Case Study C

3.1 Maitland's Native VEGETATION

Snapshot of the last 130,000 years

Between about 130,000 and 17,000 years ago vegetation across the Lower Hunter (including Maitland) changed from coastal rainforests and wet eucalypt forests to semi-arid plant communities. This dramatic change was a result of a cooler global climate and falling sea levels.

As global climates became warmer, sea levels rose and rainfall in the Lower Hunter doubled. Eucalypt woodlands and forests expanded throughout the valley. Around 6,000 to 5,000 years ago, Maitland's plant communities were probably found in almost the same areas as today.

The spread of vegetation communities is influenced by elements such as rainfall, aspect, topography, geology and soil type. Information on these natural elements along with vegetation surveys, aerial photos, satellite images and computer modelling have been used to map Maitland's vegetation of today compared with that before European settlement.

A vegetation community is a particular combination of native plants. For example, the *Alluvial Tall Moist Forest* community is composed of tall eucalypt species such as Sydney Blue Gum and Swamp Mahogany, and a number of small trees consisting of rainforest species and paperbarks. These plants are found together on deep alluvial soils (i.e. riverine sediments).

The influence of natural elements on vegetation communities is shown by the *Lower Hunter Spotted Gum and Ironbark Forest*. Locally, there are good examples of this forest type around Ashtonfield and Thornton. It only occurs on clay-based soils formed from Permian geology found on hilltops south of the Hunter River. So we are able to say that where clay-based soils from Permian material occurs, *Lower Hunter Spotted Gum Ironbark Forest* would have once been found.

Edited from a cartoon by Susan Wicks, in Hirst, G. (Ed) 1993, *Black 'n' White 'n' Green*, Sydney: Envirobook; p. 95.

Maitland's native vegetation today

Vegetation mapping has shown that over 90% of native vegetation in the Maitland Local Government Area (LGA) has been cleared. What remains is testament to the diversity of vegetation that once covered the area.

Before European settlement fourteen vegetation communities existed in the Maitland LGA and now ten communities remain. These communities have been severely reduced, with each community cleared by at least 75% of its original extent.

Some vegetation communities have been completely cleared from the Maitland LGA. These include:

- *Coastal Foothills Spotted Gum Ironbark Forest*,
- *Mangrove-Estuarine Complex*, and
- *Swamp Mahogany Paperbark Forest*.

Other communities have also been reduced. The *Lower Hunter Spotted Gum Ironbark Forest* was the most widespread vegetation community found in Maitland before European settlement. It occupied almost 13,000 hectares of land in 1750 but now is reduced to just 1,200 hectares.

Maitland's remaining bushland can be categorised as:

Agricultural bushland

This bushland exists as small isolated patches in the rural landscape. Its survival from vegetation clearance was probably because the land was too steep for agriculture.

Structurally intact bushland

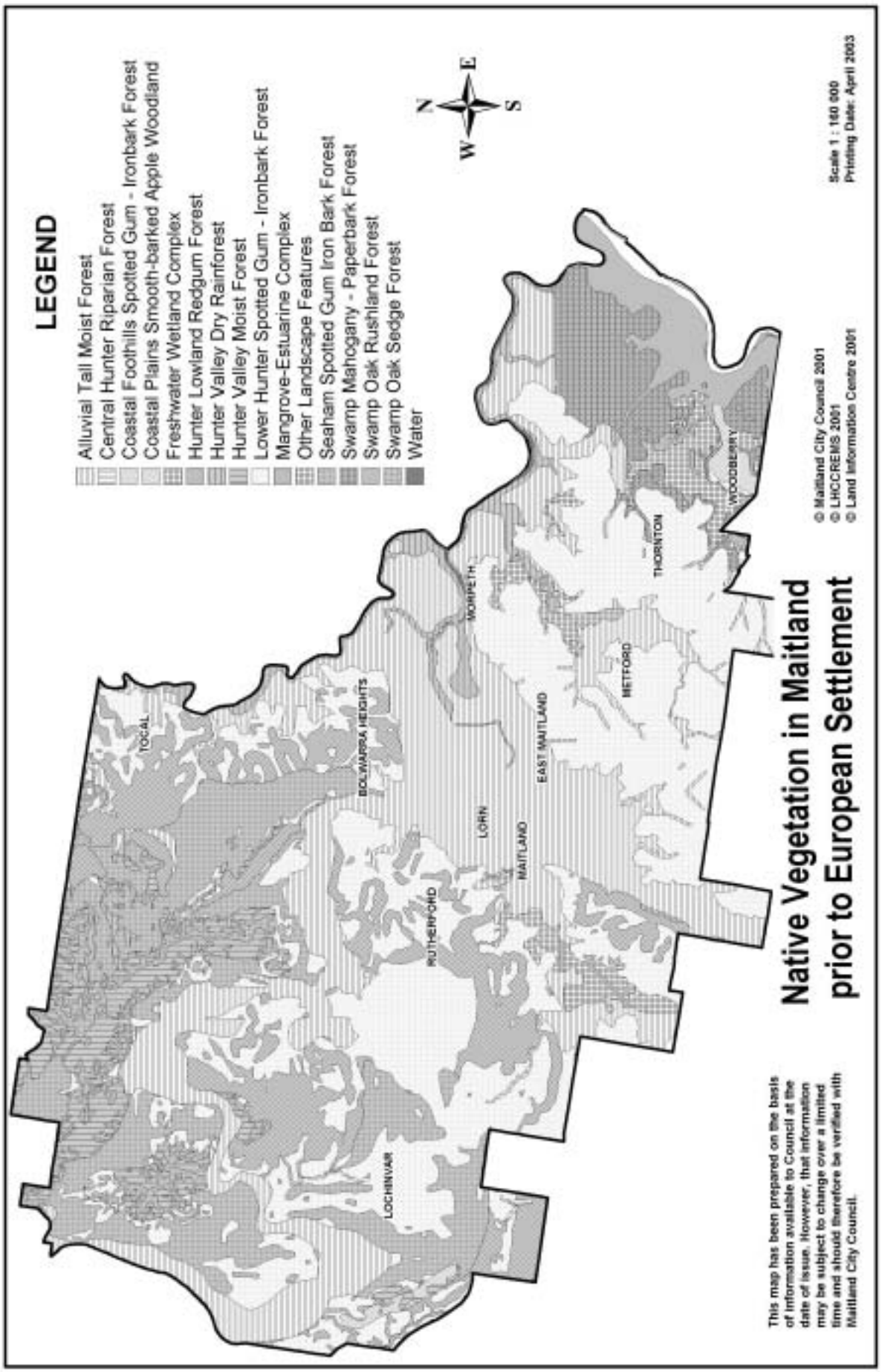
This refers to large intact areas of bushland mainly located in the south-east of the LGA. It was originally retained due to low soil fertility and the presence of mining operations in the area.

Urban bushland

This bushland occurs in small isolated reserves in local urban areas. Brooklyn Park Reserve, located at the end of The Boulevard, East Maitland, is the largest portion of bushland in Maitland that remains in public ownership.

Regrowth

This type of bushland occurs where vegetation was cleared and natural regeneration has occurred.


LEGEND
Alluvial Tall Moist Forest
Central Hunter Riparian Forest
Coastal Foothills Spotted Gum - Ironbark Forest
Coastal Plains Smooth-barked Apple Woodland
Freshwater Wetland Complex
Hunter Lowland Redgum Forest
Hunter Valley Dry Rainforest
Hunter Valley Moist Forest
Lower Hunter Spotted Gum - Ironbark Forest
Mangrove-Estuarine Complex
Other Landscape Features
Seaham Spotted Gum Iron Bark Forest
Swamp Mahogany - Paperbark Forest
Swamp Oak Rushland Forest
Swamp Oak Sedge Forest
Water
N
E
S
W
TOCAL
BOLWARRA HEIGHTS
MORPETH
LOCHINVAR
RUTHERFORD
LORN
MAITLAND
EAST MAITLAND
METFORD
THORNTON
WOODBERRY
Native Vegetation in Maitland
prior to European Settlement
© Maitland City Council 2001
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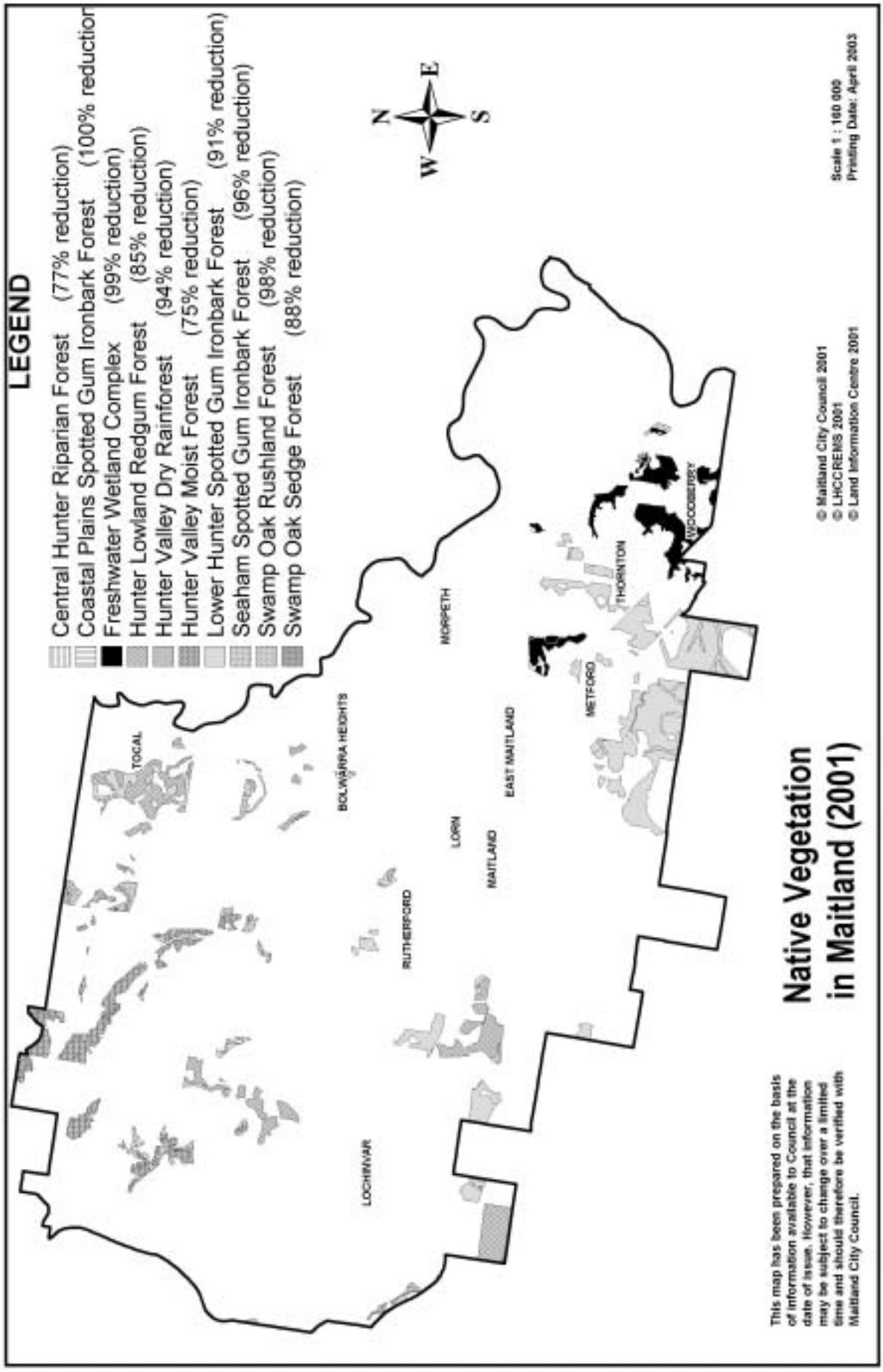
© Land Information Centre 2001
Scale 1 : 150 000
Printing Date: April 2003
This map has been prepared on the basis of information available to Council at the date of issue. However, that information may be subject to change over a limited time and should therefore be verified with Maitland City Council.


