CARING FOR OUR COUNTRY

Clarence Landcare

A COMMUNITY RESOURCE

CLARENCE COAST & ESTUARY RESOURCE KIT

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Aboriginal Australians Acknowledgement

The Clarence estuary, coast and associated landscapes are part of the traditional lands of Aboriginal people and their nations, in particular, Yaegl people and their traditional country are acknowledged.

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Chapter 1: Introduction 1
The Northern Rivers Region 2
The Clarence River Catchment 3
Where do you live in the catchment? 5
Aboriginal Australians connection to river landscapes 6
Resources 7

Chapter 2: Know your estuary 8
What is an estuary? 8
The Lower Clarence River 9
Resources 12

Chapter 3: The world is your oyster so look after it! 13

Chapter 4: What is an impact? 14

Natural and human 14
Natural impacts 15
Estuarine Processes 15
Drought and flood 17
Acid Sulfate Soils 17
Climate Change 18

Human impacts 20
Water Pollution 20
Nutrients 20
Faecal contamination 20
Construction waste and soil erosion 20
River impoundments 21
Flood mitigation works 21
Groundwater use 22
Fishing 23
Recreational and commercial boating 24
Aquaculture 24
Agriculture and grazing 25
Forestry 26
Extractive industries 26
Reclamation and dredging 26
Training walls 27
Waterfront developments 27
Canal estates 27
Marinas and recreational facilities 28
Pest and Weeds 28
Road and bridge construction 29
Caring for the Coast 30
Resources 31

Chapter 5: The importance of native vegetation 32
Habitats of the Estuary 33
What is riparian vegetation and why is it important? 37
Why Fish Need Trees on the Clarence River Estuary 38
Protecting, maintaining or restoring native vegetation 39
Resources 40

Chapter 6: Lessening the impacts - what you can do 41
A project example - Romiaka Island: fixing bank erosion and providing fish habitat 41
Romiaka Island Sustainable grazing: protecting saltmarsh, replanting riparian areas, protecting threatened species 43
Turbidity - managing soil run-off 45
Managing weeds in riparian areas 45
A project example - The Lower Clarence Riparian Rescue: vine weed infestations on the Clarence Estuary 47
A project example - The Clarence Floodplain: floodgates, drains and fish passage restoring the balance 49
A project example - Clarence River Fish Track: effects of flows and barriers on the distribution of freshwater fish in the Clarence River system. 51
Managing Salinity 52
Preventing water pollution - What can you do 52
Making your business fish friendly 52
Something to consider when developing land 53
Shorebirds 54
Resources 56

Chapter 7: Local government and legislation 57
The role of local government 57
Catchment Action Plan for the Northern Rivers 57

Chapter 8: References 61

Abbreviations used in this document are:

DECCW	Department of Environment, Climate Change and Water
NRCMA	Northern Rivers Catchment Management Authority
I and I	Industry and Investment = **NSW DPI** (NSW Department of Primary Industries and Fisheries)
NRM	Natural Resource Management
PVP	Property Vegetation Plan
LALC	Local Aboriginal Land Councils
CVC	Clarence Valley Council
LGA	Local Government Area
LEP	Local Environment Plan

Introduction

The aim of this community resource kit is to bring together much of the available information about the Clarence estuary into an easy to use guide with information and examples about how an estuary functions and how to care for the water catchment in which we live. Much of the general information about estuaries is relevant to other estuaries in the Clarence Catchment such as the Wooli Wooli River and Sandon River.

If you have recently moved or already live in the Clarence Valley this community resource is designed to guide and encourage everyone to adopt practices at work and home that will minimise negative impacts on our coastal catchments.

Estuaries are meeting places for fresh and ocean water and for people pursuing recreation and livelihoods. They are highly dynamic, complex environments in a constant state of flux with phenomena like turbidity, salinity and pollutants all acting on the system at once.

As coastal populations continue to grow, the pressures placed on the land - sea interface increases each year.

The special characteristics of the Clarence Estuary make it a popular recreational river.

Practical solutions and examples of how local people, local government, catchment authorities and other organisations are tackling the problems that can impact our waterways are included in Chapter 6 Lessening the Impacts. Further resources, suggested reading and contacts are contained in each chapter.

While all attempts have been made to provide up to date information, this resource kit provides a general introduction to the topics and can be read in conjunction with the Northern Rivers Resource Kit for Rural Landholders, available free from Landcare offices. It should be noted that at the time of publication some of the government department names and information may have changed.

The Northern River Rivers Region

The regional landscape

The Northern Rivers covers an area of 50,000 square kilometers from the Camden Haven River in the south, to the Queensland border in the north, and from Lord Howe Island in the east to Armidale and Glen Innes in the west.

Around sixty percent of the region is freehold tenure, with 21, 500 km^2 managed as Crown Land, National Park and State Forest.

There are two distinct parts to the region - the coastal zone and the eastern slopes of the tablelands and several individual landscape types ranging from Coastal Floodplain to Volcanic Plateaus, Escarpments and Ranges.

The region is a National Biodiversity Hotspot, being the third most bio-diverse region in Australia and supports a large number of threatened species and ecologically endangered communities.

The Northern Rivers region is known for its agricultural (beef, sheep, dairy, sugar), horticultural, timber and commercial fishing industries and is an increasingly popular place to live and a destination for tourism, with an estimated 6 million visitors each year.

The region has more than 550,000 people and experiences a population growth of more than two percent a year along the coast. Major coastal urban centres include Port Macquarie, Coffs Harbour, Ballina, and Tweed Heads.

Water supply is from unregulated rivers with the majority of use for town water supply.

