of wetlands where current rehabilitation projects are being undertaken by these organisations, community-based groups and land holders include Lake Bathurst and The Morass, the hanging swamps of the Blue Mountains, and montane wetland endangered ecological communities in northern NSW. To restore these wetlands, management planning; on-ground works such as fencing, off-stream watering, and weed and feral pest control; and revegetation are being used. In these instances, the challenge is to find a balance between the environmental and productive uses of land and water.

One issue of specific relevance to upland wetlands is mining. Although mining activities are localised, they can have significant impacts on the hydrology and ecological function of swamps, for example through subsidence impacts from underground mining. Historically, peat was extracted from Wingecarribee Swamp, the largest peatland on mainland Australia, for 25 years until it underwent a massive structural collapse in 1998 (Arachchi and Lambkin 1999). In recognition of the importance of peat as a carbon sink, the fact that peatlands are a rare vegetation type in NSW with a distinctive biota, and the collapse of Wingecarribee Swamp, peat mining is no longer considered sustainable in NSW.

## 2.4 Wetland management in NSW – future

### 2.4.1 The threat of climate change

Whatever tools are used to reduce the vulnerability and build the resilience of NSW wetlands over the coming years, human-induced global climate change and associated changes in flooding and sea-level rise will pose a major challenge to their effectiveness.

The Intergovernmental Panel on Climate Change (IPCC) observed that Australian average temperatures had increased by 0.9° C since 1950. The IPCC predicts an increase in extreme weather conditions, including more prolonged drought, bushfires and extreme temperatures. Changes in climate will be likely to affect the water resources of NSW, possibly leading to shifts in wetland distribution or ecosystem type. Associated sea-level rise may result in more storm surges, increased salinity of estuaries and freshwater aquifers, and altered tidal ranges and flooding duration in rivers and bays. Further loss of coastal saltmarsh, which is an endangered ecological community, is predicted as a result of climate change unless provisions are made for upslope migration. Opportunities to allow for upslope migration will be constrained by topography as well as urban development and infrastructure.

These predictions require a measured response, and need to be considered in a historical context. Land holders and natural resource managers in NSW have always contended with a variable climate and as such are inherently adaptive. Climate change presents a threat of magnified climatic variability coupled with a change in the base parameters of rainfall and temperature, which will fundamentally change environmental conditions, as well as social and economic resilience to these changes. Consequently, principles and strategies to take future climate change into account are included in this policy.

Planning and prioritising efforts for wetland conservation need to recognise the importance of factoring in the resilience of particular wetlands and their capacity to respond to climate change predictions. Maintaining adequate vegetated buffers will be an important factor in maintaining wetland resilience to climate change, particularly intertidal wetlands that will need to migrate upslope with sea-level rise.

It is critical to recognise the important role wetlands can play in adapting to the impacts and implications of likely climate change in NSW. For example, mangrove forests may reduce storm surge associated with more severe weather; saltmarshes provide essential habitat for migratory shorebirds; lakes and lagoons provide drought refuge for plants and animals, and may contribute to sustained base flows for rivers. Protecting the wetlands of NSW is the principal way of protecting these functions – and many others – which provide benefits beyond the wetland boundary.

## 3 Why are wetlands valuable?



Wetlands are home to threatened species such as the endangered giant dragonfly *Petalura gigantea*, which is dependent on groundwater. Photo: I. Baird

### 3.1 For their intrinsic value

Wetlands provide habitat for a wide range of animals including waterbirds, fish, frogs and invertebrates, and water-loving plants such as sedges, rushes and various tree species. Wetlands also provide shelter, breeding grounds and nurseries for a variety of fauna, particularly insects, fish, frogs and waterbirds. Wetlands support many listed threatened species and ecological communities.

### 3.2 For the ecosystem services they provide

In addition to their intrinsic value, wetlands perform a number of functions that are valuable to human beings, termed 'ecosystem services'. According to the United Nation's Millenium Ecosystem Assessment program (United Nations 2005), there are four types of ecosystem services, and wetlands are rich providers of each of them.

#### 3.2.1 Provisioning services

Provisioning services refer to direct economic benefits that wetlands provide, such as food and fresh water, wood, fibre and mining.

Estuarine wetlands in NSW contain large areas of seagrass, mangrove and saltmarsh which support a diversity of juvenile fish species, including those that are harvested for commercial purposes. Inland floodplain wetlands, such as those at the termination of the Gwydir, Macquarie and Lachlan rivers, have highly productive herbaceous growth which supports grazing.

For over 150 years, forestry activities have occurred within stands of seasonally-flooded river red gum along the Murray and Murrumbidgee rivers, with the NSW Central Murray State Forests being listed as a Ramsar site in 2003.

