Snapshot of the Tuggerah Lakes Estuary Management Study

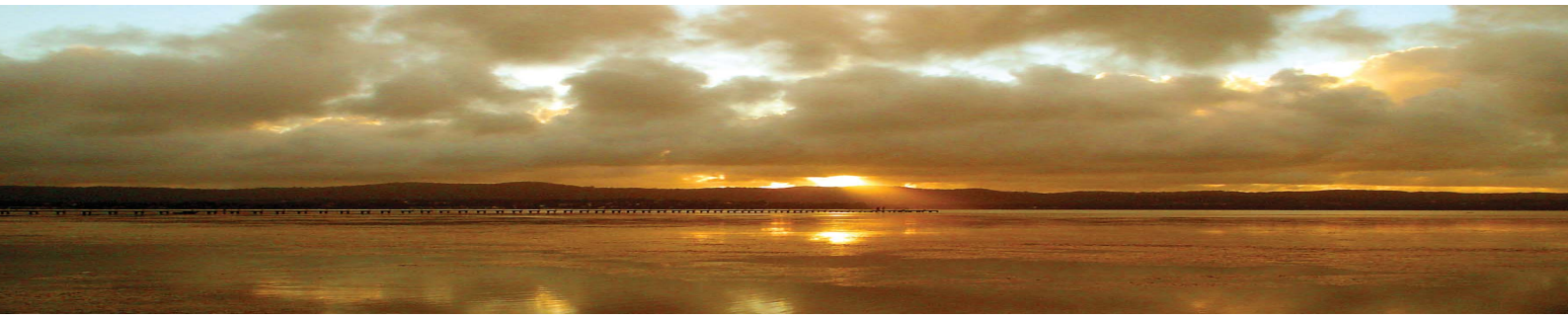
June 2005

Estuary Management Process

Tuggerah Lakes Estuary Process Study, 2001

Tuggerah Lakes Estuary Management Study, 2005

Tuggerah Lakes Estuary Management Plan



Summary document information adapted from Roberts, D.E. and Dickinson, T.G. (2005). Tuggerah Lakes Estuary Management Study. Prepared for Wyong Shire Council and Department of Infrastructure, Planning and Natural Resources. BIO-ANALYSIS: Marine, Estuarine and Freshwater Ecology, Narara

Layout and Design - Elena Lazzarotto
Front cover and inside cover photographs courtesy of Andrew Rowland

For copies of this document or more information about the Tuggerah Lakes Estuary Management Study, contact Wyong Shire Council's Project Manager Siân Fawcett on 43505506 or email: fawcetts@wyong.nsw.gov.au

or contact Neil Kelleher, Senior Natural Resource Officer, Coast Estuaries and Waterways Engineer, Resource Access and Compliance at the Department of Infrastructure, Planning and Natural Resources, Hunter Region (Gosford) on 43377313 or email: Neil.Kelleher@dipnr.nsw.gov.au

You can also find information about the Tuggerah Lakes Estuary Processes Study and Estuary Management Study on Wyong Shire Council's web site
www.wyong.nsw.gov.au/environment_home.html

Prepared by

BIO-ANALYSIS
Marine, Estuarine & Freshwater Ecology

In association with

Umwelt
Environmental Consultants

For

WYONG SHIRE COUNCIL

CENTRAL COAST

Department of
Infrastructure, Planning and Natural Resources

Community Resource Information
For The Tuggerah Lakes Estuary Management Study

Julie Garratley

FOREWORD

The Tuggerah Lakes, known as the jewel of Wyong Shire, is a major attraction for residents and visitors to Wyong. Most of us have seen how our developing Shire has placed enormous pressure on the Estuary which we treasure.

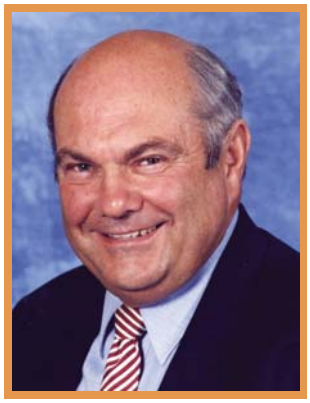
Since 1996, Council and the Tuggerah Lakes Estuary and Coastal Management Committee in close association with The Department of Infrastructure, Planning and Natural Resources have been working towards developing a holistic Management Plan for protection of the Tuggerah Lakes Estuary in such a way that integrates social, economic and environmental issues relating to managing the Tuggerah Lakes Estuary. In 2001 the Tuggerah Lakes Estuary Process Study was released which described the physical, chemical and biological patterns and processes within the estuary and gave an assessment of the overall "health" of the Tuggerah Lakes Estuary.

On completion of the Estuary Process Study, Council began work on the Tuggerah Lakes Estuary Management Study. This study has taken all the scientific information gathered during the formulation of the Tuggerah Lakes Estuary Process Study, analysed the issues facing the Lakes and estuary and listed potential management options to address the highlighted issues.

I am proud to announce that the Draft Tuggerah Lakes Estuary Management Study has undergone extensive consultation with the community and peer review by estuary managers, scientists and Government Departments, all of which have been extremely encouraging. I would like to congratulate the Tuggerah Lakes Estuary and Coastal Management Committee on production of such an outstanding document.

This represents a major milestone for Council in developing a holistic Management Plan for a sustainable future for the Tuggerah Lakes Estuary. The next and most important step for Council now is to turn the wealth of information contained within the Draft Tuggerah Lakes Estuary Estuary Management Study into an Estuary Management Plan. The plan will outline selected on-ground works, investigations or initiatives for management, their priority, costs, responsibility and indicative timeframe.

On behalf of Wyong Shire Council and the Tuggerah Lakes Estuary and Coastal Management Committee, I proudly welcome the Tuggerah Lakes Estuary Management Study and Summary Document.



Councillor Bob Graham
Deputy Mayor
Chair, Tuggerah Lakes Estuary and Coastal Management Committee

CONTENTS

Taking Care of

Tuggerah Lakes

Julie Garratley

Think of the Central Coast and you think of the lakes. Generations of so many families have spent holidays here, and stories abound about fishing, paddling and enjoying the tranquility of a summer evening. These days, the lakes and their catchment are home to 136 thousand people, many of whom also look to the lakes for employment and relaxation.

Coastal lagoons like the Tuggerah Lakes are naturally very variable waterways, with big swings in fish and bird populations. The level of salt in the lakes (or salinity) also changes with rainfall and depends on whether the entrance is open or closed. In Tuggerah Lakes, these natural changes are amplified by changes driven by agricultural, urban, recreational and industrial uses. The ways that we think about the Lakes as a place to live, look at, take a stroll or drop a line have also changed over time.

The **Tuggerah Lakes Estuary Management Study** brings together information about natural patterns and processes in the lakes, information about how locals and visitors use and value the waterway, information about acceptable trends and changes, and options to help Council and the community shape a healthy future for Tuggerah Lakes.

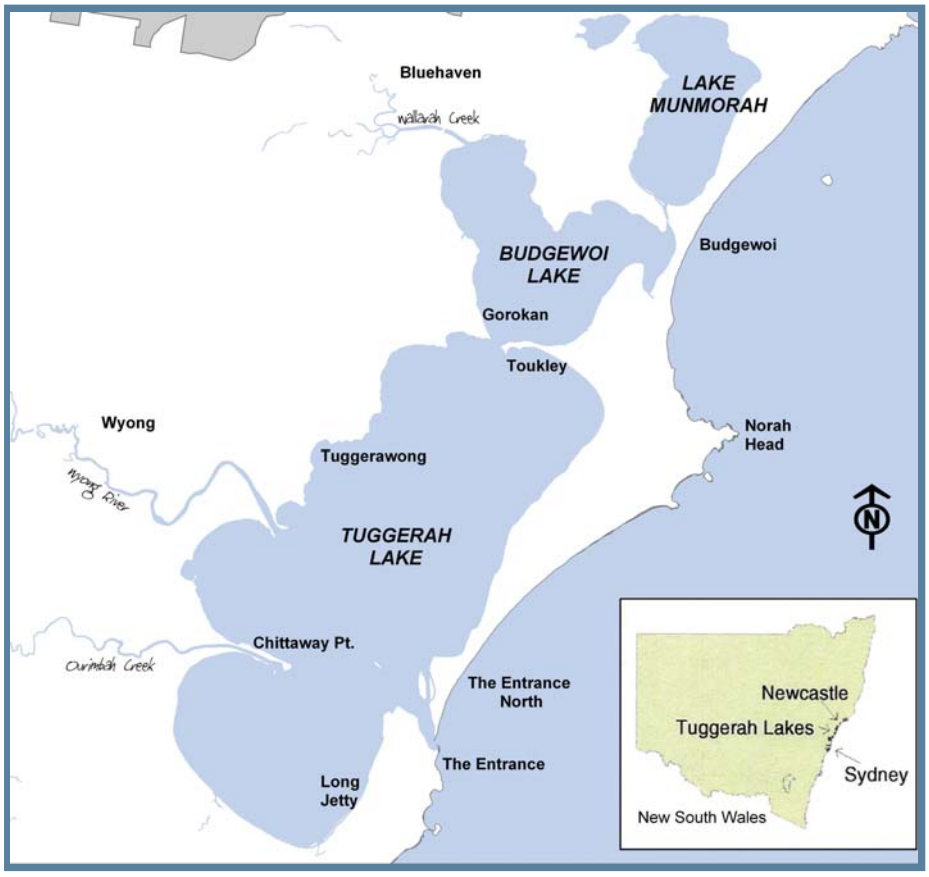
The Tuggerah Lakes Estuary Management Study has been prepared by consultants on behalf of Wyong Shire Council.

This community resource document contains information about how to manage changing environmental conditions to protect the things about Tuggerah Lakes that are important to residents and visitors who use the lakes. It highlights environmental, social, cultural and economic features that are identified in the Tuggerah Lakes Estuary Management Study.