Key natural resource management issues

- threats to natural heritage values and biodiversity, including pest plant and animal invasion, wildfire and loss of habitat through other land uses
- pressures associated with population growth, such as rural and urban land use conflict, loss of arable land to urban use, increasing impacts on natural areas from human activity
- land degradation through erosion and non-sustainable use
- threats to water quality from urban and agricultural run-off, sedimentation, loss of riparian vegetation and quantity through over-extraction and the impacts of climate change
- specific issues to this area such as acid sulfate soils, blackwater and cane toad invasion

A regional plan for action

In 2006, the Northern Rivers Catchment Management Authority (NRCMA) prepared a strategic plan to guide regional natural resource management priorities and investment. The Northern Rivers Catchment Action Plan (CAP) incorporates six years of community consultation and planning and centres on seven broad themes – Community, Land-use Planning, Biodiversity, Water, Coastal Management, Marine and Soil/Land Resources. To find out more about the NRCMA Region or the CAP visit http://www.northern.cma.nsw.gov.au . Source; Northern Rivers Catchment Management Authority website, 2009.

The Clarence River Catchment

The Clarence catchment is located on the far north coast of NSW in the Northern Rivers Region and has a population of about 65000 residents.

The Clarence River is the largest of all NSW coastal rivers in both catchment area and river discharge. The 250 km long river has a catchment area of approximately 22,700 square kilometres and an average annual discharge of almost 3.9 million megalitres.

The catchment is defined by the Macpherson Ranges (North) and by Baldblair, the Doughboy Ranges and the Dorrigo Plateau (South). The Great Dividing Range, from Stanthorpe to Glenn Innes defines the western rim of the catchment. Closer to the coast, the Richmond Ranges north of Iluka and the coastal ranges from Coffs Harbour to Yamba form the north eastern and south eastern boundaries, respectively. (HRC 1999)

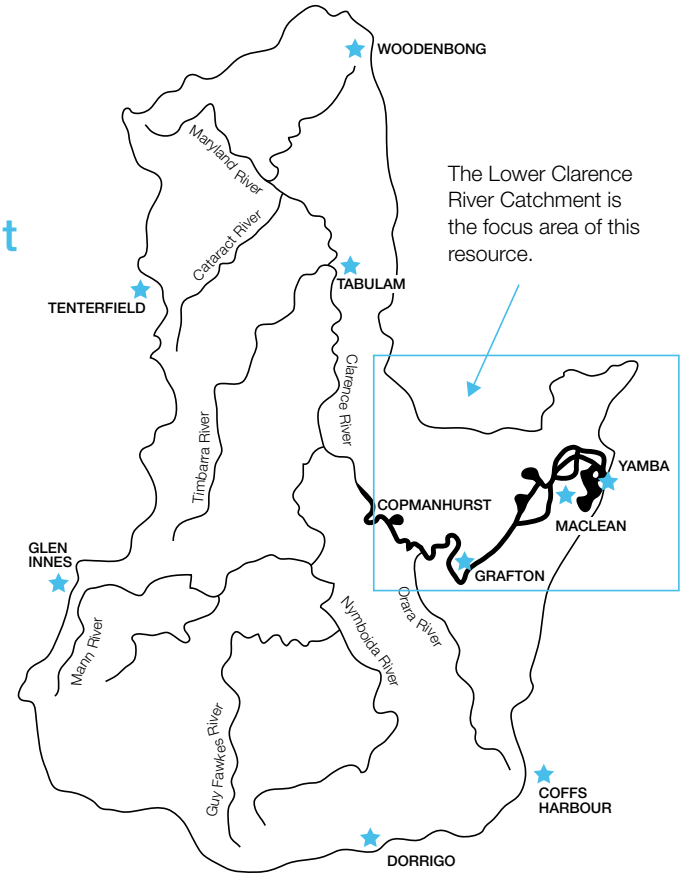
The mouth of the river is located between the towns of Yamba and Iluka, with its estuarine reaches extending approximately 108 km upstream to Copmanhurst. The estuarine limit of Mangroves is noted at around Ulmarra (downstream of Grafton). The towns of Grafton, Maclean, Yamba and Iluka are the main centres of population along the estuary.

Nearly half of the catchment is managed by National Parks (20%) or State Forests (30%) with over 20% of the areas protected in World Heritage Areas, National Parks, and Nature Reserves. Around 49% is agricultural land and approximately 1% is urbanised.

The key catchment management issues are; riverbank erosion, gully erosion, invasive weeds, pest species (cane toads, foxes), fire management practices, acid sulfate soils, urban and recreational pressures and coastline erosion.

The 830 square kilometres Clarence floodplain consists of low lying, flat alluvial plains, intersected by lagoons, channels and creeks. The floodplain supports the largest commercial fishing region in the state as well as significant sugar cane, timber and beef cattle industries.

Half of the catchment area is utilised for agriculture including a cane industry which contributes significantly to the local economy and employment. On average, the Harwood Mill crushes around 780,000 tonnes of cane annually producing 92,000 tonnes of raw sugar with an estimated value of around 23 million dollars. (www.nswsugar.com.au, 2010)



The Clarence River Catchment and Lower Clarence River Catchment, source: modified from "Independant Inquiry into the Clarence River System" Final Report Nov 1999, Healthy Rivers Commission of NSW.

Sugar cane has been grown on the Clarence floodplain for over 125 years and there are over 250 cane farms. Agricultural and urban development on the coastal floodplain is protected from floods by 110 kilometres of levees and 268 kilometres of publicly managed drains. The investment in these structures is a major public asset. See case study of the Clarence Floodplain Project in Chapter 6.

Nearly half of the catchment is managed by National Parks (20%) or State Forests (30%) with over 20% of the areas protected in World Heritage Areas, National Parks, and Nature Reserves. Around 49% is agricultural land and approximately 1% is urbanised.

There is a great diversity of vegetation types and wildlife habitats and the catchment is home to many endangered species including the last viable populations of the Eastern Freshwater Cod.

Darter. Image courtesy P. Kenway.

There is a growing tourist industry focused around water activities such as recreational fishing, swimming, boating and surfing. Tourism contributes more than $100 million annually to the economy of the Clarence Valley. Boating is a major recreational activity, with 90% of recreational boating related to fishing.

Many parts of the Clarence River system are in relatively good condition. There is a great diversity of vegetation types and wildlife habitats and the catchment is home to many endangered species including the last viable populations of the Eastern Freshwater Cod. Like most Australian river systems, the Clarence is subject to extremes in flow, ranging from periods when flow is negligible (sometimes reduced to a series of isolated pools in the upstream reaches) to large floods when the river can become kilometres wide.