Tourism is also a major service provided by wetlands – one example is the Myall Lakes Ramsar site on the NSW mid-north coast.

Raw materials such as sand and peat have been extracted from various NSW wetlands, including the Hawkesbury–Nepean River, Kurnell Peninsula and Wingecarribee Swamp. Continuing demand for sand as a building material means that this service is considered in some instances to be more important than either the wetland's intrinsic value or the other ecosystem services it provides. Wherever possible, these activities should avoid and minimise impacts on wetland values and services.

With respect to peat, many remaining peatlands in NSW are listed as endangered ecological communities and with the collapse of Wingecarribee Swamp in 1998, partially due to mechanical peat extraction, peat mining is no longer considered to be sustainable in NSW.

### 3.2.2 Regulating services

Regulating services refer to the critical role wetlands play in regulating ecological and biophysical processes. Many regulating services that wetlands provide are related to their capacity to purify water, retain floodwaters, and provide a buffer to terrestrial areas at risk of flooding or pollution.

Vegetation in wetlands can absorb strong winds and tides, making them excellent for foreshore protection. Plants in the wetland also help to filter pollutants and sediments in the water. For example, riparian vegetation can play a significant role in reducing the amount and concentration of nitrogen entering streams, protecting downstream water quality.

As wetlands capture and detain runoff, they can hold flood waters which could otherwise damage human health and property. For example, the Macquarie Marshes help prevent flooding of downstream towns and settlements, as they slow flood waters and spread them over the floodplain. The tendency of wetlands to release water slowly by acting as surface reservoirs or as discharge zones of large regional aquifers or smaller perched aquifers also means that they can maintain the base flows of rivers during dry weather. The Blue Mountains hanging swamps are examples of wetlands associated with regional and perched aquifers and they slowly release water to provide constant base flows for creeks, river and waterfalls.

### 3.2.3 Cultural services

Cultural services cover the aesthetic, spiritual, educational and recreational aspects of wetlands.

Wetlands continue to be an important resource for communities. They are places for teaching and learning, places to connect with the past and places that can contribute to community wellbeing. For example, wetlands are often the focal point for human communities.

Wetlands have special social, cultural and spiritual importance for Aboriginal people. They may support certain plants with cultural values and areas related to Dreamtime stories. For Aboriginal communities, wetlands may include places connected with important spiritual and cultural occurrences. They may also include places connected with important people and can contain physical evidence of past uses of the area.

Pristine wetlands, in particular, are excellent sites for scientific research, as they provide insight into wetland values and functions in the natural state, which can help with the conservation, rehabilitation and management of degraded wetlands.

### 3.2.4 Supporting services



Waterbirds on the Lowbidgee floodplain provide nutrients to areas used for organic farming.  
Photo: J. Maguire, DECCW

Supporting services relate to the support wetlands provide for ecosystem function, many of which are easy to overlook but all of which are vital. For example, clean water and productive fisheries are sustained by a wetland's capacity to assimilate nutrients and pollutants. Atmospheric carbon is cycled through the food chain and may be sequestered in the long term, particularly in peatlands which globally are one of the largest sinks for greenhouse gases.

Nutrient cycling occurs in different modes in wetlands, from the uptake of elements necessary for biological growth, to the movement of nutrients by animals and water. In estuarine wetlands, burrowing animals such as crabs transfer nutrients into and out of the sediment.

On floodplains, nutrients are exchanged between the river and wetlands according to the drought–flood cycle. On the Lowbidgee floodplain, for example, bird breeding can provide huge inputs of nutrients from droppings to areas that are then used for organic farming.

## 4 Guiding principles



When wetlands are sustainably managed, they provide valuable habitat. Here, birds are breeding in the Macquarie Marshes. Photo: B. Johnson, Sydney Catchment Authority

For the sustainable management of wetlands, the NSW Government will adopt the following principles to guide decision-making:

### Principle 1: Wetlands are valued as significant parts of NSW landscapes – their conservation and management are most appropriately considered at the catchment scale.

Wetlands usually function as sinks and can therefore be exposed to numerous impacts from the entire catchment, such as weed invasion, excessive input of sediment, and changes to water regimes. The conservation and management of wetlands cannot succeed simply by controlling activities within their discrete boundaries. The impacts of surrounding land and water uses must be considered and managed to ensure that they do not diminish the health of the wetland. Examples of good management include sediment control, weed exclusion zones and water containment areas. These actions are highly relevant for those critical times when wetlands act during floods to replenish the river with organic material that is an essential source of energy and nutrients.

The principle of 'no net loss' should be implemented for developments. This principle can be achieved through state and local government planning and regional natural resources management activities, such as the strategic provision of on-ground works and property management planning.