Further details about all of the issues discussed in this introduction can be found in the main volume of the Tuggerah Lakes Estuary Management Study. The Study can be obtained at Wyong Shire Council offices and libraries, or viewed on Council's web site.
wyong.nsw.gov.au/environment_home.html

Want to know more?

Check the full report of the Estuary Management Study at Wyong Shire Council offices, libraries and Wyong Council's website.
wyong.nsw.gov.au/environment_home.html



The information is intended to help interested members of the community to comment on the best approach to managing the lakes:

- Are we using the right information?
- Have the right people had an opportunity to be involved?
- Have we correctly identified the places and activities that need careful management?
- Have we identified reasonable options to protect valuable places and processes?
- Have we made it clear how decisions will be made, reported and implemented?

Your input is important

Your feedback on the Estuary Management Study is welcomed. We need your comments to ensure that the Tuggerah Lakes Estuary Management Study draws on the best information about the lakes and reflects what's really important to local people.

Community comments that were made during earlier consultation about the estuary have been considered in the preparation of the Tuggerah Lakes Estuary Management Study.

Details of how to contribute to the study can be found on page 39.

Who is responsible for managing Tuggerah Lakes?

The NSW Estuary Program is a partnership between the state government and local government. Planning for healthy and productive estuaries is funded on a 50/50 basis by these partners. The Department of Infrastructure, Planning and Natural Resources (DIPNR) and Wyong Shire Council have primary responsibility for decision making and also for many of the management actions.

Other important players in the management of the lakes include:

- Hunter - Central Rivers Catchment Authority;
- Department of Environment and Conservation (formerly EPA and NPWS);
- Department of Primary Industries (NSW Fisheries, Mineral Resources and NSW Agriculture);
- Department of Lands;
- NSW Maritime Authority; and
- Delta Electricity.

However, achieving a safe, attractive and healthy Tuggerah Lakes system in the future also depends on the ideas and actions of local businesses, residents and community groups, (including commercial fishers, tourism businesses, the development industry, Aboriginal Land Councils and traditional owners, recreational boating and fishing groups and citizen groups such as Landcare and Precinct Committees).

The Estuary Management Study takes into account the policies and programs of these organisations. Following review of the Tuggerah Lakes Estuary Management Study, the Tuggerah Lakes Estuary Management Plan will recommend a co-ordinated strategy for the lakes as a whole, incorporating actions for state and local organisations and for the community.

Julie Garratley

Andrew Rowland

Julie Garratley

Andrew Rowland

Steps Towards an Estuary Management Plan

To help provide a consistent approach to assessing the health of estuaries and priorities for investment to protect important natural resources and community assets, the Department of Land and Water Conservation (DLWC), now Infrastructure Planning and Natural Resources (DIPNR) prepared a statewide Estuary Management Manual in 1992. The Manual sets out a basic process for thinking through the important issues for each estuary. Nearly fifteen years of experience in implementing the assessment model set out in the Manual has led to a number of changes to what is considered best practice, and these have been incorporated into the study.

In addition, the broader context for estuary management has been changed as catchment and other natural resource management planning has become more regionalised. Completion of the Estuary Management Plan is now identified as a priority action within the Central Coast Catchment Blueprint. The priorities identified in the Estuary Management Plan will take into account other natural resource priorities in the Blueprint and associated Action Plan.

Despite these changes to natural resource planning framework, the core tasks for developing an estuary management plan remain the same:

The Estuary Management Process

1. ESTUARY PROCESSES STUDY –

this study was completed in 2001

- Understand the basic estuary type and fundamental physical and ecological processes.
- Understand natural variability in the system.
- Appreciate the linkages between natural processes in the estuary and process inputs from the catchment and the ocean.
- Document the important scientific features of the estuary.

2. ESTUARY MANAGEMENT STUDY –

this is the current stage of planning for the Tuggerah Lakes

- The full Estuary Management Study can be viewed at Council offices, libraries and on Council's website.

- Understand how people use and enjoy the estuary – what's important to residents and visitors; what's important to scientists and managers?

- What would a balanced estuary management plan need to achieve – What would conservation, economic development, recreation access and facilities look like? Who would benefit from these outcomes?

- What risks need to be considered in balancing the community vision for the waterway and its catchment, with natural processes and conservation values?

- What are the current issues – what's driving existing conflicts? What's driving observed trends in the condition of the estuary? Are these trends natural or outside natural variability?

- What options are available to reduce conflict, improve estuary health/ productivity and protect places of high conservation value? (These places may be important because of natural, social or cultural features and associations).

- What criteria should be applied to make good decisions about the important assets that the estuary provides?

3. ESTUARY MANAGEMENT PLAN –

to be prepared upon finalisation of the Estuary Management Study.

The proposed actions in the Estuary Management Plan will form a series of recommendations to federal and state authorities, as well as Councils. These will need to be incorporated into plans of management, work programs, budgets and grant programs to be carried out, but will have the priority that comes from the comprehensive Estuary Management planning process. The Plan will also address:

- Which organisations have responsibility for making decisions?

- Which organisations have responsibility for implementing management actions or works? How will these organisations be kept accountable for management promises?

- What is the proposed schedule of actions to guide development and protect the important natural and community values of the lakes?

- How much will all these actions cost and who will pay?

Wyong Shire Council appointed a number of specialist consultants to assist with the preparation of the Estuary Processes Study and Estuary Management Study. The consultants report directly to a project manager at Council, also to the Estuary and Coastline Management Committee. Members of the Committee represent diverse interests in the future of the lakes and meet monthly to review progress.

For all three stages – the Estuary Processes Study, Estuary Management Study and Estuary Management Plan, Wyong Shire Council has an independent external peer review program to ensure that the advice provided reflects the most up to date scientific opinion and best management practice for coastal lakes.

Julie Garratley

What makes Tuggerah Lakes special?

Many families have memories of happy holidays enjoying the lakes and the nearby ocean beaches.

Many people associate the lakes with waterbirds such as black swans and pelicans. However, the Tuggerah Lakes Estuary is home to many important bird habitats, which attract many nationally threatened, vulnerable and migratory bird species.

The Tuggerah Lakes is one of Australia's most significant regions for both Sharp-tailed sandpipers and Curlew sandpipers.

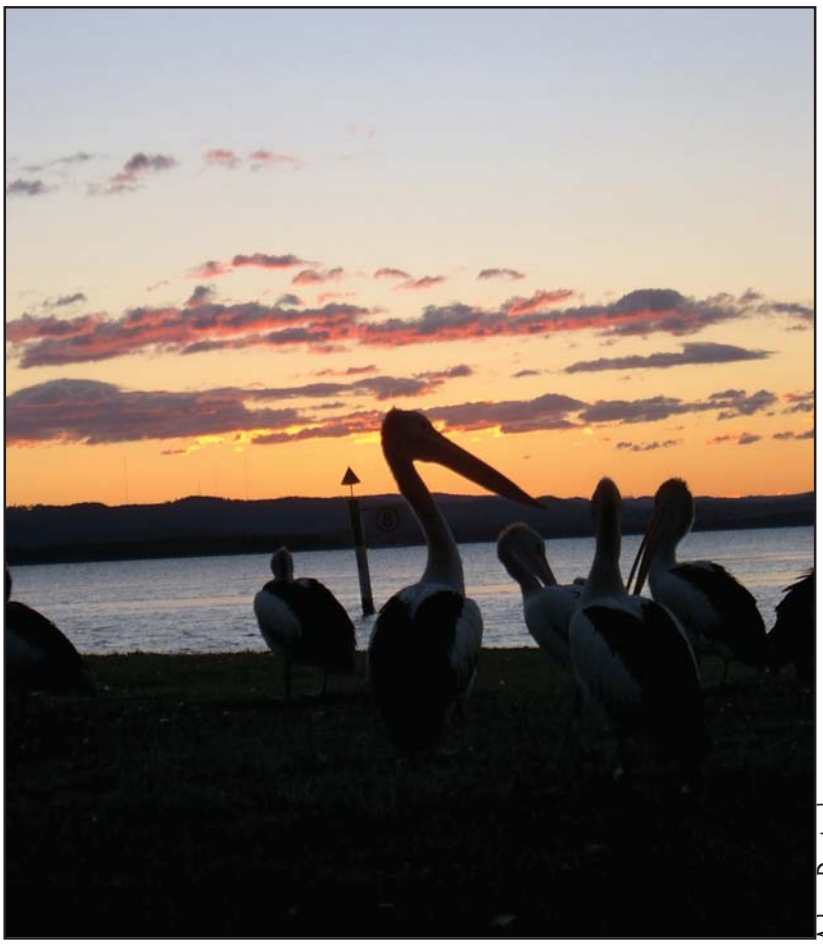
Fishing is perhaps the activity most people think of first, with big catches of mullet, flathead, bream and prawns by both commercial and recreational fishers. But if you look closely, the lakes are also home to some very interesting species.

Seagrass is widespread in the shallow bays of Tuggerah Lakes. It's like an underwater garden, with many interesting species, as well as the fish sought by commercial and recreational anglers. Add a bit of nutrient and it grows well; add too much nutrient and it is overwhelmed by "weeds" – in this case, algae. Look closely amongst the long fronds of seagrass and you might be rewarded by seeing a seahorse. At least six species of these amazing creatures can be found in Tuggerah Lakes and they have recently been listed as "Protected Species" by the NSW Department of Primary Industries.

Scientists believe that there were several species of sponges in the lakes in the past. One of these, a species of the genus *Suberites*, appears to have been quite widespread in Lake Munmorah and Budgewoi Lake until recently, but its numbers are currently very low.

Much of the low lying shoreline around Tuggerah Lakes was formerly a gently sloping saltmarsh community. Saltmarsh habitat is important for fish stocks, birds and also helps with the breakdown of dead seagrass (wrack) out of the water. This reduces the amount of organic sediment that can accumulate around the lake shoreline.