LEGEND
Central Hunter Riparian Forest (77% reduction)
Coastal Plains Spotted Gum Ironbark Forest (100% reduction
Freshwater Wetland Complex (99% reduction)
Hunter Lowland Redgum Forest (85% reduction)
Hunter Valley Dry Rainforest (94% reduction)
Hunter Valley Moist Forest (75% reduction)
Lower Hunter Spotted Gum Ironbark Forest (91% reduction)
Seaham Spotted Gum Ironbark Forest (96% reduction)
Swamp Oak Rushland Forest (98% reduction)
Swamp Oak Sedge Forest (88% reduction)
N
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TOCAL
BOLWARRA HEIGHTS
MORPETH
RUTHERFORD
LORN
MAITLAND
EAST MAITLAND
METFORD
THORNTON
WOODBERRY
LOCHINVAR
Native Vegetation
in Maitland (2001)
This map has been prepared on the basis of information available to Council at the date of issue. However, that information may be subject to change over a limited time and should therefore be verified with Maitland City Council.
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Scale 1 : 160 000
Printing Date: April 2003

Case Study C

3.1 Maitland's Native VEGETATION

Impacts of vegetation loss

Loss of native vegetation has a significant impact on the health of our local environment. Removing vegetation can lead to salinity, soil erosion, declining biodiversity, poor water quality and dieback (refer to *Local Issue Investigation* case studies for salinity and erosion).

Declining biodiversity

Biodiversity is the variety of plants, animals and micro-organisms present on earth, including the genes they contain and the ecosystems they form. Biodiversity is essential to all life.

Original or remnant native vegetation is like a biodiversity bank. When this vegetation is cleared biodiversity is lost. Large-scale clearing in Maitland has caused the local extinction of animals such as the Emu and many small animals such as the Squirrel Glider and Brush-tailed Phascogale are now very rare.

The conservation of biodiversity relies upon retaining native vegetation. Many studies have shown that to conserve biodiversity and maintain ecosystem health over 30% of the original extent of an ecosystem needs to be conserved. Across the Hunter Region three vegetation communities have already been cleared below 30%:

- *Alluvial Tall Moist Forest*,
- *Hunter Lowland Redgum Forest,* and
- *Swamp Oak Sedge Forest*.

Poor water quality

Native vegetation affects water quality indirectly by preventing soil erosion and dryland salinity, and directly by filtering surface water. When vegetation is cleared water flows across the land faster and in greater volumes. This causes soil erosion that produces sediments that pollute our waterways. This process is evident along the Hunter River where removal of vegetation has caused river bank instability and the river has begun to fill with sediments.

Dieback

Dieback refers to the decline in tree health and sometimes premature death. It is caused by insect attack, disease and pollution. Dieback mainly affects small patches of isolated remnant trees, especially where soil has been compacted by cattle. Maitland has been identified as a hot-spot for dieback, and examples of dieback are common in the rural landscape.

Human influences on vegetation

Humans, both Aboriginals and Europeans, have influenced vegetation across Maitland for a long time. Firstly, the Wanaruah tribe favoured fertile areas around wetlands and rivers for gathering foods and other resources for over 10,000 years. They used 'firestick farming' to attract wildlife to certain areas. This involved burning vegetation to create and maintain areas of open country and promote the growth of native grasses, which attracted kangaroo and wallaby.

European settlement had a more dramatic effect on vegetation over a shorter period of time. European settlers were attracted to Maitland by the valuable timber resources along the Hunter River and on the surrounding floodplain. Huge quanities of Red Cedar (*Toona ciliata*) and Rosewood (*Dysoxylum fraseraum*) trees were cut from the area. By the 1900s there were no mature Red Cedars left in the entire Hunter Region. Today's extensively cleared landscape is a vast contrast to early settlers' accounts of the local area.

Early Europeans were encouraged to clear native vegetation for agriculture on the fertile floodplains and other low-lying lands at great speed. The only areas left untouched were usually those with less productive soils and slopes too steep for agriculture.

In addition to clearing native vegetation, European settlers impacted on vegetation indirectly by introducing exotic animals and plants. Several animal species brought to Australia have become threats to native flora, particularly cattle which will eat and trample understorey vegetation.

In more recent times local remnants of native vegetation have been cleared for urban and industrial development. This has included a significant loss of the *Lower Hunter Spotted Gum Ironbark Forest*. Large tracts of this forest type were cleared at Ashtonfield to make way for houses, and in Thorton for the Thornton Industrial Estate.

Dieback on grazing land near Aberglasslyn.

Case Study C

3.1 Maitland's Native VEGETATION

Vegetation community profile:
Lower Hunter Spotted Gum Ironbark Forest

Dominant Species:

- Spotted Gum (*Corymbia maculata*)
- Broad-leaved Ironbark (*Eucalyptus fibrosa*)
- Grey Gum (*Eucalyptus punctata*)
- Turpentine (*Syncarpia glomulifera*)
- Ball Honeymyrtle (*Melaleuca nodosa*)
- Mauve Flax Lily (*Dianella revoluta*)
- Kangaroo Grass (*Themeda australis*).

Habitat

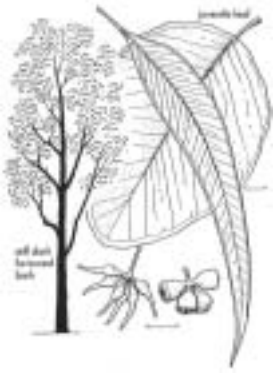
The forest provides habitat and food to many local fauna species, including the Sugar Glider and Ringtail Possum, and the threatened Greater Broad-nosed Bat and Glossy Black Cockatoo.

Status

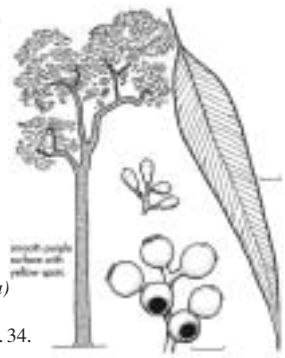
Since European settlement the extent of this community across Maitland has been reduced by 91%. The *Spotted Gum Ironbark Forest* now covers less than 1,200 hectares despite being the most widely distributed community in Maitland.

Much of this forest is found in large structurally intact areas in the south-east of the Maitland LGA in close proximity to the rapidly urbanising areas of Ashtonfield and Thornton.

As a result of the habitat significance and the development threats to the *Lower Hunter Spotted Gum Ironbark Forest*, it has been nominated by the Hunter Catchment Management Trust as an Endangered Ecological Community. This nomination is presently being considered by the NSW Scientific Committee (refer to *www.npws.nsw.gov.au/wildlife/threatened.htm* for information on threatened species in NSW).



Broad-leaved Ironbark
(Eucalyptus fibrosa)
Illustration from:
Robinson, L. 1994; p. 48.



Spotted Gum
(Corymbia maculata)
Illustration from:
Robinson, L. 1994; p. 34.

Managing our native vegetation: The Maitland Greening Plan

Only 6.8% of Maitland's native vegetation remains, with around 95% of this occurring on private property. The management of our vegetation is therefore complicated as it falls to many landholders who all have different interests, values, and resources available to them.

The Maitland Greening Plan has been developed by Maitland City Council to provide a strategy for the future management of vegetation across Maitland. The plan focuses on the vegetation that remains in the Maitland LGA, and provides a strategy for revegetation.

The plan made thirteen recommendations, many of which Council has commenced. Implementation involves a partnership between Council and a community reference group. Some of the key recommendations of the Maitland Greening Plan are:

- Setting **retention targets** for each native vegetation community - a minimum 10% retention target was set for most vegetation communities.
- **Acquisition of bushland** with a high conservation significance and development threat. The purchase of bushland is to be considered with priority given to high conservation value bushland and those areas with a high degree of public benefit.
- Establishing a **native plant distribution program** to distribute local native plant species to landowners in priority areas.
- Setting up **community education trial sites** to demonstrate best management practices for land degradation issues (e.g. erosion, salinity).

On-ground action

Landholders and the community can help conserve and improve local native vegetation. This might involve planting native trees, shrubs and grasses. Revegetation that links remnant vegetation and watercourses can also provide important corridors for wildlife movement.

Landholders can also conserve remnant vegetation by fencing native vegetation to protect it from livestock and by controlling weeds. This can allow for natural regeneration, ultimately leading to expansion and improved health of the remnant vegetation.

Community groups across Maitland undertake on-ground projects to enhance and conserve native vegetation. The projects include revegetation, bush regeneration and lobbying Council to save areas of remnant vegetation.

Case Study C

3.1 Maitland's Native VEGETATION

Native vegetation profile: Maitland's lost rainforests

Where are they found?

If you look carefully around Maitland today you will find some clues that tell you a little-known story about Maitland's vegetation. These clues are windows into our natural history.

Before European settlement, one vegetation type would have dominated Maitland's riverbanks, floodplain, sheltered slopes and steep escarpments. This land is now mostly cleared and you will only find hints of what this vegetation once was - in sheltered steep terrain on Rosebrook Ridge in the north-west of Maitland, on a rocky escarpment along the Hunter River, and in a deep gully at Webbers Creek, Tocal.

In some places the only clues that remain are just a few trees, such as Fig Trees and Lilly Pillies. These are remnants were once surrounded by a lush and dense rainforest.

All that is left of Maitland's rainforest is patches, such as the remnant trees found at Bolwarra Wetland. Sometimes these isolated remnant rainforest trees do not prosper because they have lost the protection of the full forest community.

Small patch of remnant rainforest on the slopes of Bolwarra Wetland.

Most of Maitland's remnant rainforest is located on private property. A large area of public-owned bushland, however, supports rainforest along Two Mile Creek, East Maitland. This reserve is called Brooklyn Park and is adjacent to Greenhills Retirement Village. Some common plants include:

- Cheese Tree (*Glochidion ferdinandi*)
- Red Ash (*Alphitonia excelsa*)
- Mock Olive (*Notelaea longifolia*)
- Wonga-wonga Vine (*Pondorea pandorana*).

What did Maitland's rainforest look like?

There are several types of rainforest in the Hunter Valley. They range from cool-temperate rainforest at high altitude (e.g. Barrington and Gloucester Tops), to subtropical rainforest (e.g. Paterson and Williams River valleys), with dry rainforest scattered throughout.

Maitland had three types of rainforest communities:

- *Hunter Valley Dry Rainforest* with a low, closed canopy featuring Port Jackson Figs, Whalebone Trees and many climbers. It is found on sheltered slopes and rich soils, including areas like riverbanks.
- *Alluvial Tall Moist Forest* is found on rich soils in the floodplain and consists of a eucalypt canopy and rainforest and paperbark understorey.
- *Hunter Valley Moist Rainforest* is found on the drier hilly slopes and consists of a eucalypt canopy with a dry rainforest understorey.