## Principle 2: Water regimes needed to maintain or restore the ecological resilience of wetlands should be provided through water management planning, water recovery and water purchase, recognising that a balance between environmental and human requirements must be reached.

Water availability is a fundamental driver of wetland health. Adequate volumes and natural patterns of wetting and drying are needed to maintain wetland condition. The plants and animals living in wetlands are adapted to variable inundation. When patterns are disturbed, this affects the range of plant and animal species that wetlands can support.

It is important, therefore, that dams, weirs, levees, floodgates and barrages are managed to maintain the characteristics of natural inundation. This will mean that some wetlands that are now permanently flooded will be allowed to dry out, while other wetlands that are not currently receiving enough water or tidal flushing will have their water and tidal regimes restored as far as possible. Restoring the natural flooding patterns of wetlands is fundamental for restoring their natural ecological resilience.

Coastal wetlands have been greatly affected in many areas by inappropriate development, whether it be by filling for urban development or by drainage for agricultural development. Over-draining of coastal landscapes particularly threatens freshwater wetlands, and can result in acid discharge into rivers. Ecologically appropriate water regimes can be restored by using shallower drains that remove surface water while maintaining groundwater levels; installing in-drain structures, such as drop-boards, which have an added advantage for adaptive management; and infilling drains. For inland wetlands, maintaining natural wetting and drying regimes will avoid the build-up of sulfidic sediments that can lead to acid discharge.

Water availability in some valleys may mean that not all wetlands can be sustained during droughts. To ensure the optimal use of available water for greatest conservation outcomes, environmental water management plans should be prepared for affected valleys. These plans should detail the water requirements of wetlands, including the requirements of flora and fauna, and articulate a watering strategy to maximise conservation outcomes. Such plans will improve the capacity of managers to sustain wetlands through periods of prolonged drought.

Water quality also plays a role in wetland health. Run-off from towns, cities and farms may contain toxic substances or high levels of nutrients. If contaminated flows enter wetlands, they can cause problems such as eutrophication, fish kills or excessive plant growth. Increased salinity and turbidity can alter the composition of vegetation, affecting the habitat of many other species that depend on particular plants. Thermal pollution is also an important factor affecting wetlands, as not all wetland species can tolerate large changes in water temperature.

## Principle 3: Floodplains should be managed to maintain the natural distribution of water to and from wetlands, and to allow for the movement of aquatic biota.

The natural inundation of floodplains provides many environmental and economic benefits. Flood waters replenish floodplains with nutrients and organic matter and circulate carbon throughout the system. This process supports natural floodplain and wetland ecosystems, maintains habitats and provides fertile land for agricultural production. Deposited sediment also elevates the floodplain, which is important for coastal areas facing sea-level rise.

Historical development on inland and coastal floodplains has resulted in the loss and reduced hydrological connectivity (alienation) of many wetlands. Inland wetlands have been affected by levees and other earthen structures built to protect agricultural development from flooding. Such 'flood barriers' have led to the loss of connectivity to riverine systems, and the loss of the natural ecosystems and the services they provide. Coastal wetlands such as saltmarsh have been cut off from tidal inundation by seawalls and other land retention structures. The cumulative impact of flood control works on water sources and their dependent ecosystems has been considerable.

Wetland functions need to be considered up-front in floodplain management and in the formulation of development proposals. Land that is identified as alienated as a result of earlier development should be reconnected or rehabilitated wherever possible. Tidal flows may need to be restored. In these instances, the focus should be on wetlands of high environmental value on the floodplain, with social and economic factors, particularly flood risk, considered as part of an integrated appraisal.

In NSW, rural floodplain management plans are in preparation or have been gazetted for 12 major rural floodplains covering about 28,510 square kilometres. These plans cover the major floodplains associated with sections of the Namoi, Gwydir, Liverpool Plains, Macquarie, Lachlan, Murrumbidgee and Murray rivers, and Billabong Creek. In these plans, efforts are being directed to reconnecting at least 60% of the natural one-in-five-year flooded area to the river.

#### Principle 4: Wetlands of international, national and regional significance should be identified and given priority for conservation and investment.

Some wetlands, due to their natural or cultural significance, are so important that they need to be given special protection and managed as a priority. This may be because the wetland supports particular threatened species or migratory waterbird species, or because it is an excellent example of a wetland type in a region. Some wetlands have already been identified as having significant international, national or regional value. As recognised assets of greater value, these should receive priority for funding.