Tuggerah Bay is the best place to see saltmarsh now, as many former saltmarsh areas have been filled to make flat land for large scale development. About 85% of the former saltmarsh habitat around Tuggerah Lakes has now been lost. As a direst consequence of losing so much saltmarsh in Tuggerah Lakes estuary, we have lost the White fronted chat - a protected bird species that was once common in saltmarshes and estuaries. The NSW Government has recently recognised the ongoing threat to this valuable habitat and has listed saltmarsh as a Threatened Ecological Community.



Adam Deutsch

Living with lagoons

Tuggerah Lakes is not one lake but three, connected to each other by shallow and narrow channels and only intermittently connected to the ocean. It has been in this form for thousands of years. Coastal lakes like Tuggerah present difficult challenges to the people who live around them, but they also have special features that are worth protecting. So, if we try to change Tuggerah Lakes to make them more like other lake systems, such as Lake Macquarie, Wallis Lake or Port Stephens, we will lose many of the natural attributes of the lakes, and the features that have attracted people here.

Did you know:

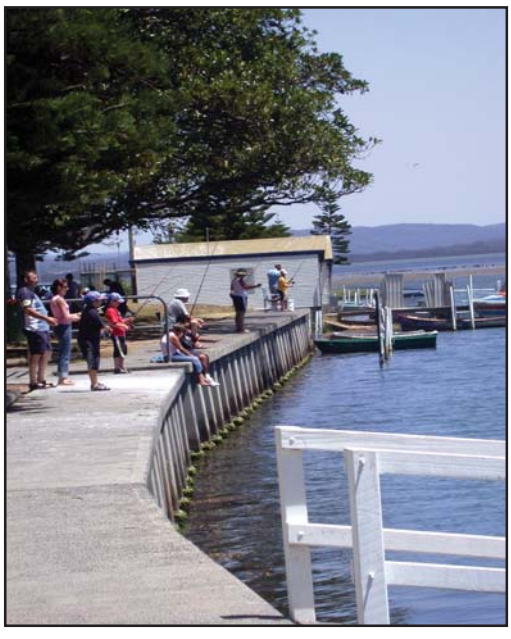
- Tuggerah Lakes are "healthier" now than they were in the 1980s and early 1990s. Water quality meets standard objectives for healthy estuarine waterways more often, the water is generally less turbid (cloudy) and the frequency of algal blooms has declined. However, despite these improvements, the area of seagrass has not recovered from the losses twenty or so years ago, and saltmarsh areas continue to decline due to filling, mowing and other direct impacts. Maintaining a healthy lake system will need a concerted effort from everyone, to keep nutrient levels down and foster the recovery of aquatic habitats.

- The lakes have had only one channel connecting to the sea for at least 1000 years. This is at The Entrance.

- The entrance to Tuggerah Lakes has closed regularly in the past, particularly during long dry periods. Historical records suggest at least 13 periods of closure over the last 100 years, some for as long as three years at a time. Long periods of entrance closure are typical of coastal lakes which have small catchment areas relative to lake area. In these systems major flushing flows from the catchment, which force the entrance to open and stay open, are quite rare.

- The sandy barrier between Budgewoi Lake and the sea is low and narrow. Blowouts through the dunes meant that during big storms in the early 20th century, waves could sometimes wash over from the sea to the lake. Since the area was mined, the dunes have been reshaped and there have been no washovers for many years, probably since 1955.

- The salinity of Tuggerah Lakes varies from around 15 to 35 parts per thousand (ppt), (ocean salinity is 35ppt). Salinity in the lakes is affected by catchment rainfall and the connection to the ocean. Wyong Shire Council now operates a dredge at The Entrance, to maintain a small permanent connection between the lakes and the ocean. This also helps to maintain a relatively steady salinity in the lakes. In the past, the lakes could become very saline (more than 40ppt) in dry periods but after heavy rain, floodwaters from the catchment would drive salinity down dramatically.



Julie Garratley

Danny Roberts

- Tuggerah Lakes has an area of 80 square kilometers. This is about 12% of the lake catchment area of 670 square kilometres. Four main watercourses feed freshwater into the lakes – Wyong River, Ourimbah Creek, Wallarah Creek and Tumbi Creek. These creeks have established wide floodplains and deltas extending into the body of the lake. Large lakes, such as Tuggerah Lakes act as giant sedimentation basins, slowing down flows from the catchment and encouraging deposition of sediment. Most of the nutrients from the catchment are also retained in the lakes, making them very sensitive to changes in the development of the catchment.

- Seagrass, macroalgae and saltmarsh are the main components of aquatic and foreshore vegetation at Tuggerah Lakes. Up to 85% of the saltmarsh habitat around Tuggerah Lakes has been degraded by development. Research at Tuggerah Lakes and elsewhere has shown that gently sloping saltmarsh shorelines help to break down seagrass wrack. Conversely, seagrass wrack helps provide nutrients and encourages the growth of saltmarsh plants. Both seagrass and saltmarsh are important elements of estuary ecology.

- Compared to other large lake systems and estuaries, the ratio of Tuggerah Lakes' catchment to the lakes' area is relatively small. This catchment to lake area ratio, together with long periods of entrance closure, mean that the natural nutrient status of the lakes would have been quite low. A big change occurred as settlement expanded around the lakes shores and into the catchment. From about 1940 to now, discharges from septic tanks, fertilisers and nutrients attached to soil particles eroded from the catchment and stormwater runoff from urban areas have all added nutrients to the lakes. Investment in a Shire wide sewerage scheme, with ocean outfalls rather than discharges to the lakes, has helped to control the nutrient load, but ongoing vigilance is necessary to minimise the contributions from all types of landuse and an increasing population.

Danny Roberts

Danny Roberts

- The lakes are shallow (average depth only about 1.7 metres), so wind waves are an important process for circulating and mixing lake water. The lakes have a small daily tidal range (usually less than 10 cm) and tidal currents from the entrance provide only slow flushing of the main body of the lakes. Tidal movements and induced lake circulation affect only a small area around The Entrance. The water circulation and exchange processes around the lake entrance are quite different from those that operate elsewhere in the lakes.

- Tuggerah Lakes provides a home for 69 threatened species, mainly migratory waders and other water birds which are also covered by international conservation agreements to which Australia is a signatory. Saltmarsh and freshwater wetlands have recently been listed as Threatened Ecological communities under the NSW *Threatened Species Conservation Act 1995.* Seahorses and pipefish, which are widespread in Tuggerah Lakes, are listed as Protected Species under the NSW *Fisheries Management Act 1994.*

- The current population living and working in the immediate catchment of Tuggerah Lakes is around 116 thousand people. During peak holiday periods, this population doubles to more than 320 thousand people. Whilst numerous businesses depend to some extent on the attractions of Tuggerah Lakes, and the adjoining coastline, the actual economic importance of tourism, fishing and other industries is not well documented.

- Tuggerah Lakes has been in the top ten commercial fishing estuaries in NSW for many years, with total annual commercial catches in the range 150,000kg to 500,000kg.

- Wyong Shire Council currently spends around $60,000 per year on water quality monitoring for Tuggerah Lakes, building up a picture of how water quality varies and whether the water meets requirements for swimming and boating. Delta Electricity spends another $40,000 on environmental monitoring each year at Munmorah Power Station.

- Wyong Shire Council commits around $300,000 annually to the upgrade of stormwater drainage systems in existing urban areas, aiming to further reduce sediment and nutrient loads to the lakes.

Tall tales and true–

what makes a good catch?

Tuggerah Lakes has long been very popular with fishers, providing food and recreation from prehistoric times to the present day.

Photo by Bill Hansen, courtesy of Sainty and Associates

We'd always have holidays in Toukley. We loved it so much and there was plenty of fish, plenty of prawns. We had loads of fish down here three times a day. But just for a change, we'd sometimes walk across to Noraville and fish there. Dad bought a 25 yard net and we'd have one haul with the net to catch some prawns and then we'd go out to fish. Oh that's what we lived for! We always had a boat, we went halves in a boat, my husband and dad, and every time they came home we'd spend all our time cleaning the fish. Plenty of fish, they'd never fail. There was that much fish, we lived on fish. Put a prawn on the hook and you'd always get a fish, and mostly bream, they were beautiful bream, and Mum was the cook. Rita Struck (referring to 1920s/30s) in Scott 2002.

Andrew Rowland

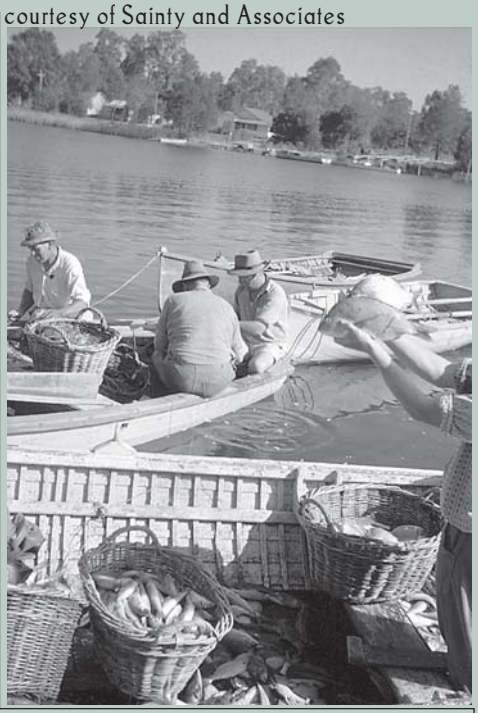
The site of the camp was prettily situated on the bank of Wyong Creek, which hereabouts joined the lake. A bark canoe paddled by a very old grey bearded man, now silently approached, and drew up close to our camp; the canoe was so deeply laden with fish of all sorts as to be inches only above the water. The old man, by name "Jew Fish", at once commenced to throw the fish onto the shore. There was no rush or scramble for them; in fact no-one seemed to pay attention to this.

Observations of John Mann, who attended an Aboriginal corroboree on the Wyong River in 1842 (from Scott 2002).

Tuggerah Lakes leads with the quantity of fish caught (in estuaries of NSW) during the year, taking no less than 13,888 baskets or 2314 in excess of Lake Macquarie. We attribute the increased supply to the waters which had previously been closed being thrown open to fishermen, and they appear to have made the best of it. From this lake, large quantities of fish are sent direct to country towns, and the balance to the markets.... This lake is largely used by line fishers, and with splendid results, the pleasure parties taking away large quantities of bream, flathead and whiting, and we regret to say that this means that many small and immature fish are caught.