A range of past activities and the current period of rapid development and changes in land use have had, and continue to have, an adverse effect on parts of the river system.

Lower Clarence River Catchment issues

- managing floodplain activities that can impact on water quality in the estuary
- maintaining riparian vegetation and estuarine wetland ecosystems
- minimising the impacts of floods on towns and agricultural productivity
- ensuring sustainable fishing practices
- minimising waste created by various land and water uses
- management of coastal landscapes and marine environments
- managing sustainable urban growth
- managing and protecting biodiversity
- ensuring compatible and sustainable land development
- planning for climate change issues

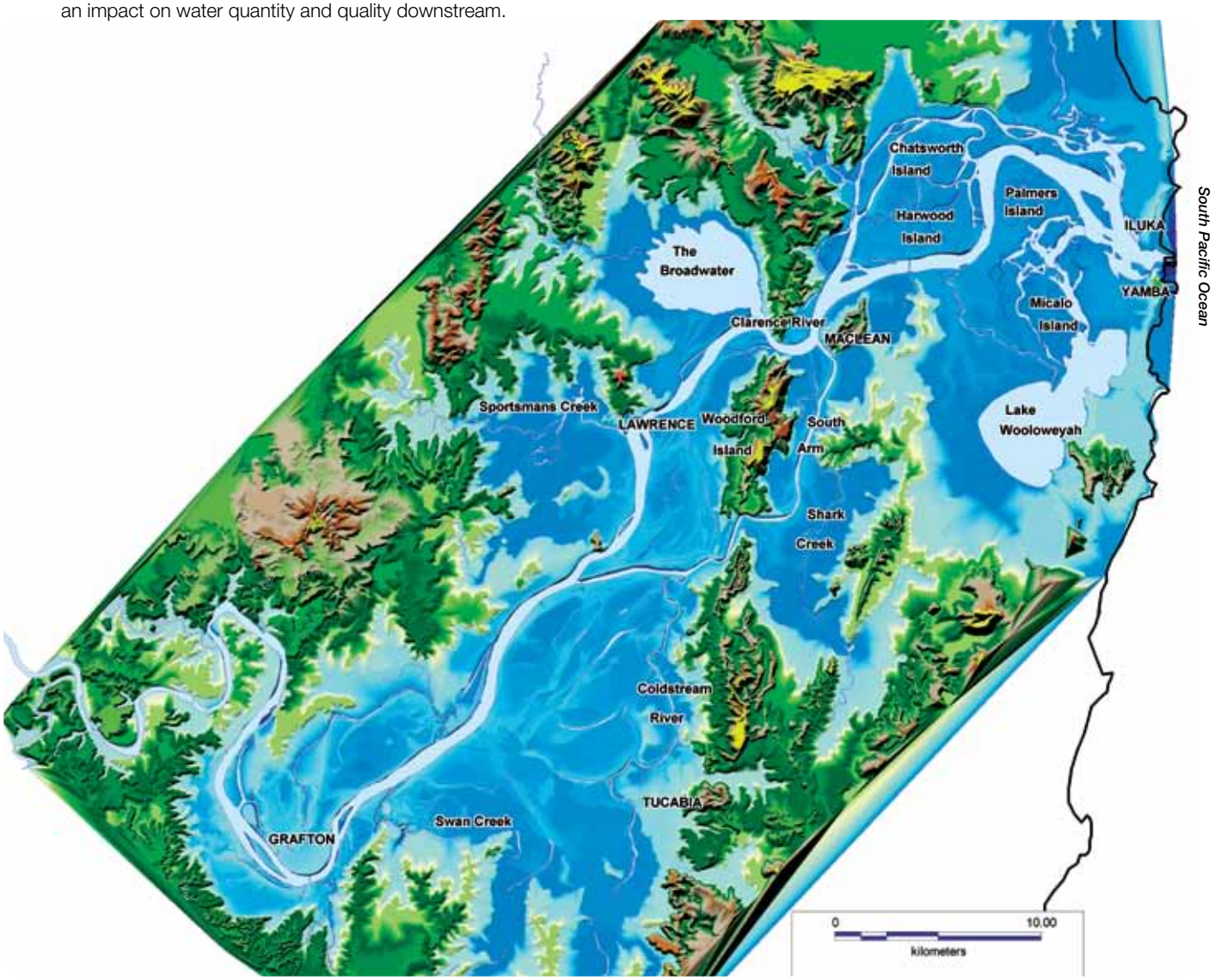
(Source http://www.oceanwatch.org.au)

Where do you live in the catchment?

Perhaps your property has a creek or gully running through it or you live in town with storm water and drainage infrastructure. Wherever you live, your activities and daily choices can have an impact on the water quality. It is important to remember that every dry gully or slope will also be part of the spider web network of water running off the land and out to sea. Although they may have no water in them for periods of time, they are connected and its important to be aware of what is entering them in wet periods and where this is flowing to.

Activities such as forestry, farming, water extraction, mining, septic sewage treatment and infrastructure development have an impact on water quantity and quality downstream.

Within the lower catchment the loss of wetlands and riparian vegetation, flood mitigation and drainage works, dredging, pollution and associated eutrophication, urban development, waste disposal and the exposure of acid sulfate soils have impacted on water quality, estuarine ecosystems and resources.



Map source Clarence Valley Council.

Aboriginal Australians connection to river landscapes

The Clarence River estuary, associated wetlands, forests and coast have been described as excellent hunting grounds which sustained Aboriginal communities for thousands of years before European settlement.

Aboriginal middens along the coast contain vast quantities of oyster shells carbon dated back to 6000 BC. The personal knowledge of Aboriginal use of the estuaries and waterways of the north coast is maintained traditionally by peoples of Aboriginal nations. In the Clarence, this includes the Yaegl, Gumbaingirr and Bundjalung peoples.

Yaegl people are coastal and river dwellers of the Lower Clarence region of the North Coast. Their immediate northerly neighbours are the Bandgalang, of the broader Bundjalung language group, and their southern neighbours are the Northern Gumbaingirr, of the broader Gumbayngirr language group.