Today, a large and impressive tract of dry rainforest remains on a rocky escarpment on a bend of the Hunter River close to Maitland Vale. Some of the plants growing here include:

- Whalebone Tree (*Streblus brunonianus*), a small tree usually found in subtropical rainforests;
- Native Frangipani (*Hymenosporum flavum*);
- Wild Quince (*Alectryon subcinereus*), a small tree with edible seeds that are soft and nutty;
- Native Rosella (*Hibiscuis heterophyllus subsp. heterophyllus*) a hibiscus with spectacular pink flowers with a deep red centre. The bark was used by Aborigines as fibre for rope, string and baskets.

Why is there so little left?

Rainforests are important ecosystems because they support a rich diversity of plants and animals, including many food and medicinal plants for humans.

The rich fertile soils of the Hunter Valley floodplain and riverbanks supported diverse rainforest ecosystems. These rainforests and their soils were highly favoured by early Europeans for timber and agriculture respectively. As a result, virtually all of Maitland's rainforests were cleared. Only rare pockets of rainforest escaped clearing and these are now clues to reconstruct a part of our local natural history.

Acknowledgement & References

This case study has been prepared by Lana Collison (*Maitland Landcare Coordinator*). Other information sources included:

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Case Study C

3.2 Flora & Fauna of MAITLAND'S WETLANDS

The character and adaptations of wetland plants

The presence of waterplants is often used to define an area as 'wetland'. Living in a wetland environment means plant species need to cope with seasonal cycles of flooding and subsequent drying out, and waterlogged or undrained soils.

Cumbungi (*Typha orientalis*) is found commonly around Maitland's wetlands. It has evolved to survive in these environments through a range of adaptations. These are described and illustrated on the following page.

Other species could be classed as a bit more adventurous or versatile. They manage to cope with life within wetlands but are also adapted to survival in surrounding dry forested areas. Two local examples of this type are Swamp Oak (*Casuarina glauca*) and Broad-leaved Paperbark (*Melaleuca quinquinervia*).

Unlike Cumbungi, these species are not able to survive permanent inundation. They tend to occupy the fringe of wetlands or localised raised areas within the wetland.

Flora of local wetlands

Vegetation surveys and computer modelling were carried out during 2000-01 through the Lower Hunter - Central Coast Regional Environmental Management Strategy (LHCCREMS). As a result, reliable data now exists on the abundance and distribution of local native species and how these have changed over time.

Four vegetation communities once comprised local wetlands. Despite being largely cleared, Maitland is fortunate to have small patches of three of these vegetation communities remaining. Table 1 provides a summary of the vegetation communities that characterise Maitland's wetlands.

Remnant pockets of native vegetation are like pieces of a puzzle. They can help us to understand the features of the local environment and its history. The completed puzzle may also provide a guide to regeneration of areas such as local wetlands.

Threats to local wetland flora

Maitland's wetlands have experienced serious impacts from human activities since the early 1800s. Even prior to this, local Aboriginal people would have used these ecosystems extensively, but with far lesser impact.

The poor fate of wetlands relates to their position on the lowest and most fertile part of the landscape. These areas were most accessible, grew large and good quality trees for timber, and were highly prized for agricultural production.

The main threats to flora of local wetlands today include:

Clearing

Clearing of wetland vegetation (waterplants, grasses, shrubs and trees) for urban, industrial and rural development has resulted in:

- the loss of habitat and food for native wildlife, and reduction of biodiversity across all wetlands;
- an increase in soil erosion;
- salty groundwater rising towards the soil surface causing *dryland salinity* (see below).

Hydrological changes

Changes in hydrology through the construction of flood mitigation works (e.g. levees, floodgates) and sealed surfaces (e.g. roads, buildings), and the filling of low-lying or wetland areas have resulted in:

- an increase in stormwater runoff and more restricted areas for open water. This has caused a general increase in water levels in the last remaining wetland areas with fewer cycles of drying out;
- a decline in the distribution and diversity of plant species as many are not adapted to living in continuously wet conditions. Some native species such as Cumbungi, however, require continuously wet conditions, so have 'taken over' some local wetlands.

Dryland salinity

The emergence of dryland salinity across low-lying areas has resulted in:

- dieback of many species not tolerant to salt conditions leading to the exposure of salty ground to the forces of erosion;
- an increase in abundance of salt-tolerant species (e.g. Common Rush - *Juncus usitatus*), which upsets the balance within existing plant communities.

Case Study C

3.2 Flora & Fauna of MAITLAND'S WETLANDS

Broad-leaved Cumbungi (*Typha orientalis*)
Characteristics and adaptations for life in a wetland

Description
Cumbungi is a native perennial waterplant that can grow up to 4 metres high. It has extensive rhizomes (underground stems) that are branched and up to 2.5 centimetres diameter. The leaves are usually flat and stand erect, up to 3 centimetres wide.

Cumbungi has a distinctive and highly visible inflorescence (group of flowers coming from a common stem), being a spike of tightly packed flowers. The spike of male flowers occurs separately and above that of the female flowers. The two are separated by a short length of stem. One inflorescence can produce up to 200,000 seeds that are dispersed by wind over large distances.

Habitat
Cumbungi grows in stationary or slow flowing water up to 2 metres depth, and does not tolerate drying out. It has spread extensively across many local wetlands including Woodberry Swamp, Tenambit Wetland, and Rathluba Lagoon.

Significance
Due to its wide distribution and restriction of water flow through a wetland, this native plant is considered by some to be a weed. Even so, it provides important food and habitat for small animals and protects the edge of wetlands and creeks from eroding.

Cumbungi had a number of uses by Aboriginal tribes (e.g. Awabakal, Wanaruah) that utilised local wetlands, for example:

- the fibrous and starchy rhizomes were peeled, roasted and then pounded to make a powder. The powder was then mixed with water and cooked again into a gelatinous 'damper';
- new shoots were often eaten, although they contain few nutrients;
- stems were used for weaving, thatching and comprised long, strong fibres that were useful for twine;
- once the flowers had dried and gone fluffy, they were used for fire lighting.

Illustration from:
Robinson, L. 1994; p.432.

Adaptations
The success of Cumbungi is a result of the adaptations it has developed. Changes to our local wetlands have also been advantageous to Cumbungi.

The adaptations enabling Cumbungi to survive and thrive in our local wetlands include:

- tall narrow leaves that pose little resistance to changing water levels and high winds provide protection against damage;
- rough internal fibres and a hollow stem structure also provide protection against damage from high winds;
- significant height so plants are unlikely to ever be completely submerged;
- a large surface area of leaves provides for vigorous growth and maintains ample shade and a microclimate with high humidity. This minimises evaporation from the water surface and helps to maintain the wet conditions needed for the species' survival and expansion;
- large air spaces within the plants' internal structure ensure a constant supply of oxygen, an important feature since wetland soil is typically waterlogged with low to zero availability of oxygen.

Case Study C

3.2 Flora & Fauna of MAITLAND'S WETLANDS

Swamp Oak (*Casuarina glauca*)

Description

The Swamp Oak is a 8-20 metres tall tree that frequently produces root suckers. Swamp Oaks have separate male and female plants. The female's flowers develop into cones and male flowers are short elongated spikes. Swamp Oaks were cut for shingles during early European settlement as the wood makes excellent timber.

Habitat

Swamp Oak is found along wetland edges, coastal streams and major rivers in brackish waters.

Illustration from:
Robinson, L. 1994; p.152.

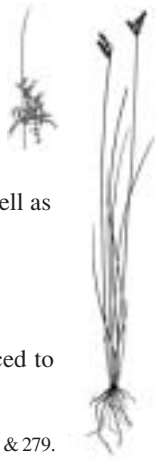
Adaptations

Swamp Oak leaves are reduced to rings of tiny teeth on specialised branchlets. Along the length of the branchlets are grooves sheltering the stomata, these enable the Swamp Oak to tolerate hot dry conditions and inundation. They are also adapted to saline conditions but this may make them stunted.

Common Rush (*Juncus usitatus*)

Description

A native rush forming dense clumps to 1m high, with shiny dark green and narrow blade-like stems (1-2 millimetres wide).



Habitat

Grows in damp and saturated soil, as well as periodically wet areas.

Adaptations

In saline conditions it will often out-compete other plants. Leaves are reduced to sheaths at the base of the stem.

Illustration from:
Harden, G.J. 1993; p.4: 267 & 279.

Sacred Ibis (*Theskiornis aethiopica*)

Description

Sacred Ibis have a white plumage and distinctive sickle-shaped bill. Associated with gods of ancient Egypt, some birds have been found dead in Egyptian tombs. They feed on fish, frogs and macroinvertebrates.

Habitat

Sacred Ibis are found in wetlands and on wetland fringes. They are able to travel long distances.

Illustration from:
Slater *et al* 1989; p.59.

Adaptations

The Sacred Ibis is a wading bird, it is able to walk in shallow water to find food and has a distinctive sickle-shaped bill for removing food from mud or turbid water and among reeds. It is well-adapted to city life and has been seen feeding from rubbish bins.

Damselfly nymph (*Odonata or Zygoptera*)

Description

Nymphs have a long thin body with three tails which are their gills. Their tails can be long and thin like a stick or round and shaped like a leaf. They can be brightly coloured with blue, red, yellow, purple and a shiny black. Damselfly larvae are carnivorous, they feed on small aquatic insects and crustaceans.

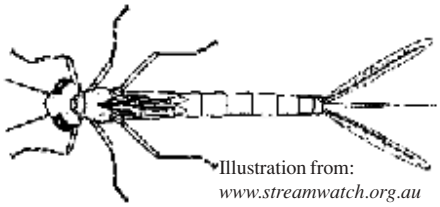


Illustration from:
www.streamwatch.org.au

Habitat

Damselfly larvae live in slow flowing rivers, swamps and creeks in and amongst reeds on the edges of the water. They are almost never found in polluted waters.

Adaptations

A nymph's body is streamlined in shape so that it can move easily through the water. It can flatten its body onto the bottom of the pond to hide from prey. Nymphs have large eyes facing forward to spot prey and judge distances. They have strong claws and legs to resist currents and to grip prey. Their gills are at the back end of the body and have a large surface area to obtain oxygen.

Case Study

3.2 Flora & Fauna of MAITLAND'S WETLANDS

Table 1: Local wetland vegetation communities - the species and changes in coverage

Vegetation Community	Dominant Species			Extent 1750	Extent 2000	% Reduction
	Tallest	Medium	Lowest (<1m)			
Freshwater Wetland Complex	• Prickly-leaved Paperbark • Swamp Oak • Narrow-leaved Paperbark • Forest Red Gum		• Water Primrose • Water Couch • Tall Spikerush • Common Rush • Slender Knotweed • Ferny Azolla • Cumbungi • *Cyperus exaltatus*	1,105 ha	5 ha	99%
Swamp Mahogany - Paperbark Forest	• Swamp Mahogany • Cheese Tree • Broad-leaved Paperbark • Swamp Oak • Cabbage Tree Palm • Narrow-leaved Paperbark	• Saw Sedge • Sydney Golden Wattle • Bleeding Heart	• Swamp Water Fern • Bordered Panic • Harsh Ground Fern • Bracken	1,561 ha	0 ha	100%
Swamp Oak - Rushland Forest	• Swamp Oak • Swamp Paperbark • Broad-leaved Paperbark • Swamp Mahogany	• Common Reed	• Twig Rush • Sea Rush • Sand or Marine Couch	938 ha	10 ha	98%
Swamp Oak - Sedge Forest	• Swamp Mahogany • Forest Red Gum • Swamp Oak • Swamp Paperbark	• Narrow-leaved Paperbark <u>Vines:</u> • Common Silkpod	• Tussock Sedge • Scurvy Weed • Lesser Joyweed • Bordered Panic • Harsh Ground Fern • Saw Sedge • Buttercups	49 ha	6 ha	88%

(Adapted from the Maitland Greening Plan, Stage 2 Part B (Maitland City Council, 2000)).