Fisheries Annual Report 1884 (in Scott 2002).

Photo by Michael Clouten, courtesy of Sainty and Associates



Scott (2002) notes that *early in the twentieth century, the abundance of fish was one of the main attractions for holiday makers from Sydney and Newcastle. You were regarded as a "dud" if you couldn't catch fish.*

It is interesting to note, however, that in the winter of 1897, fishermen were commenting about the scarcity of fish in Tuggerah Lakes. Similarly, very big catches were reported in 1901, but fish were again very scarce in 1905.

Source: Scott, A. 2002. Tuggerah Lakes. Way back when...

Time and tide – changes in Tuggerah Lakes

Pre European settlement — Aboriginal sites around the lake shoreline demonstrate a lifestyle based on estuarine resources (fish, shellfish and wetland plants) over a period of about 6000 years.

1830s — Logging in the upper catchment, transported down Ourimbah Creek and shipped from Cabbage Tree Harbour.
Descriptions of thousands of black swans feeding on ribbon weed

1842 — Reports of Aboriginal corroboree on the Wyong River, fish abundant.

1860s — Chinese fishermen smoking fish and prawns at Canton Beach
Jabiru reported as "not uncommon".

1880s – early 1900s — Chinese fishermen replaced by fishers from the south coast, first at Canton Beach and later at Tacoma. Very big catches of fish reported, but some variability from year to year.
Abundant young fish in weed beds near the entrance, Ourimbah Creek, Wyong River, eastern side of Budgewoi Lake.
Reports of "slimy weed" at multiple locations.
After severe storms and floods – weed wrack piled up on the shoreline.
Entrance closed 1883, with low dune across the entrance area.
Manual opening of entrance channel 1896.
Entrance open 1898.
Big flood 1899.
Vast numbers of diverse water bird species reported in 1905.


Anthony Scott

1900 - 1910 — Improved transport to the lakes district – railway, traffic bridge across Wyong River and Ourimbah Creek, stone jetty at Tuggerah.
Oyster leases at The Entrance.
Big flood 1903.
Musk duck believed to be most common when entrance closed – high water levels and lower salinity.
Dredging Wyong River mouth for Navigation, 1903.
The Entrance closed for about 8 months in 1915 – flooding along Wyong creek just prior to entrance re-opening.

1920 — 200 lot subdivision at The Entrance. People arrived by train to Wyong and boat across the lake. There was also a ferry service from Toukley to Buff Point and Wallarah Point. "Tent city" at The Entrance in summer holidays.
Stone jetty built between Green Point and Buff Point to get out beyond the weed around the shore, which was brought in by the wind.
Big flood 1927 – lake level up across the sand between Noraville and Budgewoi.
Fishermen would shoot duck to earn a living if fish numbers were low.
Steam dredge at Pelican Island – in the 1920s, up to 20 feet of water was reported at the wharves (Taylors Wharf at The Entrance).

1930 - 1950 — Gradually increasing local population (13000 people in 1950).
Big catches of fish by holiday makers.
Canton Beach – all pure white sand - people would swim way out over sand to "the step", similarly at Long Jetty – no weed on the sand flats out to the end of the jetty.
Wild waterbirds shot for food and sold to market during the depression and a 'mass of musk ducks" on the top lake in 1930s.
The Entrance reported to be closed for three years about 1939-1940. High water levels in the lakes. Manual excavation of a channel in July 1940. Within a week reports of entrance running strongly and a drop of nearly 1 m in lake level. Big fish run out with drop in lake level.
Big floods in 1930s – working bees at Long jetty to cart away excess weed piled up on the shore.
Washovers reported at "The Gap" in 1930s.
Mud banks at mouth of Wyong River – 1930s.
"Red wool" weed in the spring – 1930s couldn't fish with nets because there was so much of it.
Slime on lake floor in 1940s.
Big flood 1949.

1960s — Munmorah Power Station commences operation.
Debate about impacts of commercial fishing on fish stocks (high fishing effort with lots of visiting commercial fishermen).
Reports of abundant "stackweed" (*Ruppia*) first appear, but very variable from year to year (Higginson surveys) – distribution affected by big storms in 1964 and 1965. Very heavy growth of stackweed in 1962 – people reported that they could not get into Budgewoi Lake by boat because it was choked with stackweed.

1960's continued

Increase in weed growth attributed to warm water from power station – but also changes in weed species in Lake Munmorah.
Reports of loss of amenity for holiday makers because of increasing amounts of weed in shallow water areas.
Some reports of fish kills around power station, attributed to hot water discharges.
Dredging of the Budgewoi channel, with sediment dumped across the "Big Sand" - foreshore moved much further out with increased sediment pumped onto the old tidal delta.

1970s

Increasing reports of algal growth and dense weed growth in all three lakes, was well as foul odours from rotting weed and algae.
Seepage from septic tanks reported flowing directly to lakes.
Reports of "mud" around lake shore – where there had been sand.
Occasional discharges of flyash to Budgewoi Lake.

1980s

Major urban expansion in immediate lake catchment area.
Masses of "cobwebby" algae – rolls along the bottom and gets caught up in the ribbon weed.
Further expansion of strap weeds, ribbon wed and stackweed in all areas.
Black mud and sulfurous odours – change from the "wet weed" odour that had been reported by local residents 20 and 30 years earlier.

1980 - 1990s

Tuggerah Lakes restoration project, foreshore reclamation, dredging of black organic mud, "Bell end" and larger sediment traps on stormwater drains.
Weed harvesting around the shoreline and introduction of floating weed harvester on the lakes.
Major dredging around Canton Beach and dredging at The Entrance to maintain a small ocean opening at all times.
Occasional big fish kills reported at Lake Munmorah.
Some fishermen believe that the power station cooling water killed stackweed and reduced shellfish abundance in Lake Munmorah; also questions about impact of power station discharges on greasyback prawns.
Reports of significant decline in abundance of jelly fish in the lakes – lakes reported as "being full of blubber" in 1930s- 1960s.
Musk ducks very rarely seen.
Big increase in power boats and then jet skis.

Danny Roberts

1990s

Wyong sewerage scheme completed, cutting the high load of nutrients and bacteria from urban areas on the lake shore. However, nutrient loads from urban stormwater remain an issue.
Moderate flood 1990 – The lake entrance very wide for a couple of weeks.
Ongoing rapid expansion of urban development in the lake catchment.
Reports of large numbers of waterbirds in the lake – referring to seasonal patterns over many years – black swan, chestnut teal, pelican, cormorants, black bittern, knots, lapwings, black winged stilts, little egrets, sea eagles and whistling kites.
Mine subsidence under some wetlands (Colongra) and lake shore (Buff Point).
Regular 'beach cleaning" on recreational beaches – safety issues (rubbish) plus clearing organic mud from swimming areas.

2000 onwards?

Further urban expansion in catchment area – Warnervale.
Introduction of Water Sensitive Urban Design introduces new design controls to minimise nutrient loads from growing urban areas and reduce urban impacts on catchment hydrology.
Continuing dredging of the entrance channel.
Ongoing Council investment in improved stormwater controls.
Reports of reduced weed and macroalgae.
Waterskiing and sailing popular on all three lakes.
Ongoing poor compliance with faecal coliform requirements for primary contact recreation (especially in creeks and at Canton Beach).
Reports of decline in sponge species diversity and population in the lakes.
Saltmarsh listed as a Threatened Ecological Community.
Ongoing debate about dredging the mouth of Tumbi Creek.
Signathids (sea horses and pipe fish) listed as protected species.

A MANAGEMENT PLAN FOR THE FUTURE OF TUGGERAH LAKES DEVELOPED IN PARTNERSHIP WITH THE COMMUNITY AND BASED ON GOOD SCIENCE

(Source: Scott, A. 2002. Tuggerah Lakes. Way back when...)

Are the Lakes Healthy?

"Healthy" can mean many different things. Most of us would agree that a healthy lake system in an urban area is one where important natural values are conserved, but which also supports community lifestyle needs such as recreation, employment and sense of place.

The lakes have been studied for many years and we can now get a good feel about trends in their condition, and whether any irreversible changes have occurred.

Some important indicators are noted below.

A Sustainability Scorecard –

Water quality suitable for swimming

Regular monitoring of water quality at popular swimming beaches indicates that requirements for clarity and bacteria are often not met, particularly after rain brings urban stormwater runoff into the lake.

Area of seagrass

The lakes are no longer considered to be eutrophic (overloaded with nutrients) as they were in the 1980s. Although the amount of suspended sediment in the lake water has reduced since the 1980s, the area of seagrass has increased only marginally after a major decline at that time.

Habitat for diverse species

Sponges, jelly fish, seahorses and waders all live in Tuggerah Lakes. The area of saltmarsh continues to decline and seagrass recovery has only been marginal over the past 10 years.

Wetland area

The area of wetlands and saltmarsh in the lake system continues to decline. Freshwater wetlands in the catchments are threatened by both the quality and quantity of urban runoff.

Commercial and recreational fishing catches

Catches of fish and prawns have always been variable and Tuggerah Lakes continue to supply large quantities of fish to the Sydney market.

Stable, well vegetated estuarine creek banks

Creek banks continue to erode, adding both sediment and nutrients to the lake system, but there has been considerable investment in revegetation and structures to stabilise channels, as well as in dredging of excess sediment from creek mouths.

Algal blooms

Historical reports suggest that occasional algal blooms have always occurred in Tuggerah Lakes and are part of a healthy lake ecosystem. However there was a boom in algal blooms during the 1960s to about 1990, with rafts of macro algae growing over sea grass and bare lake bed areas. This algae was a major contributor to the black mud that proliferated around the lake shore at the time. Algal blooms still occur. There has been a shift in lake shore sediment from sand to silt and organic material in many areas, although some parts of the lakes have always had clay rich sediments near the shore.