Territorial areas are complex and have been debated in the literature throughout the twentieth century (Kijas, J. 2009).

Dirrungan's Reef, located across the entrance to the river mouth at Yamba is an Aboriginal cultural site and although dredging has been carried out to keep the shipping lane open and maintain a reasonable depth of water cover over the reef, the cultural significance of the reef to Aboriginal people is acknowledged.

For a better understanding of Aboriginal Australians connection to the water, please refer to the paper by Behrendt that has been partially quoted here.

'The river systems of NSW have been a focus of life and central to the identity of many Aboriginal peoples for thousands of generations. Many person-hours are spent fishing by Aboriginal people along the river systems of NSW. For Aboriginal people fishing is much more than a 'recreational' activity. It is a family activity and provides an opportunity for older people to reveal places, knowledge and ideas to younger people. It is a time when young people can admire the skills, knowledge and wisdom of their elders.

Fishing places a person in a direct relationship with the environment, with the cultural practice of fishing mediating that relationship. This situation validates culture. It is a time when all the experience and knowledge and wisdom of the Aboriginal practitioner have value. It is a time when literacy is irrelevant. A time when the whole sweep of colonial history is irrelevant.

"Beiirrinba" (Clarence River) 2001 by local Yaegl artist © Frances Belle Parker.

In this way, fishing is a decolonised experience. For a colonised people for whom political and geographical decolonisation are not realistic lifetime aspirations, opportunities to decolonise the mind are vital and life affirming. Fishing produces highly valued food for the autonomous Aboriginal economy. The fish produced enable individuals to give, exchange and share within the kinship network or in accordance with other interpersonal obligations. It enhances a person's ability to fully participate in their social duties as an Aboriginal citizen. The sum of many such enhanced personal abilities aggregates to enhance the functioning of Aboriginal society'. (Behrendt. J., et al. 2003)

As non-indigenous Australians we are able to acknowledge indigenous places, particularly when contemplating a development of land.

Image: "Features include Maclean and Ashby (shown by the two concentric circles), Woodford Island (represented in the bottom left hand corner), the hills which surround Maclean and Ashby and the Clarence River (Beiirrinba). The river is depicted by the Tingari (Life cycle design) to maintain the meaning, "The River of Life".

Acknowledgements: The above image and text are sourced from the powerpoint "Clarence River Journey – from the source to the sea" a Clarence Catchment Total Water Cycle Management Curriculum Support Resource developed by H. Tyas Tunggal for North Coast Water in 2003.

Resources and Contacts for Chapter 1

Fact sheets on Land and Water Management Issues in the Lower Clarence River Catchment
The Lower Clarence River Catchment Fishing Industry and Waste Management in the Lower Clarence River Catchment
http://www.oceanwatch.org.au

Reading, Historical perspectives

There were always people here: a history of Yuraygir National Park, Kijas, J. (2009)
Published by the Department of Environment and Climate Change, Sydney DECC 2009/218
ISBN: 978 1 74122 866 3
Book available from DECC Office, Victoria Street, Grafton or http://www.environment.nsw.gov.au/resources/cultureheritage/09218ynphistory.pdf

From Clarence Heads to Yamba, McNamara, J.
Riverboats of the Clarence, Lee, S.
Both available from the Yamba Museum, River Street, Yamba.
Phone: 02 6646 1399.

Red Gold: the tree that built a nation, 3rd edition, Vader, J. 2002.
ISBN 1 876334819, New Holland Publishers.

To view a Dreamtime story about the Clarence River go to http://users.on.net/~ulgundahi/Dreamtime.htm
The Story of Nungera - Clarence River.

The recognition and protection of Aboriginal interests in NSW Rivers, Behrendt, J. and Thompson, P. (2003). Occasional Paper prepared for the NSW Healthy Rivers Commission, by Chalk and Fitzgerald, Lawyers and Consultants, Sydney.

Contacts

Yaegl Local Aboriginal Land Council Office
Hillcrest Community Hall, Jubilee Street, Maclean, NSW.
Phone: 02 6645 3676

Birrigan Gargle Local Aboriginal Land Council
2 Robinson Street, Yamba, NSW.
Phone: 02 6646 1664

National Parks and Wildlife Service – Department of Environment and Climate Change (DECC) Services: Cultural Heritage Officers to assist with identifying whether your land has places of importance to Aboriginal people and how you can manage them.

Northern Rivers Catchment Management Authority

Aboriginal NRM Catchment Officer
PO Box 1417, Coffs Harbour NSW 2450
Phone: 02 6653 0150

Grafton Office
State Government Offices
Level 3, 49 Victoria St (PO Box 618)
GRAFTON NSW 2460
Phone: 02 6642 0622 Fax: 02 6642 0640

What are the Issues in the Estuary?

The sometimes competing uses and activities of people in estuaries can conflict with each other and/or cause problems for the natural functioning of the estuary.

Examples of some of the issues in estuaries are listed below and are worth exploring. Information can be found at NSW Natural Resources Departments website (incorporating DECCW, NSW Office of Water and Industry & Investment) at http://naturalresources.nsw.gov.au/index.html

- Poorly managed or inappropriate catchment landuse practices that affect water quality.
- Effects of poor water quality on the estuary eg; human health, fish habitat and fish health. Poor water quality can result from a wide variety of human activities. These include high nutrient runoff from agricultural land, toxic and high nutrient runoff from urban areas, discharges from sewage treatment plants (STPs) and other licensed activities and soil erosion from land clearing activities resulting in high turbidity.
- Silt and sand deposits in estuary entrances – riverine and coastal processes.
- Inappropriate coastal development – Sustainability Assessments being undertaken for Coastal Lakes by the NSW Government, the role of Local Government in providing development controls and approvals, the "Tyranny of the small decision" and cumulative impacts.
- Natural versus artificial opening frequency of ICOLLs – the conflict between maintaining natural habitat values of ICOLLs and their surrounds vs flooding issues of nearby residents.
- Declines of fish stocks in estuaries – effect of commercial and recreational fishing versus loss of estuarine habitat due to encroaching development and poor land management practices.
- Recreational, port and other uses of estuaries – jetties, wharves, dredging, sea walls, constructed entrance changes, sullage disposal, marinas, canal estates, trawl fishing, bait collection, anchor drag, boating wake.
- Changes to water runoff rates/frequencies in catchments – hardstand surfaces, altered stream channels, flood gates, dams, weirs and other structures.