Currently within NSW, wetlands are conserved in national parks, nature reserves, flora reserves, State forests, historic sites, Indigenous protected areas, Crown land reserves, council reserves, aquatic reserves and marine and estuarine protected areas. Protection mechanisms include listing under the Ramsar Convention, *State environmental planning policy no. 14 – Coastal wetlands*, appropriate zoning in local environmental plans, state natural resource policies, conservation agreements, wildlife refuges and various plans of management. The State Government is working towards reducing red tape and streamlining planning processes to assist the community in maintaining and protecting wetlands.

The NSW National Parks Establishment Plan 2008 (DECC 2008) identifies wetlands, floodplains, lakes and rivers as one of seven key types of land for acquisition over the next ten years. The plan targets the upper Darling and its tributaries in western NSW and coastal floodplains and estuaries. Across NSW, reserve establishment will focus on consolidating existing reserves and on coastal areas, specifically consolidation around coastal lakes identified by the Healthy Rivers Commission (2002). Any wetlands purchased pursuant to this plan will be subject to normal government approval processes and availability of funding.



A framework for identifying, classifying and managing high conservation value aquatic ecosystems (HCVAE framework) is being developed by the Australian Government in consultation with the states. Applying consistent criteria in evaluating the conservation status of wetland ecosystems will help to ensure all wetland types are conserved in the protected area network. This process will be supported by collection of ecological baseline data, and the production of adequate mapping and databases on wetland ecosystems and their location; their tenure; their ecological, social and economic values; and their susceptibility to climate change.

### Principle 5: Land management practices should maintain or improve wetland habitats, ecosystem services and cultural values.

Many issues other than water regimes affect wetland health. These include weed and pest animal control, grazing, cropping, maintenance of vegetated buffers, fire management and rehabilitation of wetland vegetation. Management of wetlands for their wet and dry phases must be addressed in water and land management plans and strategies.

As many NSW wetlands are located on private lands or affected by activities on private lands, land holders can improve wetland health by adopting good management practices. Controlling access by stock will help to ensure that wetland vegetation is not destroyed, and seed banks and soil structure are not adversely affected. In riparian areas, controlling stock reduces the amount and concentration of nitrogen entering streams, thus protecting downstream water quality. In coastal areas, preventing damage to mangrove and saltmarsh helps maintain their capacity to function as nurseries for juvenile fish.



Pest, weed and land management protect native species in wetland areas, such as the red-bellied black snake. Photo: D. Love, Sydney Catchment Authority

Wet pasture management is another useful management practice in coastal areas, involving the use of native wetland species and high water levels rather than traditional dryland species on drained land. This practice has led to increased productivity, reduced acid discharge, increased habitat for fish and wetland birds and improved biodiversity.

Vegetated buffers around wetlands play an important role in maintaining wetland health. Potentially damaging external influences, particularly those caused by incompatible land uses, are reduced by incorporating a suitably vegetated strip on the edge of the wetland. This buffer helps to maintain and protect ecological processes and functions in the wetland. Buffers reduce changes to subsurface and surface water flows; sedimentation or erosion; increases in noise and temperature; toxins, bacteria, and viruses; physical intrusions and disturbances; and the introduction of weed and pest species. Adequate widths of buffers required to achieve these outcomes will depend on a range of local and catchment parameters including hydrology, soils, vegetation and topography, and on the adjacent land use.

With careful planning, prescribed fire can be used as part of an integrated strategy to control noxious weeds and animals and promote native plant regeneration, as well as sustain ecosystem health through its affect on nutrients and habitat configuration. Such approaches have been used successfully in Moira Lake, where burning is used in combination with carp harvesting and reinstated environmental flows to improve the lake's health. However, this practice should be avoided in some wetlands or circumstances where fire may deplete carbon stocks and exacerbate the effects of drought and noxious weed invasion. Fire in areas of coastal peat also has damaging effects, such as altering natural vegetation composition and destroying fauna habitat.

The management practices outlined above, and others, can be developed fully in property vegetation plans or other farm plans, or management schemes for conservation agreements or wildlife refuges. The long-term management benefits of working on small, private wetlands are considerable when cost-benefits are calculated. The managers of these wetlands are also vital partners in addressing issues that cross over property boundaries such as vertebrate pests, hydrology, and weeds. Incentive funds may be available to land holders from catchment management authorities to support these farm plans (subject to Government approval). Well-managed wetlands can also be identified as BioBanking sites that would attract funds from development proposals that unavoidably impact on other wetlands.

There are numerous sources of information on best practice land management in and around wetlands. Guidelines are available from agency websites such as the Department of Planning and catchment management authorities, as well as from industry groups.

## Principle 6: Wetlands should be recognised as places with important cultural values, in particular that wetlands are an important part of Country for Aboriginal people.