Greg White

The Big Picture

What are we trying to achieve in Tuggerah Lakes?

Whilst we all have ideas about what a healthy lake system would be like, an overview of the characteristics of a sustainably managed lake system has been developed in the Central Coast Catchment Blueprint. These have been adopted as the overarching framework (or management principles) for the Tuggerah Lakes Estuary Management Study. A series of management objectives for the Tuggerah Lakes estuary has been developed to expand on these six primary principles for sustainable lake management. The management actions suggested to address issues in the lakes are designed to meet these objectives.

The Six Primary Principles

1. Water quantity and quality

Water quantity and quality meet community needs and ecosystem requirements

- Fresh water flows from the catchment are sufficient to support lake ecology
- Maintain flow patterns whilst minimising flood threats to life and property
- Provide water quality in the estuary that is suitable for primary contact (swimming)
- Minimise changes to groundwater flows
- Provide sufficient water for community water supply

2. Managing vegetation

The physical structure and vegetation of river, lake and wetland riparian zones are protected and/or rehabilitated to sustain healthy ecosystems

- Protect, maintain and restore freshwater wetlands, aquatic and semi aquatic vegetation, floodplain vegetation and riparian (river bank) vegetation

Julie Garratley

3. Variety of plant and animal communities

Biodiversity and ecological integrity are maintained and enhanced. Assist the recovery of threatened or endangered species

- Maintain catchment biodiversity and ecological function to protect the estuary
- Minimise types of disturbance that threaten natural estuarine processes.
- Maintain and protect environmentally significant areas
- Ensure fishing is sustainable

Jonathan Clark-Jones

4. Land use, natural resources and culture

Human settlement, agriculture and other land uses take place while protecting and enhancing Aboriginal cultural heritage, soil, water and ecosystem health

- Management of the estuary and catchment protects and enhances indigenous and historic cultural heritage
- Provide socially and economically justified levels of development whilst containing ecological impacts
- Support primary industry in the catchment that maintains land capability and downstream ecology

5. Social and economic needs

The coastal zone environment is protected whilst providing for the social and economic needs of the community

- Support existing industry where it is ecologically compatible; require social and economic justification for new development
- Provide for public access and amenity at designated beaches/recreation areas

6. Good science and information

Improve knowledge of catchment and estuarine systems

- Identify the extent of information gaps and where appropriate undertake studies to improve understanding.
- Ensure the community is proactively involved in estuary health and management

Andrew Rowland

Ten tracks to healthy lakes

In environmental management, there is rarely a "one-stop" or quick fix solution. Sometimes making one set of changes will set off other unexpected changes. Nearly always, the solution will involve a combination of approaches and careful monitoring of what happens so that the management can be adapted and changed as more information becomes available.

Andrew Rowland

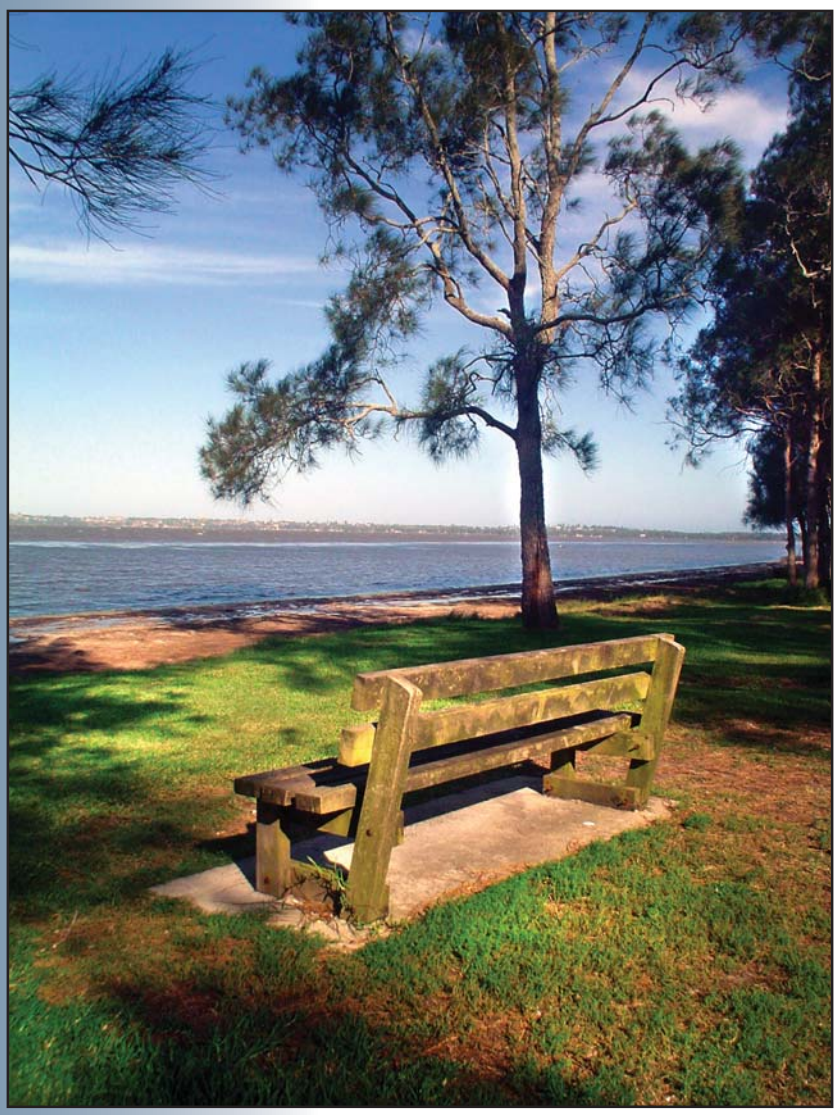
Here are ten main types of action that can help to achieve the objectives for Tuggerah Lakes:

- awareness and education for the whole community – making sure everyone has access to clear information about the lakes and how their value to the community can be protected;
- a continuing program of community participation in the review and decision making – ongoing partnerships between community and government to make sure investment is focused on the right issues;

Andrew Rowland

- financial and other incentives for landholders and businesses to encourage sustainable management;
- further studies and research, to provide better management information about natural processes, community values and the benefits of investment in the lakes' assets;
- land use planning/zoning, including choosing suitable sites for development or intensive recreation, or creating conservation areas in parts of the lakes, their tributary creeks and floodplains that have special natural habitats and communities;
- regulation/enforcement – new rules or stronger enforcement of existing rules about how the lakes and their catchment are used (eg discharges from industry and stormwater, or allowable fish catches, or boat speeds);
- capital works such as installation of waste water recycling systems, constructed wetlands, dredging, walking paths, improved stormwater infrastructure and stream rehabilitation or revegetation. This investment can reduce the amount of pollutants entering the lakes, control erosion impacts or improve community access and enjoyment of the foreshore;
- maintenance of existing sewerage, stormwater and other infrastructure systems to improve their effectiveness;
- monitoring and reporting lake condition – keeping track of what's happening; and
- foster good communication between the estuary managers and the community, and celebrate successes.

Different combinations of tools are right for different issues.



Andrew Rowland

Making good decisions

An important part of effective management of the lakes is a clear process for deciding what needs to be done, and where it should be done first. Not everyone will have the same views about these priorities. Consultation with residents, businesses and authorities about the various options contributes to sound decision making. Other important factors include:

- Does taking no action present a high risk to important features of the lakes?
- Do we know enough to be confident about the decision? What contingencies might be needed?
- What are the benefits of the action for the lakes and for the people who use them?
- What difficulties will the action present –would this action fix one problem, but create others?
- How well does the action address the issue – will it only work some of the time? Will threats to important places remain?
- What else would need to happen – is this action one of several that would need to happen simultaneously to get the desired result?
- Will the action be cost effective?
- Does the responsible organisation have the funds to pay for this action, in conjunction with its other responsibilities? What trade- offs might be involved?
- Is the community prepared to pay for special attention to this issue, above other issues
- Is the action a short term stop gap or part of a longer term strategy for the lakes

Defining problems and potential solutions

Issues and options for Tuggerah Lakes

Management actions for Tuggerah Lakes aim to enhance the health of the whole system. Look for issues and options for managing water quality, flows from the catchment, vegetation, habitat and lake uses under the following headings:

Take a walk on the Lake side – managing the lake foreshore. This is the part of the lakes where nearly everyone has direct experience (pages 24 - 27)

Up the creek – managing the main tributaries of the lakes – the conduit between the catchment and the estuary (pages 28 - 30)

Open water – what needs to be done to ensure the health of the main body of the lakes (pages 31 - 33)

Entrance channels and washovers – managing the connection between the estuary and the ocean (pages 35 - 35)

On the wildside – managing remaining high conservation value areas in the estuary (page 36)

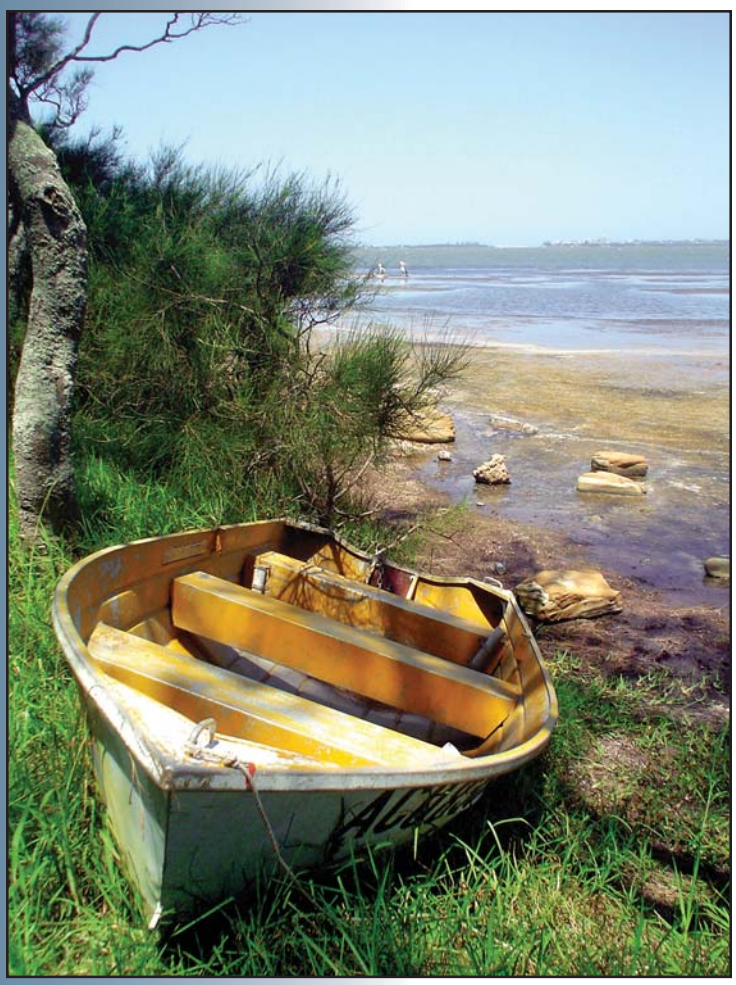
Making management happen – how to make sure actions are implemented, and the plan doesn't just take up shelf space (page 37)

More information about the issues affecting all of these components of the lakes is presented in the Tuggerah Lakes Estuary Processes Study and Tuggerah Lakes Estuary Management Study.