Case Study C

3.2 Flora & Fauna of MAITLAND'S WETLANDS

Fauna of local wetlands

The distribution and abundance of local wetland fauna has been greatly reduced since the early 1800s. This is based on a comparison of today with the recollections of older Maitland residents and journal records from early European explorers and settlers to the area.

Despite impacts on local wetlands these ecosystems remain home to a diversity of native animals. Observations have been collected from wetlands at Woodberry, Tenambit, Morpeth, Bolwarra, and Telarah, which give insight to the range of native species found locally.

Birds

Hoary-headed Grebe
Grey Teal
Wood (Maned) Duck
Wandering Whistling-Duck
Masked Lapwing Plover
Dusky Moorhen
Purple Swamphen
Royal Spoonbill
Straw-necked Ibis
Intermediate Egret
White-faced Heron
Little Pied Cormorant
Brown Goshawk
Black-shouldered Kite
Nankeen Night Heron
Pied Butcherbird
Pied Currawong
Black-faced Cuckoo Shrike
Spangled Drongo
Willie Wagtail
Eastern Rosella

Amphibians

Eastern Dwarf Tree Frog
Peron's Tree Frog
Common Eastern Froglet
Brown-striped Marsh Frog

Reptiles

Eastern Water Dragon
Bearded Dragon
Long-necked Tortoise
Red-bellied Black Snake
Three-toed Skink
Wood Gecko

Mammals

Human
Swamp Wallaby
Brown Antechinus
Swamp Rat
Long-nosed Bandicoot
Common Ringtail Possum
Eastern Broad-nosed Bat

Macroinvertebrates

Mosquito Larvae
Damselfly Nymph
Caddisfly Larvae
Mayfly Nymph
Freshwater Shrimp
Water Boatman
Whirligig Beetle
Water Mite
Flat Worm
Nematode
Blood Worm

Threats to local wetland fauna

The widespread loss of native vegetation and extensive filling of local wetlands since the early 1800s have been the main driving forces for the decline in native fauna. Such destruction represents a major loss in habitat and availability of food - both needed for reproduction and survival of species.

As well as the impact of clearing, the major threats to local wetland fauna today include:

Introduced pests and predators

Increased populations and distribution of introduced pests and predators such as foxes, domestic dogs and cats, Mosquito Fish, and European Carp have resulted in:

- reduction in the distribution and abundance of native wetland fauna. For example the Emu, Brolga, and Bustard are now locally extinct partly due to the impact from predators;
- greater competition for food and habitat.

Hydrological changes

Hydrological changes (described previously) have resulted in:

- a shrinking of the range of habitat and food options for fauna, with some species thriving at the expense of others.

Water pollution

Water quality has declined through extensive urban, rural and industrial development adjacent to wetlands. This has resulted in:

- a decline in the health, reproduction and survival of some species (e.g. Green and Golden Bell Frog);
- a decline in macroinvertebrates, a staple food for most wetland fauna.

Acknowledgement & References

This case study has been prepared by Kylie Yeend (Environmental Education & Project Management Consultant). Other information sources included:

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Case Study C

3.3 Investigating WOODBERRY SWAMP

A rich and varied history

Woodberry Swamp was probably inhabited and used by the Pambalong clan of the Awabakal Aboriginal tribe. Their staple foods included fish, shellfish, wildfowl, kangaroos, snakes and goanna, which were abundant in the streams, wetlands and fertile floodplains of the area.

From about 1805 timber-getters cleared the area in and around Woodberry Swamp of its forests - Red Cedars and Eucalypts were of great value. Following on the heels of the timber-getters, settlers moving into the area in the 1830s had a relatively easy task to establish agriculture as there was only regrowth and stumps to contend with. Initially, the area was divided into a few large estates where cotton, wheat, tobacco, maize and sugar were grown.

Farming was undertaken mainly by tenant farmers. In the Millers Forest area they were mostly Irish. An unconfirmed legend states that an estate owner, Vicars Jacob, sent home (England) for his agents to secure tenants for him, placing on the requisition that there were to be *no Irish*. A sympathetic or mischievous clerk, however, changed the "no" to "only".

In the early days, the Hunter River was the 'highway' and Morpeth was established as the main town for river trade. The main northern railway line was extended from Newcastle to Maitland by 1858, cutting through Woodberry Swamp, and leading to the establishment of the townships of Tarro, Beresfield and Thornton along the route. The railway also led to the decline of the Morpeth river trade.

An aerial view of Woodberry Swamp looking south. The main northern railway line can be seen cutting off part of the swamp from the industrial and residential areas at Beresfield.

The pattern for development in the area was set by flooding, the expansion of transport and access, and the location of mines. This pattern continues today. The flood-prone alluvial flats and wetlands were developed for agriculture whilst flood-free areas were developed for residential and industrial uses.

A catchment snapshot

Water flows to Woodberry Swamp through a series of small creeks - Weakleys Flat Creek, Scotch Dairy Creek, and Viney Creek - before meeting the Hunter River at Woodberry. The catchment area for Woodberry Swamp is 5,340 hectares. It features a range of different land use zones.

Agriculture

Agriculture in the area mainly includes beef cattle grazing and poultry production. The area used to support a small number of dairy farms, however, the last of these finished production at the end of 2002. The cropping that once occurred on the floodplain has largely ended with only a small percentage of land (approx. 5%) being used for production of lucerne, turf and vegetables.

Grazing cattle on cleared agricultural land around Woodberry Swamp. Water Hyacinth, covering a dam shown in this photo, has become a major problem on the wetland.

Rural residential subdivision

This land use occurs on the fringe of urban areas amongst remnant bushland and cleared farmland. It features low density residential development with a rural character and a mixture of land use activities (e.g. small scale agricultural production, gardens, and nurseries).

Case Study

3.3 Investigating WOODBERRY SWAMP

A catchment snapshot (cont.)

Urban (residential) subdivision

Urban development has expanded rapidly in the surrounding towns of Thornton, Beresfield and Woodberry. These residential areas feature medium-density housing with an extensive network of roads and services established mainly on cleared farmland.

Residential development has occurred down to the margins of Woodberry Swamp. The wetland is often used as a sales pitch - "residential lots with beautiful water views".

Industrial subdivision

Industry has also expanded rapidly over land that was otherwise bushland or cleared grazing land. These subdivisions contain 'light' industrial development concentrated mainly in the Thornton and Holmwood Industrial Estates. This form of industry is classed as 'non-offensive' and non-hazardous' in terms of its generation of noise, waste, air and water pollution.

Steggles poultry processing plant also sits on the edge of Woodberry Swamp, this is classed as 'general' industry and has been established on the site since 1954.

Steggles has a licence to discharge waste waters to the swamp but has embarked on a process to reduce the volume of discharge (e.g. through improved water efficiency and alternative uses of waste water).

Mining

The Donaldson coal mine commenced operations in the upper catchment in January 2001. This mine is an open-cut operation that currently has about 100 hectares of active workings within remnant bushland (including infrastructure like roads and workshops). Over the course of its life the mine will have had a 'footprint' of 300 hectares.

The mine does not discharge water to the catchment from its pit. Water runoff from roads and rehabilitated landscapes, however, does flow to Scotch Dairy and Weakleys Flat Creeks. This water must first pass through a series of sedimentation ponds on the mine site before it is discharged from the site.

Donaldson Mine is located amidst remnant bushland to the south of the New England Highway.

Remnant bushland

Extensive clearing of native vegetation has occurred within the catchment. The vegetation coverage is now less than 30% of its original extent.

The largest intact sections of bushland are located to the south of the New England Highway, providing an important vegetation corridor through to the Watagan Mountains and Wollemi National Park. This vegetation community is known as *Lower Hunter Spotted Gum Ironbark Forest*.

Lower Hunter Spotted Gum Ironbark Forest has the potential to be listed as an Endangered Ecological Community. The main concerns are that there has been extensive clearing of this vegetation community and that very little is currently protected in National Parks or State Reserves. Less than 9.5% of the original extent of this forest type remains in the Maitland local government area, and only 5% remains in the Hunter Valley.

The catchment's remnant bushland provides important services to the local community, including water quality improvement, prevention of soil erosion, recreational opportunities and beautification.

Case Study C

3.3 Investigating WOODBERRY SWAMP

The significance of Woodberry Swamp

Ecological importance

Woodberry Swamp provides habitat and food to a variety of native fauna and supports a broad range of native flora. Various threatened fauna species have been observed in and around the wetland area, such as the Green and Golden Bell Frog, Little Bent-wing Bat, Greater Broad-nosed Bat, Powerful Owl, Blue-billed Duck, and Glossy Black Cockatoo.

Woodberry Swamp plays an important role in removing sediment, nutrients and bacteria from water before it flows into the Hunter River. The wetland must struggle with this role as it accepts more than its fair share of sediment, nutrients, pathogens, heavy metals and other water pollutants from surrounding land use.

Economic importance

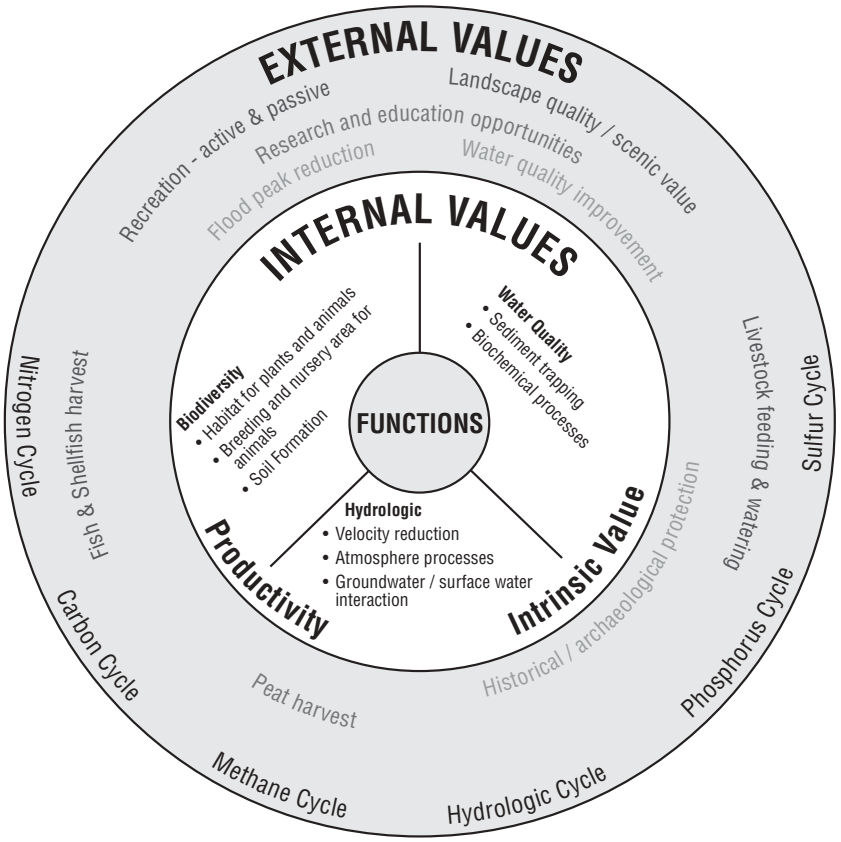
Woodberry Swamp provides a range of natural resources and benefits to the agricultural industry. Historically, the wetland and its surrounds were an important source of valuable timber and agricultural produce. Today, the wetland provides a source of food and water for grazing beef cattle.