Know your estuary

What is an estuary?

King Prawn in the Mangroves. Image courtesy N. Blake.

Estuaries are places of transition, where water from the land meets and mixes with the open sea.

They are found at the lower end of rivers and may vary in size from small coastal creeks and lagoon systems to large lakes and river systems like the Clarence River. Estuaries contain diverse ecosystems that form the foundation of the coastal food chain. They provide important habitats for a variety of marine and terrestrial plants and animals.

Estuaries are often referred to as the "nurseries of the sea" because they are the breeding grounds for many fish, crustaceans, and other marine life.

NSW has more than 130 estuaries of varying sizes that are of immense environmental, social and economic importance.

Concern is growing about the negative effect that increasing coastal urbanisation is having on our estuaries. Population growth and urbanisation are placing stress on our fragile coastal ecosystems.

Habitat degradation, declining water quality, resource depletion, loss of amenity, and restricted access are just some of the issues of concern to local communities.

Nutrients, sediments and toxins created by urbanisation, agricultural activities, vegetation clearing and industry, can eventually end up in an estuary, affecting the water quality and life within. In this way estuaries are the report cards of the catchments.

Dams and water extraction for irrigation and water supply, alters the hydrology of estuaries and may lead to increasing sedimentation, closed entrances, altered freshwater flows and changes in tidal flushing. These changes can have profound impacts on estuarine and coastal ecosystems (DNR, 2006.)

Estuaries are highly dynamic, complex environments. The physical, chemical and biological processes of an estuary are highly integrated, each component acting on the other to determine the type of ecological conditions. For example, inputs into the system and tidal processes directly affect physical processes within the estuary which affect the chemical processes which then determine the existing ecology. Nature adapts to these changes. Our perceptions of what rivers, creeks and estuaries should look like as well as our expectations for using these areas may need to accommodate the fact that these natural environments have been modified over time by human activity. Their sensitivity to changes should be a guiding factor in how we treat them.

The Lower Clarence River

Explorer Mathew Flinders, on a brief, six week expedition to examine the coast north of Sydney, named the river entrance Shoal Bay in 1799, without actually discovering the river. Richard Craig, an escaped convict is given credit for discovery of the river, originally known as Big River and after informing others of the large stands of timber along the riverbanks, the timber – getters were led to the Clarence. The explorer Oxley noted on his 1826 expedition along the New England Tablelands to Moreton Bay that there was a large river emptying into Shoal Bay. It was named the Clarence River in 1839 (after the Duke of Clarence). Beiirrinba is the name that Yaegl people give to the river.

The mouth of the river is located between the towns of Yamba and Iluka with its estuarine reaches extending approximately 108 km upstream to Copmanhurst. The estuarine limit of Mangroves is noted at around Ulmarra (downstream of Grafton).The towns of Grafton, Maclean, Yamba and Iluka are the main centres of population along the estuary. There are up to 100 river islands, many of which have a rich and varied history of land use and settlement. Woodford Island is the largest river island in the southern hemisphere.

The Clarence River estuary supports the largest commercial, wild catch fishery in NSW and is a major commercial coastal shipping port on the north coast. In addition to fish harvesting from natural waterways, pond aquaculture (particularly prawns) is a growing industry on the floodplain of the estuary.

" …. Long before the arrival of Europeans in the area, local Aboriginal people were fishing the waters of the 'big river' for oysters and fish, as evidenced by the large middens found along the river banks and coastline. The first settlers to the area found a bountiful river surrounded by dense subtropical forests and swamps flowing out to the coastline. Fish were easy to come by and made up an important food source for the early settlers who set about developing forestry and farming in the area. Grafton was established in the 1850's with the river being a principal source of transport. The introduction of sheep grazing to the area occurred in the late 1850's and sugar cane farming was carried out as early as 1868 (Anon, 1980a)…."

Until well into the last century, the busy river was the focus of transport and economic activity and poor or non-existent roads, extensive areas of lowland submerged during frequent floods meant that down river towns like Yamba and Iluka were virtually inaccessible by land. So people went shopping or visiting or fishing by rowing boats, working the rising tide upriver and vice-versa; sailing craft transported timber; sea going paddlewheel and screw ships shared the water ways with boat hauled trains of sugar cane barges; ferries, cream boats, mobile general stores and children in homemade canoes. The ocean going boats would call at the main wharves from Grafton to Yamba dropping off local passengers. (Yamba Yesterday, Howland, K. and Lee, S. 1985).

"A small commercial fishery had its beginnings in 1862 when fish were caught to supply workers and their families employed in the construction of the river entrance works. This major project was designed to provide safe navigation for the coastal steamers that traded upriver. Commercial fishermen were supplying fish to the local market by the 1870's, particularly seasonal fishing for Mullet, which was an important local industry supplying the Grafton market (Anon, 1880). The fishing industry began in earnest in 1884 when shipments of fish were sent to Sydney twice a week, weather permitting. The fish, mainly Whiting, Bream, Flat Tailed Mullet and Flathead were packed in ice in large insulated boxes. The boxes were then reused to bring ice on the return trip (Anon, 1994)…..

.... Before the turn of the century boats were rowed by fishermen who used hand-hauled cotton nets to catch fish. The motor launches which became available in the 1900's allowed fishermen to travel further afield resulting in increased catches.

Commercial fishing activity in the Clarence River occurs in the Estuary General and Estuary Trawl Fisheries. Offshore activity was primarily driven by the development of the Ocean Prawn Trawl Fishery which continued to expand in the 1960's and 1970's. At present there are approximately 30 trawlers operating out of the Yamba and Iluka ports, as well as a smaller number of Ocean Trap and Line and Lobster Fishers. Ocean Hauling was one of the earliest fisheries to be utilised on the beaches in the Clarence district. The Clarence River Fishermen's Co-operative was formed in 1945 at Grafton, from where fish could be transported by rail following the decline of the coastal shipping trade. The Co-op moved to its present site in Maclean in 1949 where facilities were gradually expanded and later, a major processing Co-op opened in Iluka." (Harrison J.PFAI, 2010, A socio—economic evaluation of the commercial fishing industry).