TAKE A WALK ON THE LAKESIDE

Tuggerah Lakes has about 105km of shoreline. Responsibility for managing the foreshore is shared between Wyong Shire Council, Department of Lands, DEC (Parks and Service Division), Delta Electricity and individual private property owners. For many people, the beaches, rocky headlands and river banks are their main experience of the lake system and are the basis on which they judge the health of the lakes in terms of:

- a relaxing place to enjoy views across the beaches, or to watch the sun set over the water;
- a peaceful place to observe waterbirds and enjoy nature;
- a place to drop a line and hopefully catch a fish or two;
- a convenient place to launch your boat (sailing, rowing or power);
- a safe place to paddle or swim with the family;
- a pleasant place to go for a waterside picnic with family and friends;
- an interesting place to go for a walk or cycle; and
- a special place to go for a restaurant meal.



Andrew Rowland

Some places are accessible to large numbers of people; others are enjoyed and looked after by small groups of local residents. The shoreline of the lakes is very variable, and some areas have changed dramatically in local memory (eg. Prawn Beach). Some important characteristics of the lake foreshore areas which warrant careful thought are highlighted in the following tables.

Many of the measures to protect habitats and amenity along the foreshore require action in the catchment, to redress long standing impacts on both the quantity and quality of flows into the estuary.

Balancing habitat and conservation value

Saltmarsh and seagrass

What's the issue?	What could we do?
Seagrass wrack and black organic mud hinders boating access to the water and reduces enjoyment of swimming areas	· Target beach cleaning for high usage beaches where recreation amenity is the priority objective (eg Canton Beach). · Continue stormwater management programs to control nutrient load entering the lake system.
Removal of seagrass wrack from the shore (beach cleaning) and mowing saltmarsh on the shoreline degrades the habitat of bugs and birds	· Community awareness activities on alternative ways to manage the foreshore.
Wrack harvesting and other beach cleaning activities are a high cost for Council	· Target beach cleaning only for high usage beaches with lower ecological risks, such as Canton Beach, Elizabeth Bay.
Wrack harvesting from the water affects habitat for fish, shellfish, sea horses and prawns	· Community awareness activities on alternative ways to manage the foreshore and on the habitat value of seagrass. · Allow seagrass wrack to be naturally washed onto the shore and dry out. · Continue stormwater management programs to control nutrient load entering the lake system.
Dumping of lawn clippings and other garden waste on the foreshore degrades natural plants and makes it harder for seagrass leaves to dry, out of the water	· Ongoing awareness activities for waterfront landholders, including highlighting the benefits of the species that are affected.
More than 50% of seagrass meadow and as much as 85% of saltmarsh habitat around Tuggerah Lakes has been severely degraded	· Identify important remaining areas to be managed for conservation. · Control nutrient and suspended sediment loads that affect the viability of seagrass habitat. · Improve awareness of the economic value as well as the ecological value of these estuarine habitats for the Tuggerah area. · Explore economic opportunities that can flow from healthy seagrass and saltmarsh, including fishing and eco-tourism. · Improve shoreline management to make it less damaging to seagrass and saltmarsh habitat.

Black mud and nearshore water quality

What's the issue?	What could we do?
Organic sediments have replaced clean sand in some popular swimming and fishing areas	· Continue to work towards better controls on runoff from new and existing developent so that nutrient loads are minimised. · Monitor performance of catchment controls and enforce requirements for water sensitive urban design.
Water quality at many lake beaches does not meet the guidelines for healthy swimming, particularly after rain	· Conduct further studies on sources of faecal coliforms. · Ensure community awareness of health issues after rainfall events. · Continue stormwater management programs, particularly near popular swimming sailing areas such as Canton Beach. · Minimise risk of overflows from sewage reticulation system.

Seawalls, jetties and boat ramps

What's the issue?	What could we do?
Residents on shallow lake shores dominated by organic sediments seek local access to deeper water and improved shoreline amenity	· Provide community access in locations which minimise impacts on seagrass and saltmarsh habitat. · Continue to implement controls on nutrient loads to the lakes from the catchment.
Jetties can affect light for seagrasses and increase boating activity impacts	· Do not approve jetties over sensitive seagrass areas. · Use mesh tops on jetties so that light can still reach seagrass underneath. · Locate jetties in places boat propellers and anchors will have least impact on sensitive seagrass beds.
Seawalls on tributary creeks protect the bank from erosion, but affect erosion of adjacent sections of bank and can degrade aquatic habitat	· Education/demonstration sites showing best practice designs.
Seawalls on the lake shore can remove small areas of saltmarsh and reduce the capacity of the lake to process seagrass wrack naturally	· Demonstration sites/designs showing alternative ways to manage eroding foreshores or to achieve easy access for small boats. · Incentives for landholders to remove existing seawalls where alternatives are feasible (and for high priority bays where seagrass recovery is important).
There is limited access to Tuggerah Lakes from public boat ramps. Ramps need careful siting to provide good recreational amenity and minimise impacts on sensitive habitats	· Detailed assessment of recreational needs at existing boat ramps and alternative sites. · Assess ecological values – so ramps are not sited in high value seagrass meadows.
Some residents not complying with requirements for structures – illegal development	· Awareness program on statutory requirements for approvals. · Education/demonstration sites showing appropriate designs – habitat, bank protection and access outcomes.

Boating and swimming

What's the issue?	What could we do?
Water quality at some beaches does not meet health guidlelines for swimming and small boats	· Continue to implement stormwater controls and education programs in the catchment. · Investigate causes of non compliance in problem areas. · Maintain sewage reticulation system to minimise overflows.
Noise from power boats and jet skis affects amenity of other foreshore users and residents	· Zoning or recreational boating areas of the waterway to minimise conflicts. · Boat speed limits in vicinity of waterfront development. · Restrict the use of noisy water craft in Tuggerah Lakes.
Wrack on the beach and in the water affects the suitability of some beaches for family swimming	· Target beach cleaning activities on beaches with highest recreational demand (eg Canton Beach).

Julie Garratley

Recreation facilities – pathways and picnic areas

What's the issue?	What could we do?
The current shared walkway/cycleway is popular, but only goes part way around the lakes	· Consult with users about value of an extended pathway. · Investigate route options past private foreshore and National Park. · Consider high conservation value foreshore areas where pathway should not be built.
Demand for recreational facilities is likely to grow as the shire population grows. High quality facilities have high capital and maintenance costs for Council	· Detailed study of recreational facilities, future demand, styles of facilities desired by community users, capital and maintenance costs. ·Target facilities in high usage areas – eg combine boat ramps, picnic facilities, fish cleaning tables, playground equipment etc.
Concrete cycleway surface can disrupt foreshore habitats (saltmarsh)	· Investigate alternative locations and construction techniques – must be cost effective as well as enhance habitat outcomes.

Traditional culture

What's the issue?	What could we do?
Many Aboriginal sites around the lake and along tributary creeks have been damaged or destroyed by land clearing, agriculture, urban development, recreation and land reclamation activities	· Ensure that appropriate heritage assessment is part of major development proposals · Ensure that Elders and Traditional Owners are afforded an opportunity to comment on development that will impact on estuarine shorelines and/or known Aboriginal sites and Places. So that the Aboriginal community's values can be understood and reflected in the management decisions.

UP THE CREEK

Ken Brookes

Four main catchment areas – Ourimbah Creek, Tumbi Creek, Wallarah Creek and Wyong River drain into Tuggerah Lakes. The flows from these creeks are a double edged sword for the estuary. They bring fresh water into the lakes and drive the currents that help flush the lake system – two fundamentals for a healthy lake.

On the other hand, widespread clearing for agriculture and urban development has made catchment runoff more "peaky", with short duration high velocity flows, rather than the gradual build up and decline which is typical of a well vegetated catchment. Weirs and dams change flow patterns, reducing the frequency of small "flows". Flows in these creeks also affect the amount of sediment entering the estuary, firstly by delivering sediment eroded from the upper catchment, and secondly because of ongoing erosion of the alluvial creek banks. The later is often in response to loss of creek bank vegetation, and changed catchment runoff patterns.

So management of the lake catchment is very important for a healthy lake system.

A healthy estuary is not the only objective of sustainable catchment management and there are some difficult choices to be made. Other objectives include affordable housing, control of flooding in existing urban areas, town water supply and agricultural irrigation water.

Sharing catchment flows between the estuary and other users

What's the issue?	What could we do?
Current water sharing priorities favour catchment users (such as irrigation and town water supply) over the estuary, so less water reaches the estuary during average rainfall events	· Prepare a new water sharing plan in consultation with water users and estuary managers.
Weirs in the creeks prevent regular interchange between fresh water and salt water sections and block fish passage	· Alternatives include maintaining the current structures, introducing fish ladders or other structures, or removing weirs where other values such as water supply can be managed.