Wetlands hold many cultural, social and historic values for all people who have lived and continue to live around them. Aboriginal people in particular view wetlands as an intrinsic part of their culture and heritage. Wetlands have been a source of food, water and natural resources for Aboriginal people and they feature significantly in Aboriginal Dreaming, as well as in pre-colonial and post-colonial experience. Aboriginal people continue to use wetlands for fishing, gathering of natural resources and cultural ceremonies.

The Aboriginal cultural values of wetlands should be recognised and integrated into natural resource management. Recognising cultural values of wetlands involves consulting with Aboriginal communities, recognising Aboriginal custodianship and providing options for appropriate access. These cultural values then should be incorporated into regional wetland planning by developing tools to engage Aboriginal communities, and by placing triggers in management of wetlands based on cultural values. An example is the provision for cultural licences in NSW water sharing plans.

Wetlands also hold cultural values for non-Aboriginal communities, which relate to histories of recreation, including fishing, hunting and camping; conservation, including long-term efforts to conserve habitats; and pastoralism. These cultural values should be documented, recognised in management and promoted.

### Principle 7: Degraded wetlands and their habitats should be rehabilitated and their ecological processes improved as far as is practicable.

Many wetlands need rehabilitating, though resources to undertake rehabilitation works are limited. Wetland rehabilitation projects require careful planning to optimise outcomes. Before proceeding, the biophysical condition, assessed threat, recovery potential, strategic value and projected availability of resources should be known. This information will help prioritise rehabilitation and management efforts to achieve the greatest conservation outcome for the available water and resources, in light of projected climate change impacts.

Following an economic, environmental and social assessment of wetlands, rehabilitation should be focused on areas of greatest need and where the greatest benefit would be derived. Due to the challenges of wetland rehabilitation, it would be more beneficial for environmental and economic outcomes to rehabilitate wetlands in comparatively good condition before rehabilitating wetlands in a degraded condition. However, this may not always be the case. For example, wetlands which have been degraded but are likely to be resilient to climate change, such as sites reserved for landward expansion of coastal wetlands, may prove to be prime sites for rehabilitation. Although poorly understood for most wetlands, the maintenance of wetland plant seed banks and invertebrate egg banks is crucial for resilience in Murray–Darling Basin wetlands, and in this instance, an emphasis on the connectivity of wetlands to riverine flows is essential.

Successful rehabilitation requires integrating a number of approaches. Restoring or partially restoring the original hydrological cycle of wetlands is often crucial. The control of pest plants and animals may also be a priority. Rehabilitation projects need to comply with legislative and planning procedures. There are a number of regulations under the *Threatened Species Conservation Act 1995* and *State environmental planning policy no. 14 – Coastal wetlands* (SEPP14) which have been put in place to help protect wetlands and wetland species. For example, SEPP 14 currently requires an environmental impact statement to be prepared for restoration works that involve clearing, draining, filling or leveeing within a mapped SEPP 14 wetland. While it is necessary to have some oversight of works which may affect protected wetlands, the Government endeavours to ensure that bona fide restoration projects are not unduly inhibited.

The complexity of wetland rehabilitation and the variable results achieved so far emphasise the need for ongoing monitoring and regular reporting (see principle 12). In this way, new rehabilitation projects can benefit from past experiences.

## Principle 8: The potential impacts of climate change should be considered in planning for wetland conservation and management.

The potential impacts of climate change on inland wetlands include a reduction in river flow which, in combination with a warmer climate, may result in excessive drying out of wetlands, increased algal blooms, salinisation risks and reduced aquatic biodiversity. The potential impacts on coastal wetlands include increased inundation, salinity and loss of biodiversity; habitat migration and loss as a result of sea level rise; and loss of intertidal habitats such as mudflats and high tide roosts, which are habitat for migratory birds (van Dam et al 2004).

Wetlands and their biota are defined by their adaptation to natural climatic variation. If climate change takes these variations beyond the extremes that have been experienced historically, some wetlands will become vulnerable. The resilience of particular wetlands and their capacity to respond within the climate change predictions need to be recognised and factored into planning and prioritising efforts for wetland conservation.

In NSW, the most likely scenario for wetlands is that they will receive, on average, less water. Vaze et al (2008) estimate that future mean annual runoff in around 2030 relative to 1990 will be lower by 0–20% in the southern parts of the state and higher by 0–20% in the north-west corner of the state. No change to a slight reduction in the mean annual runoff is predicted in the eastern parts of the state.

For inland wetlands threatened with reduced water, management actions include:

- allocating a greater proportion of water to the environment
- using water control structures to enhance wetland health, for example, controlling water once it has reached the wetland so the wetland remains saturated, or controlling water flows so more water reaches wetlands
- reducing non-hydrological pressures such as weed invasion and sedimentation on marginal wetlands
- increasing the protected area network and reserve system, and linking these by corridors to allow for migration of organisms.