Many Australian native freshwater fish move within the river at different times of the year. Movements can include large scale migrations from fresh to saltwater to spawn or smaller movements within river reaches as individuals locate to

Turners Beach, looking from Pilot Hill Yamba towards the breakwall. A popular surfing, swimming and fishing spot.

alternate habitats or feeding areas. Many of the species present within the Clarence system need to move to complete their life – cycle. It is important to understand the seasonal distribution and movements of key species in relation to barriers, flows and spawning to ensure they are managed effectively.

The entrance to the Clarence estuary has been progressively trained since 1862, with major breakwater construction between 1950 and 1971. There is an excellent historical account on the building of the training wall, harbour works, establishment of the lower Clarence towns and industries, the river transport era and much more which can be found by visiting the Yamba Museum (see resources in previous section). Marina, boat building and maintenance activities are a growing industry in the lower estuary.

The Clarence Estuary Management Plan was developed in consultation with various stakeholders and was adopted in 2003. An Estuary Management Plan for the Wooli Wooli River was completed in 2009. Both plans can be viewed from the Clarence Valley Council website along with a range of management plans and strategies that have been adopted for the Clarence River Catchment and Clarence Valley local government area.

A wealth of aquatic habitats supports many species of fish including Mullet, Flathead and Bream as well as crustaceans. Mangrove and saltmarsh are also significant habitats for resident and migratory waterbirds, many of which are threatened both locally and globally.

The Clarence estuary has the 2nd largest area of seagrass (83 ha), the largest area of mangroves (765 ha) and the 3rd largest area of saltmarsh (290ha) in the northern rivers region (Williams et. al. 2006 in NRRBMP). These areas have been mapped by the former NSW Department of Primary Industries as part of the NSW Comprehensive Coastal Assessment and can be found at;

http://www.naturalresources.nsw.gov.au/estuaries/inventory/data/vegetation/clarence.shtml.

'The Swamp' – Arndilly. Image courtesy P. Kenway.

The Lower Clarence Catchment also features saltwater wetlands (in the estuary) and freshwater wetlands (just above the estuary). These include:

Wooloweyah Lagoon – a tidal barrier estuarine lagoon located 12 km from the mouth of the river has a catchment area of 206 square km (including the three connecting channels Palmers, Micalo/Shallow, Oyster) and supports large areas of seagrass, mangroves and saltmarsh. It is also an important habitat for many species of migratory waders and commercial fish species including prawns.

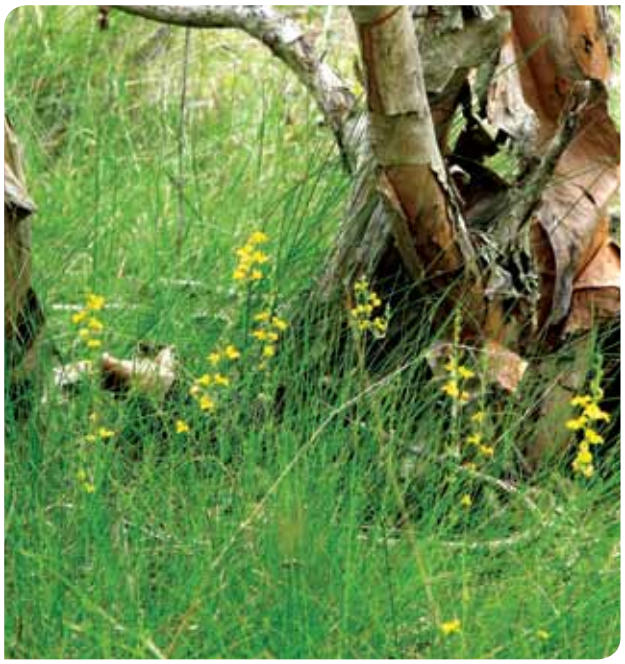
The Broadwater – a large tidal waterbody of the Clarence estuary fringed by mangroves and supporting seagrass and saltmarsh communities. It provides a drought refuge for migratory species and is an important habitat for many commercial fish species.

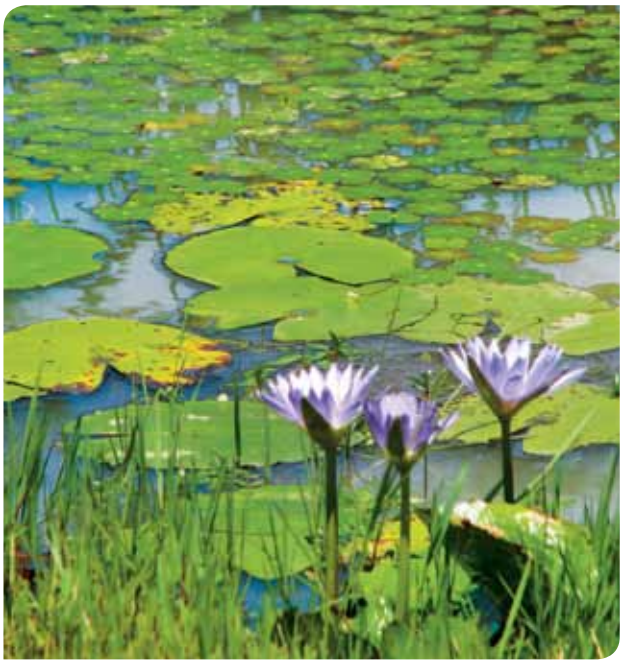
Everlasting Swamp – a freshwater wetland with vegetation including Swamp Oak, Spike-rush, Water Couch, Common Reed and Spiny Mudgrass.

However, many of these habitats have experienced decline in recent years, with seagrass declining by 80% between 1940 and 1986 and by 50% in the last 20 years. This has serious consequences for marine biodiversity, the viability of the fishing industry and for the community in terms of reduced availability of fresh, local, wild caught seafood in the region. http://www.oceanwatch.org.au

The decline has largely been caused by industrial, agricultural and urban development through land clearing (particularly removal of vegetation from riverbanks), nutrient and sediment rich runoff from developed land, dredging, land reclamation and flood mitigation works.