Achieving "clean" catchment runoff to keep nutrient loads down

What's the issue?	What could we do?
Intensive agriculture can generate high nitrogen and phosphorus loads in runoff	· Cleaner production programs for intensive farming such as poultry farms and turf farms to maximise nutrient use/retention on site, rather than discharge to waterways.
Urban stormwater brings a community's waste into their playground	· Water sensitive urban design enforced for all new development. · Retrofit stormwater controls in old development areas wherever possible. · Set aside high conservation value areas for no new residential or commercial development. · Community awareness campaigns on dog faeces, car washing etc, supported by enforcement action.
Sediment derived from urban runoff and from creek bank erosion accumulates in the lower reaches of creeks and can be remobilised. This sediment may also be contaminated.	· Restore vegetation on estuarine creek banks. · Close regulation of industrial areas. · Water sensitive urban design for new areas to keep fine sediment on site, not in the creeks. · Maintenance dredging where stormwater drains enter tidal creeks. · Control boat speed/wake in creeks where boat waves undercut creek banks. · Development consent conditions linked to water quality performance along with monitoring to ensure compliance.

Floodplain wetlands – habitat or horrors?

What's the issue	What could we do?
Many floodplain wetlands have been severely degraded and others are at risk	· Improve controls on new and existing developments to improve water quality and flow regime before it enters natural wetland systems. · Manage highest value wetland catchments for conservation. · Maintain buffers around wetlands. · Weed removal programs for selected wetlands. · Habitat restoration in selected wetlands. · Incentives for farm management practices to achieve conservation on private land. · Community awareness on how different activities affect wetland and therefore estuary health.

Protecting development from flooding

What's the issue	What could we do?
Up to 1000 residences (mostly older houses) would be affected by a 1 in 100 year flood around the lakes, and more along the main watercourses.	· Prepare floodplain management plans. · Do not locate new development in flood prone areas without the appropriate controls. · Buy back some properties in critical locations. · Clear guidelines for designs for flood protection for new development. · Consider flood risks when determining the entrance management strategy for Tuggerah Lake (a permanently open lake entrance would cause lake levels to fall, providing more room for floodwaters before houses are inundated). · Provide a controlled over flow point to alleviate high lake levels, other than at the entrance (eg at Budgewoi?) · Investigate the impact of sea level rise on flood risks. · Remove other obstructions from creek lines which may exacerbate flooding of low lying areas. · Ensure that subsidence impact assessment for longwall coal mines includes potential impacts on flooding hazard.

Dredging for navigation or estuary health?

What's the issue?	What could we do?
Sediment derived from urban runoff and from creek bank erosion accumulates in the creek channel and as delta deposits at the creek mouth. These deposits limit tidal circulation entering the creek, reduce water quality in the creek, and prevent safe navigation by even small boats.	· Improve controls on new and existing development to reduce the erosion power of runoff during storm events. · Manage creek banks to control bank erosion wherever feasible (ie a clear understanding of the process driving bank erosion is essential). · Develop an understanding of the extent to which flood flows can scour sediment out of the lower reaches of creeks, restoring tidal circulation. · Dredge the lower reaches of creeks only where important recreational values are compromised or where the deposition is indicative of a long term trend that threatens the health of ecological communities along the tributary creek.
Most bank erosion control works to date have been in the water supply catchment, but many of the lower reaches of creeks are at risk of bank erosion from vegetation removal, boat wash and flood flows. Some types of erosion are more readily managed than others.	· Identify priority bank erosion sites in estuarine reaches. · Introduce boat speed/wash limits where boat waves are an important erosive process.
Council or the Department of Lands do not manage much of the tributary creek banks, which are on private land. Creek bank restoration works can be expensive, providing a disincentive for landholders to improve habitat or change management practices.	· Investigate use of incentives to encourage landholders to reinstate riparian vegetation. · Provide clear advice for landholders on how to control bank erosion and on the assistance that may be available to them (could include demonstration sites). · Identify funding options for private land holders, in consultation with the Catchment Authority.
No existing plan identifies the high priority locations for bank rehabilitation works (including lake foreshore and creek banks)	· Prepare a strategic plan for bank management, in consultation with the Catchment Management Authority.

OPEN WATER

Julie Garratley

It is reported that "Tuggerah" is an Aboriginal word meaning "cold, bleak and exposed". John Mann, writing about the lakes in 1904, considered that this was an apt description,

"*the shores being low and sandy and the whole surface exposed to the winds of heaven. It is separated from the ocean by low narrow sand ridges through which a channel affords an occasional outlet, but this outlet is most frequently silted up.*"

Despite their less than glamorous term for the lakes, Aboriginal people found abundant food there and along the tributary creeks – fish and waterfowl, so the lake was not really a barren place.

Over the years, the main body of Tuggerah Lake, Budgewoi Lake and Lake Munmorah has supported an important commercial fishery. In early days it also provided a transport route for timber. More recently, the lakes have also been enjoyed by sailors in small craft, recreational fishers and people using jet skis and power boats. The shallow waters of the lake mean it can get very choppy on a windy day, so you have to choose your time. Overall recreational boating use appears to be less in Tuggerah Lakes than the deeper waters of Lake Macquarie to the north as the lakes are too shallow to allow deep keel yatchs.

Whilst many people describe sandy shorelines around parts of the lakes, the central basin has a mud bed. The central lake floor does not appear to have changed significantly over the last 30 years or so, and it is likely that sedimentation rates in the middle of the lakes are slow, unlike the rates of organic mud deposition experienced close to the lake shore through the 1970s and 1980s.

Danny Roberts

Kade Mills *Caulerpa taxifolia*

Protecting the lakes from weed invasion

An introduced algae species, *Caulerpa taxifolia,* has appeared in some estuaries, including Lake Macquarie, in recent years. It is not present in Tuggerah Lakes. *Caulerpa* can take over seagrass beds, with major impacts on biodiversity and potentially on fishery productivity. Once established, the noxious weed appears to be very difficult to eradicate, so it is a major risk to a healthy estuary.

An important factor for lake management, then, is controls to reduce the risk of *Caulerpa* being introduced, together with a monitoring program to detect its appearance and contingency plans to modify lake dredging, net fishing and weed harvesting techniques to minimise risks of spreading if it does appear.

Is the lake bed suitable for placing dredge spoil?

The mouths of the lakes' tributary creeks accumulate sediment from the catchment, and typically require maintenance dredging every ten years or so, to allow navigation access by small boats, to help reduce creek bank erosion and to reduce flooding risks. A major issue is what to do with the muddy sediments that are removed from these creek mouth deltas. Previous experience has taught managers that the clay rich sediment is not only saline, but also contains pyrite (ie the sediment contains minerals that produce sulfuric acid when exposed to the air). These sediments can produce very acid water runoff (sometimes like battery acid) when they are used for shoreline reclamation or as landfill.

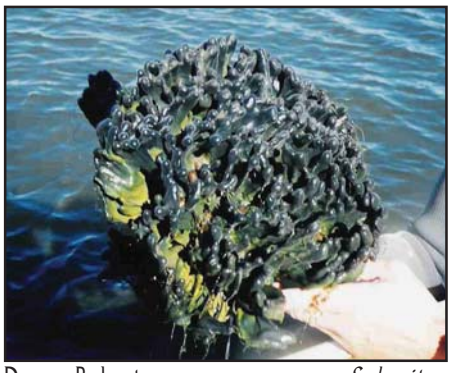
Tumbi Creek

An example of the difficult issues and decisions is the recent debate about how to manage maintenance dredging at the mouth of Tumbi Creek. Council considered numerous options for disposing of the dredged material and originally resolved to spread the spoil as a thin layer across the deepest part of the lake bed. This was eventually approved by the NSW Government; however after much community opposition Council reconsidered the issue and resolved to dispose of the spoil off-site. It is estimated that 15,000 m^3 will be removed to construct the proposed new channel closer to the original channel alignment in Tumbi Creek. Council is currently considering a number of options for the disposal process in consultation with the NSW Department of Lands, Department of Environment and Conservation, Department of Primary Industries and Department of Infrastructure, Planning and Natural Resources. The disposal method must address issues including acid sulfate sediment management, pollution, and potential impacts on the lake ecology and surrounding area.

A special sponge?

One of the interesting animal species found in coastal lakes is sponges. At least three species of sponge have been reported in Tuggerah Lakes. One species of the genus *Suberites* may well be a newly recorded sponge. It occurs in water up to around 1.5m deep, on muddy parts of the lake bed with patchy seagrass. These sponges are known to tolerate relatively fresh water, surviving in salinities as low as 13ppt for up to two weeks. In addition, *Suberites* can survive either attached to the lake floor, or unattached, so they are adapted to shallow lakes with choppy conditions. *Suberites* are right at home in Tuggerah Lakes!

Not a lot is known about these sponges, but they may well help us to better understand the variability of conditions in the lakes.



Danny Roberts *Suberites*

Fishing

What's the issue?	What could we do?
Should commercial fishing continue in the lakes, or should it be made a Recreational Fishing Haven like Lake Macquarie?	· Continue to monitor commercial fishing effort and catches in the lakes and implement Estuary General Fishing Management Strategy. · Monitor recreational fishing effort and catches (NSW Recreational Fishing Survey). · Follow trends in Lake Macquarie and other fish haven areas by reducing fishing and boating pressures. · Ensure information on fish catch statistics is readily available.
Fishery habitat has been degraded and lost	· Continue strategies to control nutrient load entering lakes. · Continue to investigate impacts of wrack removal, mowing and beach cleaning on fishery habitat.