The beauty and importance of wetlands has become more recognised since the 1990s. This shift in public perception has meant that residential areas developing alongside Woodberry Swamp have used it to support marketing and sale of residential lots – 'wildlife in your own backyard', 'water views', 'The Ponds'.

Cultural importance

Woodberry Swamp would have been (and remains) a site of Aboriginal significance. It provided food and a range of materials for daily life, with some sites surrounding the wetland having spiritual significance. Even today, Woodberry Swamp is significant to local people as an area to observe wildlife and enjoy the sense of open space - a break from the more harsh urban and industrial landscape.

The environmental and cultural significance of Woodberry Swamp is recognised by its zoning under State Environmental Planning Policy (SEPP) 14. This zone aims to protect and preserve coastal wetlands in the environmental and economic interests of NSW. This means that permission must first be gained for a number of activities such as land clearing, land draining, land filling, and construction of levees.



Wetland ecosystem functions and values (internal and external). Which of these are relevant to Woodberry Swamp?

Case Study C

3.3 Investigating WOODBERRY SWAMP

Understanding human impacts on Woodberry Swamp

Like many wetlands in the Maitland area, Woodberry Swamp is surrounded and impacted upon by a mosaic of human activities. These impacts often arise due to poor management and an undervaluing of the wetland environment. The table below summarises some of the main impacts of human activities around Woodberry Swamp.

Many of the impacts on Woodberry Swamp are interrelated, which means efforts to address these need to be holistic and apply to the cause of the impact rather than its symptoms in isolation. For instance, dealing with weed invasion should include efforts to reduce the amount of nutrients entering the wetland along with a program of removing the existing weeds.

Managing environmental impacts could be considered similar to caring for our own health – we need to prevent sickness and disease from arising, deal with the symptoms to make life more comfortable but ultimately address the underlying cause of the illness.

IMPACTS	SYMPTOMS AND ISSUES	POSSIBLE CAUSES
Loss of biodiversity	◆ The diversity of native flora and fauna has declined since European settlement in the area. Bird species, however, remain quite rich in their diversity across the catchment. ◆ Impacts on soil and its micro-organisms (an important part of biodiversity) have meant the soil is now less productive and more erodible. ◆ There has been widespread loss of habitat and food supply for native wildlife. ◆ Loss of biodiversity reduces Woodberry Swamp catchment's capacity and resilience to cope with other impacts described below.	◆ Extensive clearing of native vegetation. ◆ Predation by feral and domestic animals (e.g. dogs, cats, foxes, Mosquito fish) has reduced the populations of native fauna. ◆ Clearing, compaction of soil by grazing stock, and the sealing of surfaces with roads and buildings have contributed to the decline in soil health. ◆ Changes in hydrology and water quality have affected habitat, food, and the diversity of vegetation.
Erosion	◆ The main forms of soil erosion around the Woodberry Swamp catchment include sheet, rill and gully erosion. ◆ Erosion has the potential to remove large quantities of soil off the land surface. It becomes difficult to re-establish vegetation in these areas. ◆ Sedimentation (deposition) of eroded soil causes restriction of water flow and loss of open water areas needed for native flora and fauna in lower sections of the wetland.	◆ Extensive clearing has left large areas of land exposed to erosion by wind and rain. ◆ Clearing and an increase in sealed surfaces (e.g. roads and buildings) have resulted in larger quantities of runoff and higher water flow velocities. This often causes more severe erosion.
Salinity	◆ Some minor salt scalds have occurred in the lower sections of Woodberry Swamp during dry weather. ◆ Many plants are not adapted to growing in salty soils. This results in bare ground and an over-abundance of salt-tolerant species, e.g. *Juncus usitatus* (Common Rush). ◆ The water has a higher concentration of salt. Many aquatic plants and animals cannot survive in these conditions.	◆ Clearing of deep-rooted native vegetation results in naturally saline groundwaters being drawn up to the soil surface through evaporation (*dryland salinity*). ◆ Erosion has exposed rocks and sediment that are naturally saline.

Case Study C

3.3 Investigating WOODBERRY SWAMP

IMPACTS	SYMPTOMS AND ISSUES	POSSIBLE CAUSES
Water pollution	◆ Water quality of Woodberry Swamp has declined. This has contributed to: (i) a loss of biodiversity; (ii) blue-green algae blooms; (iii) weed infestation; (iv) bad odours from the wetland. ◆ The main water pollutants in the Swamp include: - **sediment** from erosion around development areas; - **heavy metals** from industrial and urban areas; - **pathogens** (e.g. bacteria) from urban and agricultural areas; - **herbicides and other similar chemicals** from urban and rural areas or weed and pest control on the wetland; - **nutrients** (e.g. nitrogen and phosphorus) from urban areas and agricultural activities; - **litter** from urban and industrial areas; - **total dissolved solids** (e.g. salt) from industrial activities and the on-set of dryland salinity.	◆ Water quality decline is a result of both past and present land use activities. ◆ Runoff from rainfall or land use activities (e.g. washing cars, hosing surfaces) dissolves pollutants. Pollutants are transported to the swamp and may remain dissolved in the water or settle out onto the soil as the velocity decreases. ◆ Discharge from industrial point sources contributes nutrients, total dissolved solids, and heavy metals. Unlike stormwater, however, these discharges are monitored and controlled by licences administered by the Environment Protection Authority (EPA).
Change in hydrology	◆ The amount of water flowing to Woodberry Swamp has increased steadily. This has resulted in permanent water cover of areas that may otherwise have regular wet and dry cycles. ◆ The construction of drainage channels across the wetland has changed the flow of water. It has resulted in a concentration of open water in narrow channels rather than larger shallow pools. ◆ The establishment of flood mitigation works along the Hunter River has reduced major flooding of Woodberry Swamp. This would have originally provided for a renewal of alluvial soil and freshwater across the wetland area.	◆ Clearing and more sealed surfaces have increased stormwater runoff. ◆ Steggles has a licence to discharge 14ML/week into the Swamp (approx. 7.7% of average annual flow). Discharge has been decreasing, with plans to find other uses for the water so it can almost cease. ◆ Drainage channels are constructed and maintained for agricultural purposes. ◆ Flood gates control daily water exchange between the Hunter River and Woodberry Swamp via Greenway Creek.
Weed invasion	◆ Woodberry Swamp is affected by a range of weeds including Water Hyacinth, Alligator Weed, and Flowering Lawn. ◆ Depending upon the weed species, they may: - interfere with water flow through the wetland; - out-compete native flora and fauna; - reduce light penetration through the water surface, thereby reducing the natural disinfection process (i.e. the sun's UV radiation kills water-borne pathogens); - reduce the amount of dissolved oxygen in the water during phases of decomposition.	◆ High concentrations of nutrients cause weeds to thrive whereas most native species are adapted to lower nutrient levels. ◆ There is now a large supply of weed seeds in the swamp soil, creating an on-going source of young plants. ◆ Weeds are generally symptomatic of an environment that is out of balance.

Acknowledgement & References

This case study has been prepared by Kylie Yeend (Environmental Education & Project Management Consultant). Other information sources included:

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Case Study C

3.4 WILDFOODS of MAITLAND

Introduction

The Hunter Valley lies at the centre of a number of geological and climatic zones giving the area a wide range of soils and climatic conditions. This has led to a rich diversity of plants, in some areas comparable with the richest floras in the world. From this comes a corresponding high diversity of plants that have been used for food, medicine or other purposes.

There are at least 220 species of what are known as 'bushfood' or 'wildfood' within the Hunter Valley with a large proportion occurring in the Maitland area.

Food and culture

Before the advent of agriculture, people lived a primarily hunter-gatherer existence foraging for fruits, roots, berries and hunting any suitable game. This lifestyle continued for most of human history.

Agriculture slowly developed in the Middle East and other places of the world where climate was predictable and plants and animals were suitable for domestication. Over time the hunter-gatherer way of life was gradually (athough not entirely) forgotten.

In Australia the settled agricultural lifestyle didn't arrive until the First Fleet in 1788. This was mainly due to the unpredictability of the climate and lack of species suitable for domestication. This is amply demonstrated by El Nino-inspired droughts that create havoc every few years and by the scarcity of Australian native plants and animals that have made it into agricultural production.

Compared with the European settlers, Aboriginal people had to rely on their knowledge of the bush to give them a comfortable lifestyle. A farmer may have to know the growth habits and requirements of a dozen plants and three or four species of animals and be able to store excess food. By comparison, Aboriginal people would have to know the ripening times and likely locations of up to several hundred species of plants and dozens of mammal, fish, reptile and bird species.

Bushfoods are commonly thought to be desert or tropical plants and animals. The highest population density of Aboriginal people at the time of arrival of the First Fleet, however, was on the coast, particularly south-eastern Australia where the climate was more favourable and food more plentiful.

For the first part of the early European history of Australia bushfoods played an important role. They were a crucial part of the diet in the first few years of the colony when widespread starvation was only avoided by making use of local bushfood species.

Loss of traditional knowledge

Aboriginal traditional life changed dramatically with the arrival of the First Fleet. Traditional hunting areas became farms, fish resources were over-exploited, and fire regimes were changed. Each of these lowered the land's capacity to support people's traditional lifestyle. In addition, extra pressure was placed on the land when crops failed and settlers and convicts were forced to forage for native foods to supplement their rations.

Knowledge of the range of bushfoods and medicines used by Aboriginal people has been partially lost. Fortunately there are sufficient records and maintenance of Aboriginal culture to gain a good understanding of the resources that may have been utilised.

Along the coastal strip of south-eastern Australia, for example, the rainfall is more reliable and rivers and wetlands are more common. In this area fish, shellfish, and other aquatic plants and animals would have formed a substantial part of the diet.

Finding foods

Edible plants can be found in just about every vegetation community, with wetlands, rainforest and floodplains being particularly rich in edible plants. These areas were also valuable to European settlers for timber and grazing leading to a loss of food as cattle trampled the wetlands, ate the Yam Daisies and other herbs and trees were felled for timber or to open up grazing areas. This understandably led to a great deal of conflict with the traditional owners of those areas.

While there are large numbers of edible plants within the Maitland area, there are many that need preparation or are only suitable for eating when fully ripe. Caution must be used at all times when sampling bush foods: if you are not absolutely sure of its identity or how safe it is to consume, then don't try it.

Case Study C

3.4 WILDFOODS of MAITLAND

Earthcare Park Bushfood Garden

The Bushfood Garden at Earthcare Park has been in development since 1997 and aims to showcase local bushfood species that were or could have been used by Aboriginal people or early settlers.

Plants have been deliberately sourced from local seedstock to hopefully maintain the genetic integrity of the local area.

The Garden is meant only as a demonstration site and it is expected that most of the fruits will end up in the bellies of birds, blue tongue lizards and other (hopefully native) animals.

Bluebells (*Wahlenbergia* species)

Very common throughout the site, the light blue flowers are edible, tasting slightly sweet and would make a colourful addition to a salad.

Illustration from:
Robinson, L. 1994; p.149.

Lilly Pillys (*Acmena smithii, Syzigium* species)

One of our best known bushfoods, sweet sometimes tart flesh surrounding a woody seed.