All activities within a catchment cumulatively impact on land and water resources downstream, particularly on aquatic habitats including saltmarsh, seagrass, mangroves and the fisheries they support. Good management and changed land use practices are essential in order to minimise negative impacts that result in decline of aquatic habitats. Chapter 6 has examples of some projects that are helping to improve the condition of estuarine habitats and water quality of the Clarence floodplain and estuary.





Resources and Contacts for Chapter 2

Websites

Clarence Valley coastline and estuary management plans at Clarence Valley Council
http://www.clarence.nsw.gov.au/cmst/cvc009lp.asp?cat=176

NRCMA Clarence River Fish Track Project brochure (2010).
NRCMA and NSW Industry and Investment project. Visit www.northern.cma.nsw.gov.au for further information.

Technical information about Australia's estuaries and coasts www.ozestuaries.org:

Estuary Food Webs http://www.oceanwatch.org.au/kids-stuff/our-valuable-estuaries-resources/our-valuable-estuaries/

Land and Water Management Issues in the Lower Clarence River Catchment (including The Fishing Industry and Waste Management issues)
http://www.oceanwatch.org.au

Other helpful websites

http://naturalresources.nsw.gov.au/estuaries

http://www.environment.gov.au/coasts/publications/stormwater

http://www.environment.gov.au/water/quality

http://www.dpi.nsw.gov.au/fisheries/aquaculture

www.clarence.nsw.gov.au

Fact Sheets

http://naturalresources.nsw.gov.au/estuaries/what

http://naturalresources.nsw.gov.au/estuaries/factsheets

http://naturalresources.nsw.gov.au/estuaries/whyprotect.shtml

http://naturalresources.nsw.gov.au/estuaries/inventory/index_ns.shtml

JAMBA, CAMBA and RAMSAR

http://naturalresources.nsw.gov.au/estuaries/whyimportant.shtml

The world is your oyster so look after it!

The oyster has been referred to as the canary of the waterways because its health is determined by the health of the water in which it grows.

The oyster is a native crustacean that is farmed and enjoyed all over the world. Oysters are farmed in the Clarence and Wooli Wooli estuaries. Although not as abundant as they were in previous decades, oysters can still be found occurring naturally within the estuaries. In the early days of oyster farming on the Clarence, oysters were harvested by scoop type dredging, the bed of Oyster channel being particularly productive. Nowadays the familiar wooden or metal racks with netting beds are the generally accepted practice (Yamba yesterday, 1985).

On average, a farmed Sydney rock oyster will filter an estimated 0.25 ML of estuarine river water in its lifetime, removing large quantities of suspended material, chiefly nutrients bound in phytoplankton. This means that oysters are important in maintaining healthy estuaries, but in performing this role they are exceedingly vulnerable to poor estuarine water quality. (NSW Oyster Industry Sustainable Aquaculture Strategy, 2006).

Increasing coastal populations are a direct threat to oyster cultivation. Extraction of freshwater upstream in periods of low flow, agricultural and industrial chemical run-off, land reclamation, boating, storm-water, leaky or faulty sewage systems, over-fishing, dumped garden refuse containing weeds, clearing of land along riparian edges, farm drains in acid sulfate soil zones, general urban and industrial development are just some of the activities that can contribute to a decline in oyster health and increased mortality rates.

Water clarity is a major determinant of the condition and productivity of an aquatic system. Suspended sediment can smother oysters as well as promote the growth of pathogens and waterborne diseases, and lead to dissolved oxygen depletion in the water column if the sediment is comprised of organic matter.

Pacific oysters are endemic to Japan, but have been introduced into a number of other countries including Australia. Most of these introductions have been for the purposes of aquaculture. However, few Pacific oysters are found north of Port Stephens where they have been commercially cultivated since 1991. Pacific oysters are a hardy species with fast growth and high reproductive rates. This has allowed them to establish dense populations in some areas, often displacing native intertidal species.

Acid waters creating holes in oyster shells. Image courtesy John Schmidt.

The spread of Pacific oysters, and their ability to displace (or even smother) native species, is a major concern for NSW oyster farms which cultivate Sydney rock oysters. There is also a problem of competition between Pacific oysters and other species for food and space.

Source NSW I and I at http://www.dpi.nsw.gov.au/fisheries/pests-diseases/marine-pests.

The oyster as an indicator of catchment health. Estuaries support a diverse range of functions and uses, and no use is more dependent on clean water and susceptible to pollution, than oyster cultivation and harvest. When oysters, clams, and other bivalve molluscan shellfish filter feed they can accumulate disease-causing microorganisms (pathogens) and other contaminants that may be present in the nearshore environment.

The oyster has been referred to as the canary of the waterways because its health is determined by the health of the water in which it grows. A productive and healthy oyster industry is therefore closely linked to a healthy coastal waterway (Healthy Rivers Commissions Oyster Report 2003).

What is an impact?

Natural and human

'Nature deals with the continuing flux of uncertainty mostly by processes of feedback and readjustment that seem to extend from the molecular to the global level'. (Lyle 1999)

Coastal Wetland.

An 'environmental impact' refers to the positive or negative result of an action on the coast and estuarine environments and their resources. An 'impact' does not necessarily have to be detrimental; however, this chapter places an emphasis on the potentially negative effects that can result from natural events and human activity. Human pressure on natural environments increases dramatically with population growth, disrupting natural processes and degrading natural assets. Urbanisation is perhaps the most significant of all land use changes, dramatically altering the natural capacity of watersheds to absorb and attenuate flows and contaminants. The imprint of urbanisation is generally permanent and many of the related environmental impacts are difficult to mitigate or reverse.

The continued fragmentation of landscapes and habitat that has resulted from urbanisation, recreation, industrialisation and agriculture, has created an increased uniformity in landscapes and consequential reduction, disappearance, fragmentation or isolation of the natural landscape. (Christy et al., 2004). Coastal urbanisation means that sensitive and dynamic estuarine ecosystems are continually readjusting to a variety of impacts, both natural and anthropogenic.