Dredging

What's the issue?	What could we do?
Maintenance dredging is necessary to allow ongoing small boat access into tributaries like Tumbi Creek, and to improve water quality, but disposal of dredge spoil is expensive and environmentally challenging.	· Forego navigation access in estuarine creeks, or accept lesser access to reduce the amount of material to be dredged. · Additional works in the catchment and on eroding creek banks to limit sediment load and deposition at the creek mouth – this would extend the period between dredging events. · Further research on the most effective creek mouth alignment to achieve sediment transport rather than deposition – stronger flows would mean that sediment would spread out over a larger area in deeper water. · Find a new land based site for spoil disposal, with appropriate controls – away from residences, foreshore parks, and with easy truck access. Such a site might accept dredge spoil from all creek dredging activities around the lakes. · Spread dredged material over the lake floor in the deepest parts of the mud floor of the lake.
All maintenance dredging options are expensive for Council and need both environmental and economic justification	· Consider lower cost dredge spoil disposal options. · Studies to better understand social (recreational) and environmental drivers for dredging. · Consider alternative funding sources, noting that long term funding is necessary.

ENTRANCE CHANNELS AND WASHOVERS

The entrance channel

The entrance channel is perhaps the most visited part of Tuggerah Lakes, and many people may wonder why the rest of the lakes is not like this popular location. The sandy channel adjacent to The Entrance is marine sand, pushed into the mouth of the lake by ocean waves and tidal currents. The immediate entrance area, or tidal delta, is the only place in the lake system where these depositional processes are active.

Although the tidal currents from the entrance have a limited effect on lake flushing, many people in the community have suggested that training walls should be constructed at The Entrance, similar to those at Lake Macquarie, Lake Illawarra or Wallis Lake, to keep the entrance permanently open to the ocean. Others have suggested that there should be additional entrances opened up. Whilst these ideas may be appealing in the first instance, there are many factors to be considered. Experience from elsewhere on the NSW coast has been that training walls are appropriate only where there is a strong economic imperative that outweighs associated environmental and social impacts. In its review of coastal lakes in NSW the Healthy Rivers Commission (2002) found that, overall, lakes are sustainably healthier when entrances open and close without dredging or training wall intervention.

Experience from these other lakes has been that a permanently open entrance changes water levels in the estuary; affects lake ecology by increasing tidal range and the extent of exposure of mud shoals around the shoreline and can dramatically change currents and shoaling in the entrance area. It does not greatly improve lake flushing and does not remove the need for ongoing dredging to maintain a navigable channel. For instance, at Wallis Lake, the construction of break walls transformed a safe shallow entrance area, used for family swimming to an area of dangerous currents and deep, shifting channels. At Lake Macquarie, ongoing dredging at the "dropover" ie the lakeward limit of tidally deposited sand, is required to maintain safe passage for recreational vessels, and fast currents affect navigation safety around the Swansea Bridge. At Lake Illawarra, the entrance closed during the 2002 drought, after a training wall had been constructed at a cost of $11 million.

Entrance channels

What's the issue?	What could we do?
Is a permanently open entrance at The Entrance feasible? What is the balance between benefits and impacts?	· Continue the existing dredging strategy at The Entrance. · Further investigate training walls. However a feasibility study was conducted in 1994. It was estimated that construction of training walls would cost $13-20 million (now estimated at $40 million). Maintenance costs of $100,000 annually would be anticipated. · Investigate the ecological, social and economic impacts of a permanently open entrance in more detail. Ecological issues to consider include fish recruitment, nursery areas for juvenile fish, whether the channel would be navigable, safety for swimming and fishing in the entrance channel, sand supply on adjacent beaches, impacts on saltmarsh and seagrass habitats etc. · Consult existing expert opinion – the entrances of coastal lagoons should be allowed to open and close naturally, wherever possible.
Would alternative entrance locations be feasible as a way to improve lake health?	
Does a permanently open lake entrance make a significant difference to lake water quality?	

ON THE WILD SIDE

Despite a high level of development in the catchment of Tuggerah Lakes, some parts of the lakes and their foreshore still retain many of their natural habitats, including seagrass and saltmarsh, large numbers of migratory bird species, protected seahorses and other estuarine fauna. In general, these areas are relatively inaccessible. Important areas include Tuggerah Bay, the south east section of Budgewoi Lake and the eastern shore of Eel Haul Bay. These and other areas also conserve important habitat links or corridors between the lakes and their catchment.

Natural habitat areas

What's the issue?	What could be done?
More than 50% of seagrass and up to 85% of saltmarsh habitat in Tuggerah Lakes has been severely degraded	· Prepare a conservation management plan for the two key remaining areas – Tuggerah Bay and eastern Budgewoi Lake, in consultation with landholders, waterway users, conservation groups and relevant state agencies. This could include access controls, boat speed limits, fishing controls etc. · Community awareness campaign featuring key species from these habitats – migratory waders, seahorses, economic fish species. · Continue studies on the value of these habitats in terms of estuarine ecology and productivity in Tuggerah Lakes. · Require full technical assessments of the potential impacts of subsidence on these habitats for any longwall mining proposal under the lake shore or wetland areas.
Responsibility for the management of high conservation value areas is poorly defined	· Ensure that any management plan provides clear statements about responsibility and accountability.
Trends in the health of remaining seagrass and saltmarsh habitat not well established	· Ongoing monitoring program for key sites, plus monitoring of indicator species such as migratory waders, or aquatic species.

MAKING MANAGEMENT HAPPEN

There is no shortage of ideas about what Tuggerah Lakes should be like and what should happen to make it like that. Many people have an opinion, drawing on their personal experience or observations. As with the management of any natural system, there are some big constraints to effective action, including:

- deciding who is responsible and accountable;
- being clear how the community's input will be used during implementation;
- deciding who will pay;
- deciding between alternative courses of action when there is limited reliable information;
- finding the financial and staff resources to invest in the agreed actions;
- keeping track of success plus explanations of what did not work as expected;
- keeping people informed about progress;
- ongoing misleading perceptions or publicity about what is important for estuary health;
- skepticism about the quality of the science and management capacity;
- poor understanding of what a sustainable lake system would be like in terms of environmental, social, cultural and economic outcomes;
- lack of community or institutional will to move forward; and
- achieving co-ordination with other natural resource management strategies.

Andrew Rowland

The Tuggerah Lakes Estuary Management Study provides suggestions for how some of these "management process issues" can be overcome to provide a strong community and government partnership for a healthy lake system.

Where to from here?

The Tuggerah Lakes Estuary Management Study will provide the strategic direction for the preparation of the Tuggerah Lakes Estuary Management Plan.

As with the Estuary Processes Study and Estuary Management Study, the Estuary Management Plan will be prepared by consultants on behalf of Council. During the preparation of the Estuary Management Plan, there will be ongoing opportunities for the community to share information, ideas and comments with the project team. The draft Plan will also be exhibited for community comment before recommendations are made for Council's consideration. In this way, Council can be confident that the Tuggerah Lakes Estuary Management Plan will provide for a sustainable future for the estuary – one that is based on sound science, appreciates community values and perspectives and is targeted to address the most important issues for the health of the lakes in an efficient manner.

Actions arising out of the Plan will then have to be incorporated into documents, such as Council's Management Plan, work programs and budgets as well as guide applications to grant programs. These actions will have the priority that arises from a comprehensive study of the issues impacting on the estuary.

Keep a look out for information about the commencement of the Tuggerah Lakes Estuary Management Plan and get involved.

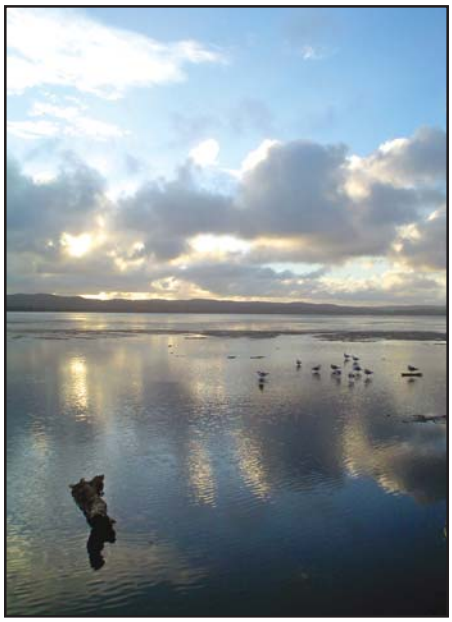
Danny Roberts

Julie Garratley

We value your comments
TELL US WHAT YOU THINK

Planning for a healthy future for Tuggerah Lakes will greatly benefit from your experience, observations and ideas.

Julie Garratley



Andrew Rowland

How to contact us

If you would like more information about the Estuary Management Study, please contact us:

Wyong Council's Project Manager
Sian Fawcett
Environmental Officer
Phone: 43505506
Fax: 43512098
Email: fawcetts@wyong.nsw.gov.au
PO Box 20
Wyong 2259

Department of Infrastructure, Planning and Natural Resources
Neil Kelleher
Senior Natural Resource Officer, Coast Estuaries and Waterways Engineer, Resource Access and Compliance
Hunter Region (Gosford)
Phone: 43377313
Fax: 43236573
Email: Neil.Kelleher@dipnr.nsw.gov.au

You can also find information about the Tuggerah Lakes Estuary Processes Study and Estuary Management Study on Wyong Council's web site - **wyong.nsw.gov.au/environment_home.html** or contact Council for a copy of the study on CD

Here are some ways you can help to protect and restore Tuggerah Lakes:

Get involved in the project – attend community meetings, make written submissions, tell us what is important to you and why. Let us know you are interested so we can keep you up to date with progress.

Join a local Landcare group; contact the Central Coast Community Environment Network to get involved in their projects; or any other conservation group or Precinct Committee.

Look after your own property and local area in ways that also help to look after Tuggerah Lakes:

- use only endemic native plants in landscaping;
- maintain good ground cover;
- mulch or reuse garden clippings and lawn cuttings, don't sweep them into the gutter, a stormwater drain or the lake shore;
- use only as much fertiliser as necessary for healthy plants;
- have a natural foreshore wherever possible;
- pick up your dog's droppings;
- minimise water and detergent use when you wash your car;
- adopt a foreshore reserve and help look after facilities; and
- enjoy and promote the special features of Tuggerah Lakes.