During drought, or in the event of a drier climate, it may be necessary to sustain the core areas of larger wetlands with environmental water allocations, while permitting the non-core areas to be managed as dry-phase wetlands. To prepare for climate change impacts, environmental management plans should attempt to identify the minimum area needed to maintain critical ecological functions and habitats.

For coastal wetlands threatened by sea-level rise, migration of coastal wetlands should be allowed to occur. This can be achieved by making provisions for landward expansion of coastal wetlands, which are often restricted by urban development. Areas identified for migration or expansion of wetlands will need to be integrated into local planning instruments or incorporated into the protected area network. Active management may also be required, such as pre-emptive translocation of species where the natural ecology of the wetland is threatened.

Many estuaries in NSW are classified as intermittently closed and open lakes and lagoons (ICOLLs), and their ecology is influenced by the frequency with which they open to the sea as well as the amount of rainfall and runoff they receive. The inundation of these waterbodies will be affected by sea-level rise and extreme storms, leading to a potential shift in ecology and stress on dependent species.

The *Draft NSW coastal planning guideline – adapting to sea-level rise* (Department of Planning 2009) provides strategic planning advice for addressing the implications of sea-level rise on the long-term protection of coastal and estuarine ecology as well as accommodating landward migration of wetlands, mangroves and saltmarsh communities.

### Principle 9: Research into wetland ecology should be encouraged to better support water and land use planning and management.

Wetlands cannot be managed sustainably unless people understand how they function. Research needs to identify the most achievable solutions for maintaining wetland integrity at catchment and landscape scales.



After delivery of 7,000 megalitres of environmental water to Yanga National Park between October 2009 and January 2010, vegetation flourished. Photo: J. Maguire, DECCW

In recent years, there has been good progress in understanding the importance of floodplain connectivity for wetland biodiversity, the reasons why waterbird species are threatened, and why the abundance of fish varies between different types of coastal wetlands. However, as many wetland processes are poorly understood, there remains a need for ongoing targeted research.

Specifically, more research is required to understand the water requirements of a range of wetlands and wetland components, and ways in which environmental water might be more effectively delivered. The impacts of climate change on wetland ecosystems and potential climate change refugia need to be identified.

This research will also need to be supplemented with knowledge arising from ongoing wetland management and monitoring. Greater awareness of the value of wetlands and their ecological systems, together with improved understanding of human impacts, are both necessary to bring about improved wetland management.

**Principle 10: Natural wetlands should not be destroyed or degraded. If social or economic imperatives in the public interest result in a wetland being degraded or destroyed, the establishment and protection of a wetland offset that supports similar biodiversity and ecological functions will be needed.**

The clear priority is to avoid wetland destruction and degradation altogether, particularly the construction of artificial wetlands on the site of viable natural wetlands. If the conservation value of a wetland is very high, or has unique qualities that are impossible to compensate for, the wetland should not be subject to development that will compromise its values. Many impacts on wetlands can be avoided by finding an alternative site, or by adopting best-practice design measures.

Nonetheless there will be instances when social and economic imperatives require wetland modification or even destruction. Some of the more obvious instances that invoke the concepts of social and economic imperatives in the public interest are service corridors (road, rail, power, gas, water, communication); military defence installations; airport and harbour facilities; power stations; major water supply and flood storage infrastructure; and essential enhancement of other infrastructure (DLWC 2002a). These imperatives should only be operative when the costs of not proceeding with the development outweigh the costs arising from the destruction of the wetland.

Where a project is overwhelmingly in the public interest and no feasible alternative to destroying or degrading the natural wetland exists, wetland offsets should be pursued to counterbalance the impact of the project. Offsets can include rehabilitation, purchase and protection of a similar wetland and, in exceptional cases, construction of a new wetland. Offset wetlands will be funded by the proponent of the development.

As wetland offsets need to replace what has been destroyed, they must provide equivalent values, functions and services. Due to the difficulties of wetland rehabilitation, the destruction of the wetland to be lost should only be permitted if it has been conclusively demonstrated that the offset has 'worked'. Offset ratios may also need to be applied to help to maintain net regional biodiversity, habitat and catchment functions. Industry and Investment NSW, for example, implement wetland offsets via the issuing of permits under the *Fisheries Management Act 1994*. Offset ratios relevant to aquatic habitat are defined in Industry and Investment NSW's *Policy and guidelines for aquatic habitat management and fish conservation (1999)*.

Wetland offsets will be calculated, approved and managed by the most applicable legislation, which will vary according to the type of wetland and the values being compensated for.