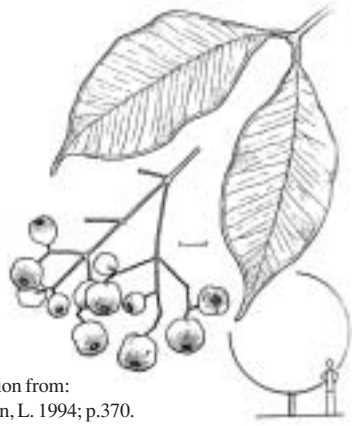
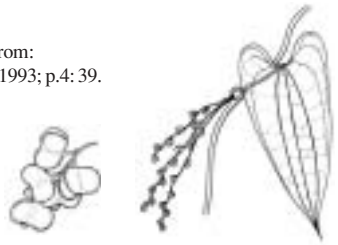


Illustration from:
Robinson, L. 1994; p.370.

Pencil Yam (*Dioscoria transversa*)

Hiding away under some of the shadier shrubs is a thin nondescript vine with heart-shaped leaves. The Pencil Yam is in the same family as the true yams. The vine is followed back to ground level and the tuber gently dug out taking care not to break the stem. The Pencil Yam is normally found in rainforest.

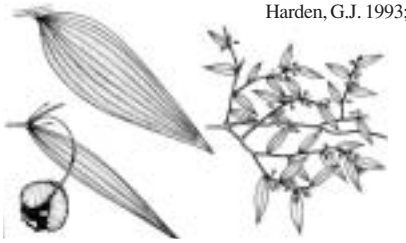
Illustration from:
Harden, G.J. 1993; p.4: 39.



Wombat Berry (*Eustrephus latifolius*)

A tough vine which produces hard orange fruits, these can be eaten but have little taste. The underground tubers can also be eaten and are very sweet and full of moisture.

Illustration from:
Harden, G.J. 1993; p.4: 43.



Slender Grape (*Cayratia clematidea*)

The Slender Grape is probably the best tasting of the local native grapes. The fruit is a small purple berry 8 - 10 millimetres diameter. Being a grape, it has tendrils to help it hold on as it climbs.

Illustration from:
Harden, G.J. 1992; p.3: 44.

Apple Berry (*Billardiera scandens*)

One of the favourite bushfoods having a nice but slightly gritty dried apricot flavour. Fruits are ripe when they go opaque and fall off. It's usually best to break the skin at the bottom of the fruit and squeeze the pulp out.

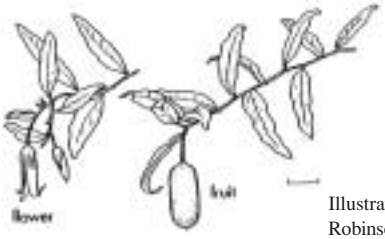


Illustration from:
Robinson, L. 1994; p.338.

Case Study C

3.4 WILDFOODS of MAITLAND

Native Violet (*Viola hederacea*)

A hardy native ground cover. The flowers can be eaten and would go well on a salad.

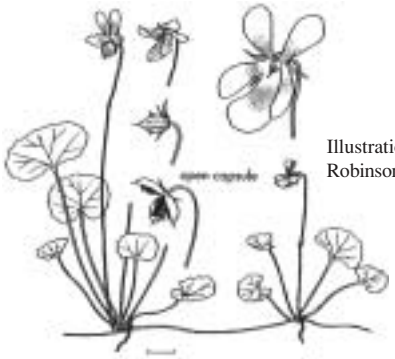


Illustration from:
Robinson, L. 1994; p.224.

Flax Lilly (*Dianella caerulea*)

Looking like a grass or a Lomandra species, the Dianella has attractive dark blue flowers with bright yellow stamens developing into a bright purple berry around 1cm diameter. The berries are edible having a sweet Alfalfa-like taste. There have, however, been reported cases of poisoning, which is probably due to either over-indulgence or eating unripe berries. A couple of these would make an attractive garnish to ice cream or fruit salad.

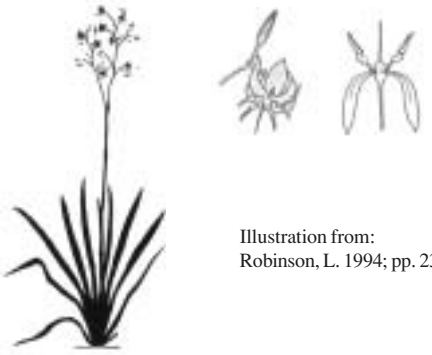


Illustration from:
Robinson, L. 1994; pp. 231, 233.

Sydney Golden Wattle (*Acacia longifolia*)

Probably one of our best known east-coast wattles. It has bright green leaves with 2-5 parallel veins and bright yellow flowers. The unripe seeds can be steamed and eaten, whilst leaves have been used as fish poison.

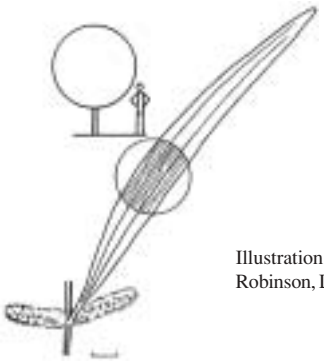


Illustration from:
Robinson, L. 1994; p.70.

Yam Daisy, Murnong (*Microseris lanceolata*)

Perhaps one of the more significant finds on the Earthcare Park site is the Yam Daisy. The Yam Daisy was a very important food source for Aboriginal people prior to and in the early years of European settlement.

They were once so common that only a short amount of time was required to dig enough tubers to feed a whole family. Unfortunately the introduction of cattle and sheep and changed land management practices have led to a huge reduction in abundance of this plant.

The Yam Daisy is so sensitive to habitat modification that it is regarded as an indicator species for healthy Grassy White Box Woodland communities (an endangered ecological community). The Yam Daisy has so far been found in only four locations in the Hunter:

- a couple of square metres near Merriwa;
- approximately 1/8 of a hectare near Wollar;
- a healthy population bordering the wetland at the Earthcare Park site (including a plant or two in the bushfood garden); and
- a small population on Kooragang Island.

The plants are very similar to the more common Cats Ear. The main difference being that Yam Daisies have:

- more or less upright leaves;
- a single flower head per stalk (Cats Ear usually has a number of flower heads);
- reddish flower stalks instead of green; and
- a characteristic 'Shepherds Crook', which straightens up for pollination and seed dispersal when the flower is immature or the seeds are ripening.

The Yam Daisy seems to respond well to to an early spring mowing.

Illustration from:
Harden, G.J. 1992; p.3: 331.

Acknowledgement & References

This case study has been prepared by Paul Melehan (Bushfood & Environmental Education Consultant). Other information sources included:

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3.4 WILDFOODS of MAITLAND

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3.1 Managing human IMPACTS ON WETLANDS

Links with Syllabus

Key Learning Area	Stage	Syllabus outcomes addressed
Science	5	5.10 (Ecosystems)
Geography	5	5A2 (Changing Australian environments) - 5.1, 5.2, 5.3, 5.4, 5.5, 5.6 5A3 (Issues in Australian environments) - 5.1, 5.2, 5.3, 5.4, 5.5, 5.6

Overview

Students gain information on the features, functions and importance of local wetlands through a PowerPoint presentation and develop an appreciation of the range of human impacts on wetlands. Options for addressing wetland impacts are considered before commencing an investigation of a local wetland – Woodberry Swamp.

Use of the Woodberry Swamp case study and coloured aerial photographs assist students' development of geographical and scientific skills. Students are involved in:

- identifying natural and built features of the wetland and its environs;
- investigating potential threats and impacts to the wetland ecosystem;
- developing management options to address wetland impacts.

Materials Required

Provided

- PowerPoint presentation (CD-rom) - *Maitland's Wetland Ecosystems*
- Case Study 3.3 - *Investigating Woodberry Swamp*
- A3 Aerial Photograph Kit (1 teacher master copy and 15 copies to be shared amongst students)
- Worksheets 3.1 & 3.2

To Obtain

- Clear overlay sheets (3 per aerial photo)
- Coloured permanent markers
- Copies of case studies and worksheets

Program P

3.1 Managing Human IMPACTS ON WETLANDS

Program Instructions

Content	Strategies	Resources
Introduction to local wetlands	Students view PowerPoint presentation. The presentation could be used progressively or in full at the commencement of the program. Definition and Examples of Local Wetlands ◆ Students to complete Worksheet 3.1. Importance of Wetlands ◆ What are students' attitudes towards wetlands? ◆ Have attitudes changed towards wetlands? If so, why? Impacts on Wetlands ◆ Have students seen impacts on local wetlands? If so, what are they and what implications have they noticed? Addressing Wetland Degradation ◆ What approach/s do students believe to be the most important and why?	◆ PowerPoint presentation (CD-rom) ◆ Worksheet 3.1
Introduction to Woodberry Swamp	◆ Students gather background information on Woodberry Swamp through reading Case Study 3.3 and other available materials. ◆ On clear overlays placed on the aerial photo students label the main natural and built landscape features, e.g. towns, main roads, creeks, railway (refer to teacher base map). ◆ Guided by information from the Case Study, students identify the main land use zones around the wetland. The land use zones are to be marked on a clear overlay.	◆ Case Study 3.3 ◆ A3 Aerial Photograph Kit ◆ Clear overlays
Impacts from human activities	◆ Guided by the PowerPoint presentation and Case Study 3.3 hold a class discussion on the potential impacts from each land use. Students record this information on Worksheet 3.2 and on one of the aerial photo overlays.	◆ Worksheet 3.2 ◆ A3 Aerial Photograph Kit ◆ Clear overlays
Managing human impacts	◆ Guided by the PowerPoint presentation hold a class discussion on managing human impacts on Woodberry Swamp. The discussion could include how to implement strategies and possible challenges. Students summarise this information on Worksheet 3.2. ◆ Program 3.2 can be used to extend this program. The focus of 3.2 is on revegetation as a tool to manage impacts on wetlands (or other ecosystems). It develops students' knowledge and skills in the planning and coordination of this management approach.	◆ Worksheet 3.2 ◆ Program 3.2 (optional)

Program

3.2 Regenerating LOCAL WETLANDS

Links with Syllabus

Key Learning Area	Stage	Syllabus outcomes addressed
Science	5	5.10 (Ecosystems)
Geography	5	5A2 (Changing Australian environments) - 5.1, 5.2, 5.3, 5.4, 5.9 5A3 (Issues in Australian environments) - 5.1, 5.2, 5.3, 5.4, 5.9

Overview

This program follows on from *Managing human impacts on wetlands* (Program 3.1). It develops students' skills in planning and coordinating the regeneration of a wetland ecosystem. It follows the steps used by environmental managers to guide their rehabilitation work.