Examples include:

- the *Threatened Species Conservation Act 1995*, which uses the Biodiversity Banking and Offsets Scheme (BioBanking Scheme). Wetlands covered by this scheme include, but are not limited to, freshwater wetlands on coastal floodplains, montane peatland and swamps, Sydney freshwater wetlands and upland wetlands, and swamp sclerophyll forest, by virtue of them being endangered ecological communities.
- the *Fisheries Management Act 1994* manages offsets associated with impacts on key fish habitats. Wetlands covered by this Act include seagrass, mangrove and saltmarsh.
- the *Native Vegetation Act 2003*, which uses property vegetation plans and the environmental outcomes assessment methodology to offset the clearing of wetlands. Most vegetated wetlands on rural land are covered by this Act.

Constructed wetlands are increasingly being used for a number of purposes, particularly as a means of waste and storm water treatment. They also help to control water pollution by filtering out harmful nutrients, provide wildlife habitat, and have aesthetic, recreational and educational value. While constructed wetlands may fulfil an important role in improving water quality, unlike compensatory wetlands, they are not designed to replace all the values of natural wetlands. For this reason, they should be seen as enhancing existing wetland systems, not replacing them. They also require different management strategies, such as periodic de-silting to conserve their main functions over time.

### Principle 11: Cooperation and incentives among land managers, government authorities, catchment management authorities, non-government organisations and the general community are essential for effective wetland management.

Many wetlands are protected in reserves; however, most NSW land is managed by farmers, graziers, indigenous communities and other private land managers. As a result, effective protection of NSW's wetlands needs to include managing wetlands on private land, and engaging private land managers in this effort.

The development of partnerships between private land managers and government, and government provision of sound guidance and incentive mechanisms, can help private landholders to manage their wetlands appropriately. There has been a significant investment by the state and Commonwealth governments in wetland rehabilitation. Catchment management authorities, government agencies and local councils also have an important role to play in giving the community, and in particular wetland owners and managers, the support and encouragement needed to protect and restore wetlands, as well as lead by example.

Other stakeholders such as recreational fishers, boat users, tourists, scientists and naturalists who also affect the health of wetlands, have a vested interest in their protection. It is important to foster cooperation with these user groups and where possible to encourage their investment in the health of wetlands.

One challenge for sympathetic and informed wetland management by land holders is the cyclical nature of wetlands and their surrounding environments. For example, cooperation between private land managers and government is achievable when water supplies are good, but more difficult during drought, when both will be driven by economic and social imperatives. Capacity for effective wetland management needs to be maintained at these crucial times.

## Principle 12: Regular reporting of wetland extent and condition is vital to assess management performance and to understand wetland dynamics.

To appreciate the impact human actions have on wetlands, monitoring the extent and condition of important wetlands across NSW will be regularly required. Monitoring should focus on evaluating the effectiveness of management strategies, such as weed removal or environmental flows (termed 'performance monitoring'), as well as tracking extent and condition over time, to see if wetlands are improving or degrading (termed 'condition monitoring').

Performance monitoring is required to measure the success of environmental water and land management in restoring wetland health, to assess and improve floodplain management planning, and to evaluate the success of rehabilitation projects.

Condition monitoring is equally important. NSW has developed a Monitoring, Evaluation and Reporting Strategy (MER Strategy) to refocus the efforts of natural resources agencies and to, amongst other things, measure progress against natural resource management targets. For wetlands, the specific target is: 'That by 2015, there is an improvement in the condition of important wetlands, and the extent of those wetlands is maintained'.

With a MER program in place for NSW wetlands, it will be possible to evaluate the effectiveness of management actions and identify any new issues or threats, such as the impacts of invasive species. Information from this program will be included in state of the environment reporting. As monitoring data builds, it will also be possible to understand the spatial and temporal changes wetlands naturally undergo – something which has not been possible on a statewide level before.

When significant loss of wetlands is detected by monitoring programs, activities which have caused the impacts should be curtailed, using provisions in the relevant legislation.



## 5 Monitoring and reviewing performance



The wetlands MER program will identify management actions that are improving the condition of wetlands and providing habitat for birds such as these intermediate egret chicks.

Photo: W. Johnson

### 5.1 Wetland monitoring

Consistent with principle 12, a program will be instituted to monitor the extent and condition of important wetlands across NSW. This statewide monitoring is part of the Government's Monitoring, Evaluation and Reporting Strategy (MER Strategy). The MER Strategy refocuses the efforts of NSW natural resource and environment agencies and aligns them with the actions of catchment management authorities, local governments, land holders and other natural resource managers to establish a system of monitoring, evaluation and reporting on the condition of natural resources.