Materials Required

Provided

- Case Study 3.2 - *Flora & Fauna of Maitland's Wetlands*
- Case Study 3.3 - *Investigating Woodberry Swamp*
- Case Study 5.4 - *Regeneration at Earthcare Park*
- A3 Aerial Photograph Kit - *Woodberry Swamp*
- Worksheet 3.3
- Worksheet 3.3 suggested answers

To Obtain

- Tracing paper and pens
- Copies of case studies and worksheets

3.2 Regenerating LOCAL WETLANDS

Program Instructions

Content	Strategies	Resources
Introduction to ecosystem regeneration	◆ Using the background information in Worksheet 3.3 as a guide, hold class discussion on: - the importance of revegetation as a management tool; - alternatives to revegetation (e.g. fencing remnant vegetation, direct seeding with native seed, planning restrictions on clearing); - the importance of setting project objectives; - examples of local regeneration projects (draw on students' own knowledge and/or Case Study 5.4 - *Regeneration at Earthcare Park*).	◆ Case Study 5.4 ◆ Worksheet 3.3
Planning a regeneration project	◆ Using Woodberry Swamp as the focus for a regeneration project, students gather background information by reading Case Study 3.3. ◆ Brainstorm some responses to each question on Worksheet 3.3. Refer to suggested answers for guidance. ◆ Students form into small groups and plan their own regeneration project based on the decision points in Worksheet 3.3.	◆ Worksheet 3.3 ◆ Case Studies 3.2 & 3.3 ◆ Suggested answers
Finalising the regeneration project	◆ Students record their project planning on Worksheet 3.3. ◆ Using A3 aerial photographs of Woodberry Swamp students prepare a tracing of the swamp and its environs. They should record the location, layout, and activities of their regeneration project on their traced map. This map could also be used to highlight possible challenges for the project.	◆ Worksheet 3.3 ◆ Case Study 3.2 ◆ Suggested answers
Active citizenship - implementing the regeneration project (Optional)	◆ Make contact with the Maitland Landcare Coordinator (Maitland City Council) and discuss options for implementing one of the regeneration projects. If it is not possible to planting around Woodberry Swamp, there may be other site options (e.g. Tenambit Wetland, Bolwarra Wetland, Morpeth Common Wetland). ◆ Students become involved in: - preparing a media release and other forms of promotion for the regeneration project; - visiting the site and meeting with the Maitland Landcare Coordinator to organise the planting day; - attending a planting day to put the regeneration plan into action.	◆ Contacts & Support Options (Section 8)

3.3 Researching Wetland Species & FOOD WEBS

Links with Syllabus

Key Learning Area	Stage	Syllabus outcomes addressed
Science & Technology	2 3	LTS2.3 (Living Things) LTS3.3 (Living Things)
Science	4 5	4.10 (Ecosystems) 5.10 (Ecosystems)

Overview

Students gain knowledge of local wetland flora and fauna through individual research using case studies, internet searches and observations. This knowledge is used to create a food web for a local wetland ecosystem, providing students with an understanding of the different roles of species in an ecosystem and trophic interactions.

This program would be an ideal follow-up to an excursion to a local wetland area (refer to Resource Kit, Section 7).

Materials Required

Provided

- Case Study 3.2 - *Flora & Fauna of Maitland's Wetlands*
- Worksheets 3.4, 3.5, 3.6
- 3.4 & 3.5 Example Species Profiles

To Obtain

- Internet access
- Copies of case study and worksheets

3.3 Researching Wetland Species & FOOD WEBS

Program Instructions

Content	Strategies	Resources
Identifying local wetland species	◆ Students read Case Study 3.2 and identify the range of flora and fauna species found in local wetlands.	◆ Case Study 3.2
Researching wetland flora and fanua	◆ Each student is assigned a local wetland species to research. ◆ Using the internet, students research their species and record information on Worksheets 3.4 (flora) and/or 3.5 (fauna), or 3.6. Recommend using Google search engine. Useful websites include: Birds: *www.birdsaustralia.com.au* Herpetology: *www.jcu.edu.au/school/tbiol/zoology/herp/herp2.shtml* Native Fish: *www.nativefish.asn.au* Insects: *www.ento.csiro.au/aicn/* Frogs: *www.frogs.org.au* Botanic Gardens: *www.anbg.gov.au/anbg/* Macroinvertebrates: *www.streamwatch.org.au/main.jsp* (look under Electronic Library) Wetlands: *www.ea.gov.au/water/wetlands* *www.dlwc.nsw.gov.au/care/wetlands/* *www.wetlandcare.com.au* *www.wetlands.org.au* (Shortland Wetlands) ◆ Class discussion on the terminology and research tasks associated with the Species Research Sheets. ◆ Students present their research findings to class. This could be done through a PowerPoint slide show or poster presentation.	◆ Worksheets 3.4 & 3.5 (secondary) or 3.6 (primary) ◆ Example species profiles ◆ Internet access
Determine feeding habits of animals	◆ Each student determines the feeding habits of the animals they have researched and then group animals into decomposers, herbivores, small carnivores and large carnivores.	◆ Case Study 3.2 ◆ Completed worksheets 3.4 & 3.5
Create local wetland food web	◆ Use the lists of animals to rearrange this information and place organisms into a food web.	◆ Worksheet 3.7
Extension activities	◆ Exploration of trophic levels, feeding relationships, food pyramids, distribution and abundance of species.	

Worksheet W

3.1 An introduction to MAITLAND'S WETLANDS

STUDENT NAME: _____

CLASS: _____

1. What natural features are shared amongst wetland ecosystems? (*Hint:* look for the features that are common amongst the PowerPoint slides on local wetlands).

_____

_____

_____

2. Using your observations from Q.1 develop a definition of a wetland.

*A wetland is....*_____

_____

3. Name 5 locations where you would find a naturally occurring wetland in the Maitland area.

_____

_____

_____

4. Name 3 locations where you would find a constructed wetland in the Maitland area.

_____

_____

5. List the human impacts that have occurred on some of Maitland's wetlands.

_____

_____

_____

_____

Worksheet W

3.2 Managing human IMPACTS ON WETLANDS

STUDENT NAME: _____

CLASS: _____

1. List potential impacts from human land use around Woodberry Swamp and its catchment.

LAND USE	POTENTIAL IMPACTS
Urban development	
Industrial development	
Mining	
Agriculture	
Rural residential development	

2. Using your list choose one human impact on Woodberry Swamp and give greater detail on:
   (a) how this impact could be managed to balance human activities and needs with conserving, protecting and maintaining the quality of the environment.
   (b) the challenges to implement this management strategy.

_____

_____

_____

_____

_____

Worksheet W

3.3 Regenerating LOCAL WETLANDS

Background Information

Wetlands across Maitland have been affected by human impacts since the early 1800s. Despite this, our local wetlands remain important ecosystems and contain a high proportion of the area's biodiversity.

Managing impacts on wetlands is largely about managing human activities in and around these areas. Rehabilitation, however, must also play an important role if we are to restore the health of these ecosystems.

Rehabilitating wetlands is a complex task. A common approach is to regenerate – to reintroduce native plants to the area. This activity brings many benefits including:

- additional food source and habitat for native fauna,
- enhanced biodiversity,
- control of erosion,
- prevention or remediation of dryland salinity,
- improved soil health, and
- beautification of the local area.

The following activity involves planning and coordinating a project to regenerate a local wetland. The steps outlined are often used by environmental managers to guide their work.

Project Planning Information

Your regeneration project must address the following objectives:

- Re-establish a diversity of local native plants in and around the wetland.
- Improve the food and habitat opportunities for local native animals.
- Involve a broad range of the local community.

Let's assume that Maitland City Council has provided $2000 from their Greening Plan budget to assist your regeneration project. Use this budget wisely and develop options to expand your resources by thinking sustainably and applying the principles of *Reduce, Reuse & Recycle*.

Worksheet W

3.3 Regenerating LOCAL WETLANDS

STUDENT NAME: _____

CLASS: _____

Regeneration Planning Schedule

1. The Regeneration Project site: _____

2. What plant species will you include in your Regeneration Project?

_____

_____

_____

_____

3. What sector/s of the local community would you involve in your Regeneration Project?

_____

_____

_____

4. How would you promote the project and involve your local community?

_____

_____

_____

_____

5. What protection will you need for your plantings? (Consider whether plants may be affected by damage from wind, rabbits and hares, grazing cattle, and/or evaporation of water during hot weather).

_____

_____

_____

Worksheet W

3.3 Regenerating LOCAL WETLANDS

Regeneration Planning Schedule (cont.)

6. You have gained the landholder's permission for a planting to occur on their property. You now need to order/gather the materials using the $2000 budget and some creative thinking to make it go even further.

   Use the following table to summarise the materials you need and their cost. Some of these materials may not be required or you may wish to consider more cost-effective alternatives.

Regeneration Materials	Required/ Not Required	Quantity	Unit Cost	Total Cost
Native plants			$1.30 each	
Tree guards & stakes			$0.39 (per plant)	
Mulch mats			$0.37 each	
Loose mulch			$0.22 (per plant)	
Fencing			$4/metre	
Water tanker			$5.50/hr (1000L)	
Labour (volunteers)			$15/hr (not paid)	
Labour (paid contractors)			$23/hr	
Other (please specify):				
			TOTAL	

Worksheet W

3.3 Regenerating Local Wetlands: SUGGESTED ANSWERS

The Regeneration Project site:
Students nominate their own site.

What plant species will you include in your Regeneration Project?
- Refer to species list in Case Study 3.2 - *Flora & Fauna of Maitland's Wetlands*.
- Students should choose a range of species and plant types (trees, shrubs, grasses) to increase diversity, and habitat and food opportunities.
- Species need to be suited to the regeneration site. For instance, waterplants should not be chosen to regenerate the drier slopes surrounding wetlands.

What sector/s of the local community would you involve in your Regeneration Project?
Options might include: landowners surrounding the Regeneration Project site, schools, Guides and Scouts, local farmers, local business/industry, local residents, service clubs, sporting clubs.

How would you promote the project and involve your local community?
Options might include:
- Articles in local newspapers (e.g. Mercury, Lower Hunter Star, The Post) promoting details of the project.
- Guest presentations to community group meetings (e.g. service clubs, sporting clubs etc.) and/or schools.
- Personal (face-to-face) or written invitations to individuals and/or groups.
- Distribute flyers about the project by letterbox drops and/or community and school noticeboards.

What protection will you need for your plantings?
- Maitland's wetlands are open and exposed. Most plantings therefore require some form of protection in their first few years. Generally, tree guards and stakes are used to protect against damage by rabbits, hares and strong winds. These are removed once the plant is able to 'fend for itself' and are reused in other planting activities.
- Mulching is also necessary, particularly on the open slopes surrounding wetlands. Despite being a more expensive option, mulch mats are often used as they are quicker and easier to put in place than loose mulch. The decision on what to use depends upon the project budget and amount of time available.
- Stock-proof fencing will be needed around the planting area if the site is being grazed by livestock.
- Some alternatives:
  Tree guards and stakes – 2L juice or 1L milk cartons with two stakes. These offer a more biodegradable alternative, an important consideration if planting in areas affected by floods. These are not as effective at protecting the plants as they are shorter and provide less space around the plant.
  Mulching – (i) grass clippings after slashing the project site; (ii) old newspapers or cardboard with loose mulch over top; (iii) donations of mulch from tree lopping companies or Energy Australia.

Worksheet W

3.3 Regenerating Local Wetlands: SUGGESTED ANSWERS

Summarise what type and quantity of materials you need and the cost.

Students complete their own regeneration materials table. The following information will be useful to guide them:

Native Plants

The usual spacing for planting native tubestock is: approx. 1.5m between trees; approx. 1m between shrubs; and approx. 0.5m between grasses. These estimates along with the number of species to be planted will give an approximate size for the Regeneration Project.

Tree Guards & Stakes

Refer to comments in Q.5. This cost includes one plastic tree guard and three stakes. If juice or milk cartons were used on wetland flats, the cost for purchasing stakes would be $0.13 each.

Mulch Mats

Refer to comments in Q.5.