The wetlands MER program will determine whether the combined effects of management actions are leading to an improvement in wetland condition and maintenance of wetland extent. The evaluation results will inform the development of an adaptive management framework to guide future actions. The program will focus on internationally important wetlands (Ramsar-listed wetlands) and nationally important wetlands, with some regionally important wetlands also represented. Other locally important wetlands may be monitored by community groups, universities, catchment management authorities and councils.

Indicators will be specific to wetland types and will be selected based on conceptual models that illustrate ways in which wetlands might be expected to change in response to improved management. The indicators were trialled in one inland and one coastal region during 2008, and will be expanded to other areas of NSW in 2009–2010, depending on available resources. The Department of Environment, Climate Change and Water (DECCW) will be responsible for the program’s design and implementation.



Monitoring management actions for wetlands will help to maintain and rehabilitate valuable areas such as this upland swamp. Photo: I. Baird

## 5.2 Review

DECCW will manage this policy, and will periodically review it based on changing circumstances. DECCW can be contacted for advice on this policy, and where relevant, for referral to the most appropriate agency.

## 6 References and further reading

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# 7 Glossary

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**Biodiversity conservation:** the maintenance of the variety of life forms, species of plants, animals and microorganisms, the genes they contain and the ecosystems they contribute to in the catchment.

**Buffer strip:** an area of land that provides a transition into the natural habitat of the wetland. Often this buffer consists of a vegetated strip of land that slows water flows, thereby absorbing or trapping sediment and nutrients.

**Catchment:** an extent of land drained by a particular stream or river.

**Catchment action plan (CAP):** a plan created by catchment management authorities that details the results that are expected to be achieved by the implementation of the plan and the timeframes for achieving those results.

**Catchment management authority (CMA):** independent statutory authority established to devolve operational, investment and decision-making natural resource functions to catchment levels. Currently there are 13 CMAs in NSW.

**Climate change:** a change of climate which is attributed to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods (United Nations Framework Convention on Climate Change).

**Connectivity:** the distribution of wetlands or other habitats that provide opportunities for the movement of biodiversity.

**Conservation significance:** areas that are of highest priority for preserving their natural values.

**Cultural heritage:** places and objects that are valued by the community. As well as buildings and landscapes, it includes objects representing traditional ways of life and symbols of events that have touched communities (from the Cultural Heritage Research Centre, University of Canberra, November 1997).

**Cultural heritage significance:** the aesthetic, historic, scientific or social values or other special values for future generations of Australians as well as for the present community (definition from the Australia ICOMOS Charter for the Conservation of Places of Cultural Significance – the Burra Charter – 1992).

**Diversity:** a measure of variability or species richness. An ecological community said to have great diversity has many species in it.

**Ecological processes:** ways in which organisms interact with each other and their physical surroundings.

**Ecosystem:** the sum of everything pertaining to a functioning biological community at a location, including species present and physical habitats.

**Ecosystem services:** the benefits to humankind provided by natural ecosystems, such as provision of clean drinking water and food, nutrient cycling and crop pollination, and maintenance of biodiversity.

**Eutrophication:** a process whereby water bodies receive excess nutrients that stimulate excessive plant growth (algae and weeds). This enhanced plant growth, often called an algal bloom, reduces dissolved oxygen in the water when dead plant material decomposes and can cause other organisms to die.

**Important wetlands:** wetlands listed under the Ramsar Convention or the Directory of Important Wetlands of Australia.

**Invasive species:** a species occurring, as a result of human activities, beyond its accepted normal distribution which threatens valued environmental, agricultural or other social resources through the damage it causes.

**Land capability:** the ability of land to accept a type and intensity of use permanently, or for specified periods under specific management, without permanent damage. It is an expression of the effect of biophysical land resources, including climate, on the ability of land to sustain uses, such as crop production requiring regular tillage, grazing, woodland or wildlife.

**Pest animals:** harmful, destructive or troublesome species of animal, or nuisance.

**Protected areas:** locations that need or receive protection because of their environmental, cultural or similar value. A protected area as defined by the International Union for the Conservation of Nature (IUCN) is: 'An area of land and/or sea especially dedicated to the protection and maintenance of biological diversity, and of natural and associated cultural resources, and managed through legal or other effective means'.

**Resilience:** the ability of an ecosystem to withstand and recover from environmental stresses.

**Thermal pollution:** refers to an artificial lowering or raising in the temperature of a waterbody. For example, the release of water from the colder denser layer near the base of major dams results in cold water pollution downstream.

**Wise use:** the sustainable use of wetlands for the benefit of mankind in a way compatible with the maintenance of the natural properties of the ecosystem (derived from the Ramsar Convention on Wetlands).



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