Loose Mulch

Refer to comments in Q.5. If loose mulch were used it would probably take an extra 1min./plant to collect and place the mulch. Whilst this may not seem much, when establishing 500 plants it means an extra 8hrs labour just for mulching!

Fencing

Fencing will only be necessary if the regeneration project is within an area that is grazed. Ideally, the planting would be in a paddock already fenced after negotiations with the landholder. The cost estimate for fencing does not include labour.

Water Tanker

Depending upon the weather and soil conditions at the time, each plant should receive about ½ bucket (4L) of water.

Labour (volunteers)

Based on local experience, it usually takes about 12 min. to establish a single plant (this includes digging, planting, placing the tree guards, stakes and mulch mats, and watering the plant). Remember to increase this to 13 min./plant if loose mulch is used.

Labour (paid contractors)

Paid contractors are only used in community plantings when there is sufficient budget (not very often!). Professional contractors would generally take no more than 5 min. to establish a single plant.

Worksheet W

3.4 Wetland Research Sheet: FLORA SPECIES

STUDENT NAME: _____

CLASS: _____

Common Name: _____

Botanic Name: _____

Size: _____

What are the habitat requirements of this species?

_____

_____

_____

Is this a flowering plant? If so, when does it flower?

_____

_____

Are there threats to the survival of this plant? If so, what are they?

_____

_____

_____

What are some other interesting facts about this plant?

_____

_____

_____

Summarise your research information in four lines.

_____

_____

_____

_____

Worksheet W

3.4 Wetland Flora Species: EXAMPLE PROFILE

Common Name: Common Rush OR Tussock Rush

Botanic Name: *Juncus usitatus*

Size: Grows up to 1metre in height

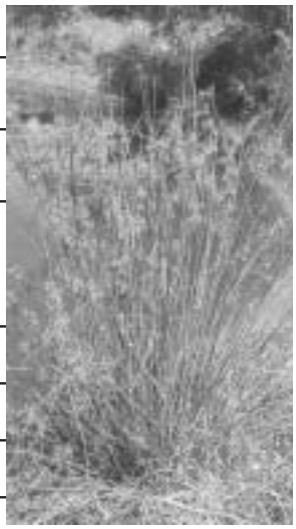


Photo: Sainty & Jacobs 1994; p.265. (see below)

What are the habitat requirements of this species?

It is an 'emergent' waterplant as its roots stay in the soil whilst its stem, flowers and most mature leaves rise above the water surface. It grows in a wide range of damp areas on saturated soils.

Is this a flowering plant? If so, when does it flower?

Yes, it flowers mainly in spring and summer, although old flowers can remain on the plant throughout the year.

Are there threats to the survival of this plant? If so, what are they?

This species is not threatened. Its extent has been reduced in some places, however, by filling and draining of wetlands and clearing for development such as agriculture, and residential and industrial subdivision.

What are some other interesting facts about this plant?

This species is quite salt-tolerant and is often used as an 'indicator species' for dryland salinity across NSW.

Summarise your research information in four lines.

Growing up to 1m, Common Rush flowers from September to February and offers habitat and food for animals as it grows along the fringe of wet areas. It has become an important indicator of the spread of salinity as it is quite salt-tolerant.

Photo taken from: Sainty, G.R. & Jacobs, S.W.L. 1994, *Waterplants in Australia: A field guide* (3rd Ed.), Sydney: Sainty & Associates.

Worksheet W

3.5 Wetland Research Sheet: FAUNA SPECIES

STUDENT NAME: _____

CLASS: _____

Common Name: _____

Scientific Name: _____

Size: _____

What are the habitat requirements of this species?

_____

_____

_____

Are there threats to the survival of this animal? If so, what are they?

_____

_____

_____

What are some other interesting facts about this animal?

_____

_____

_____

_____

Summarise your research information in four lines.

_____

_____

_____

_____

Worksheet W

3.5 Wetland Fauna Species: EXAMPLE PROFILE

Common Name: Peron's Tree Frog

Scientific Name: *Litoria peronii*

Size: Reaches 50mm in length

Photo: Robinson, M. 1998; p.98. (See below)

What are the habitat requirements of this species?

Found in wet and dry forest areas and sometimes in grassland and other open areas. It breeds in the still waters of swamps, dams, ditches and other inundated areas, and at times in backyard fish ponds.

Are there threats to the survival of this animal? If so, what are they?

Stormwater pollution - detergents, oils, nutrients, pesticides and other pollutants from human activities can interfere with breeding, food availability, and frogs"breathing'.

Draining and filling wetland areas which are important breeding sites.

Introduction of **Mosquito Fish** that feed on tadpoles.

What are some other interesting facts about this animal?

It has sometimes been called the **Maniacal Cackle Frog** because of the distinctive call of the male frog, which can be heard from September to January. Its colour can change depending on temperature, temperament and whether it's night or day.

Summarise your research information in four lines.

The male Peron's Tree Frog cackles like a maniac from September to January on the edge of still waters as it tries to attract a mate. It could find its way into your backyard fish pond providing it avoids death by water pollution, Mosquito Fish or filling of its wetland home.

Photo taken from: Robinson, M. 1998, *Field Guide to Frogs of Australia*, Sydney: Reed New Holland.

Worksheet W

3.6 Flora & Fauna of LOCAL WETLANDS

STUDENT NAME: _____

CLASS: _____

FLORA

Draw a picture:

Name: _____

Describe its appearance: _____

_____

_____

_____

Describe its habitat: _____

_____

_____

_____

FAUNA

Draw a picture:

Name: _____

Describe its appearance: _____

_____

_____

_____

Describe its habitat: _____

_____

_____

_____

Worksheet W

3.7 Local Wetland Research: FOOD WEBS & ENERGY FLOW

Create a Local Wetland Food Web

Arrange local wetland organisms into the correct boxes. Draw arrows to show the flow of energy through the food web.

Unbroken arrow = *is eaten by*

Broken arrow = *death and decay*

Secondary Carnivores (3rd order Consumers)

Decomposers

Primary Carnivores (2nd Order Consumers)

Herbivores (1st Order Consumers)

Autotrophs (Producers)

Energy from the sun

Worksheet W

3.8 Waterbird Adaptations: BILLS, FEATHERS & FEET

Background

Waterbirds have adapted in different ways to their watery home. Some swim a lot and need strong feet to paddle about. Other walk around on the edges of swamps. These birds usually have long toes to give them balance and distribute their weight so that they don't sink into the mud.

Birds' beaks or bills also show adaptations to what they eat and how they feed. A duck's bill is wide and flat, ideal for trawling through water for small insects and snails. Other ducks dabble in mud, sifting out small creatures to eat. Egrets have long, pointed bills which they dart at their prey with lightning speed.

Activity

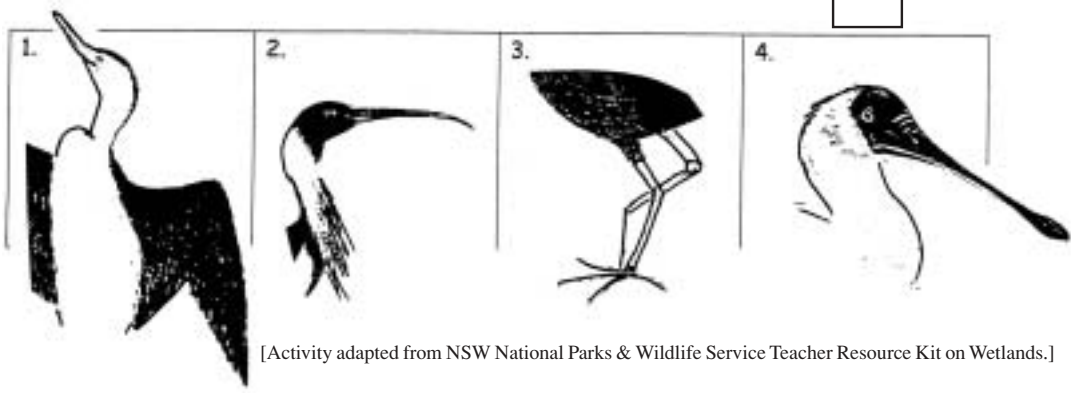
Four waterbirds found around Maitland's wetlands are described below. Read the descriptions and match the feet or bills to the animal described by placing a number in the box.

*I am a **Purple Swamphen**. My beak is bright red. I am found wading in dense reeds along freshwater lakes, swamps and streams. I am about 45cm tall and have medium length legs. I have long toes so I do not sink in the mud when feeding. Which feet are mine?* ☐

***Straw-necked Ibises** feed in both wet and dry places. They eat water insects, molluscs, frogs and snakes. They are usually found in large groups and are often seen flying in a V-formation. They have straw-like feathers hanging from below their long curved beak. Which beak is mine?* ☐

*If you ever see me you won't forget me. I breed in colonies but if I'm disturbed by humans in noisy boats I sometimes abandon my nest. I feed in shallow water. I have a long bill that I place in the water and swish from side to side as I walk along. If my bill touches something I shake it about furiously then snap at my prey. The knobs at the end of my bill help me to crush fish and yabbies before I swallow them. I'm a **Royal Spoonbill**. Which is my bill?* ☐

*I am black and often sit on dead trees or rocks, my wings outstretched in the breeze. Unlike some waterbirds, my feathers aren't waterproof with oil. My feathers get wet and heavy but this helps me swim underwater to catch fish. My bill is long, slender and sharply hooked. The hook helps me to hold onto any fish I catch. Some people call me a shag but I'm also called a **Cormorant**. Which one am I?* ☐



[Activity adapted from NSW National Parks & Wildlife Service Teacher Resource Kit on Wetlands.]

Worksheet W

3.9 Discovering Local Wetlands
FIND-A-WORD PUZZLE

Maitland is home to a number of wetlands. These ecosystems are at the lowest part of the catchment and are an important location for the feeding, breeding and sheltering of native wildlife. A wetland is also known by other names such as swamp, lagoon, or marsh.

Wetlands are found at Tenambit, Woodberry, Bolwarra, Telarah and many other places around the Maitland area. Look out for other wetland locations next time you're travelling around the area.

Our local wetlands are home to a number of common as well as threatened species of plants and animals. Some of the more common species you will find are Swamp Oak, Cumbungi, Grey Teal, Sacred Ibis, Bearded Dragon, and Water Boatman. All plants and animals fit into an important and complex food chain.

Find the underlined words in the puzzle below:

K	T	D	S	F	O	O	D	C	H	A	I	N	N	Q
K	D	Z	H	E	C	O	S	Y	S	T	E	M	S	U
W	C	B	E	A	R	D	E	D	D	R	A	G	O	N
L	A	C	N	S	T	J	S	P	E	C	I	E	S	S
A	K	T	H	A	Y	R	R	E	B	D	O	O	W	G
E	H	H	E	C	R	B	C	U	M	B	U	N	G	I
T	I	A	B	R	T	R	W	H	K	U	E	S	D	L
Y	S	K	S	E	B	I	A	E	A	A	V	L	H	A
E	S	A	W	D	H	O	B	W	T	R	K	F	C	G
R	X	O	A	I	S	Z	A	M	L	L	A	F	J	O
G	J	P	M	B	R	L	V	T	A	O	A	L	E	O
H	Q	M	P	I	A	L	Q	V	M	N	B	N	E	N
A	Z	A	F	S	M	W	T	O	X	A	E	P	D	T
I	W	W	W	C	A	T	C	H	M	E	N	T	H	S
L	R	S	M	H	M	A	I	T	L	A	N	D	U	P