It's not what you do but how you do it. We've all heard this before, but its implications for our environment are critical in terms of whether our activities will have a positive or negative impact. One way to consider your actions on or near waterways is in terms of the environments natural limits. A river has its natural controls, checks and balances keeping the system healthy, in other words it has a limited range of environmental conditions within which it can survive. Any impacts that breach this range of conditions will ultimately upset the balance of the system creating a detrimental outcome. This should dictate what we impose upon it.

Pollution impacts can be prevented and mitigated using a variety of approaches and techniques, but there are practical limits to our ability and willingness to preserve coastal habitats and resources as development progresses. There is no replacement for sound land use planning and personal stewardship that recognize and preserve the inherent qualities of natural systems for buffering impacts and preserving clean water and healthy aquatic habitats. (Christy et al. 2004).

Natural Impacts

Estuarine Processes

Natural phenomena such as tidal flushing and heavy rain events are critical for maintaining good water quality. Many of the estuarine processes like tides, wind waves, ocean waves and sediment movement will be impacting on the estuary continually. In the event of extreme weather like flooding or drought, these processes will be interrupted, changing the dynamics of the estuary. To be able to preserve our estuaries it helps to have some understanding of how these ecosystems work. Some of the main land and estuarine processes are briefly discussed here.

Water movement

Water moves along an estuary under the influence of two primary forcing mechanisms, freshwater inflows draining out to sea and the regular tidal movement of seawater into and out of the estuary. In addition, tidal and salinity behaviour within the estuary generate a number of secondary currents, which while of low velocity, are of considerable significance with respect to mixing and sediment transport. Nutrient and pollutants are dispersed by both tidal and fresh water inflows and relative importance of these dispersive processes will change in relation to the level of fresh water flow.

Mixing

Mixing refers to the intermingling of parcels of water as they are moved along the estuary under the influence of freshwater flows, tidal flows and secondary currents. Mixing, not only involves an exchange of water mass, but also of any substance dissolved in it, such as salinity, dissolved pollutants, etc. Hence, mixing processes are critical to the distribution of salinity and water quality levels throughout the estuary.

Salinity and salinity regimes

The presence of soluble salts, that is salinity, is essential to coastal waterways. As an ecological parameter, salinity gives many aquatic organisms the ability to regulate their internal ion concentration. Salinity is an important control in certain types of pathogenic organism and invasive species. Most aquatic organisms function within a specific range of salinity. Estuaries are saline by nature but loss of water due to drought or poor flushing can result in hypersaline conditions, where the saline content is higher than the ocean water. Dissolved oxygen falls as water temperature and salinity increase. Measures of dissolved oxygen refer to the amount of oxygen in water. Many processes like photosynthesis require a certain amount of dissolved oxygen.

The salinity regime of estuaries is directly affected by the influx of fresh water supplied by rivers and marine water supplied by the ocean. Salinity levels fluctuate with the penetration of tidal flows, and with mixing of fresh water and marine water by wind and currents. Freshwater discharges to Australia's coastal waterways are mainly episodic, and are primarily controlled by conditions in the catchment including rainfall patterns, vegetation type and cover, topography, catchment area and geology. Entrance size of the river mouth and sea level dictate marine water exchange, and the extent to which salinity can build up within the coastal waterway due to evaporation during times of low river flow. (http://ozestuaries.org 2006).

Deposition and sediment movement

Different types of sediment are supplied to an estuary by a variety of sources; in general natural river bank erosion and general catchment runoff produce large quantities of sand, silt and clay. Wind action on dunes and intertidal sand banks can also carry fine sand into the estuary. However, the majority of sand in the lower reaches of estuaries in NSW comes generally from infilling with marine sand gained from the beach system. It is generally well accepted for northern NSW (north of Seal Rocks) that there is a net northward littoral drift of sand with transport rates of approx. 500,000 cubic metres per year (Carley et al. 2005).

Soil Erosion and Turbidity

While soil erosion is a natural process, the rate at which it occurs has been accelerated by land clearing, road construction, mining and other land use practices (HRC, 2000). Large volumes of material enter the waterways increasing nutrient levels and turbidity. Turbidity refers to the ability of water to transmit light. The more particulate or floating matter (suspended solids) within the water column, the less light is able to penetrate. This has major implications for the growth and survival of aquatic plants because sunlight is needed for photosynthesis to occur. High sediment loads are often equated with large catchment areas that have been cleared of native vegetation and support high urban development and or intensive agriculture.

Eutrophication

Eutrophication occurs naturally in a water body as it receives inputs of nutrients, mostly nitrates and phosphates from erosion and run off from surrounding lands. An overload of nutrients into the water can increase the incidence of algal bloom, shellfish contamination and dissolved oxygen depletion, which can cause fish kills.

How salty is the river

The table below shows the salinity levels at various parts of the Clarence and Coldstream Rivers and Shark Creek on the 29th April 2010. As a guide, sea water is around 35,000 ppm salt. The desirable limit as drinking water is 560 ppm for people, 10,000 for Cattle and 2,000 ppm for poultry and pigs.

Location	Salinity (ppm)	Location	Salinity (ppm)
Clarence River at Grafton	207	Clarence River at Maclean	4300
Clarence River at Swan Creek mouth	69	Clarence River at Harwood Bridge	9070
Clarence River at South gate creek	84	Upper Shark Creek at bridge on Byron's lane	368
Clarence River at Ulmarra	96	Upper Coldstream River at Briner Bridge	150
Clarence River at Lawrence	800	Lower Coldstream River at Calligans creek mouth	157

Table: Information courtesy of CVC.

Drought and flood

Drought can be catastrophic for most biological systems and nowhere is this more apparent than in the estuary. Generally, low levels of water mean there is less flushing with fresh water. Salinity increases and there is often an invasion of marine disease organisms in oyster leases.

Rain events can increase the risk of sewage spills or seepage associated with reticulation systems, particularly in times of heavy use of the system such as; peak holiday periods. Farmers and other landholders need to ensure they are prepared for floods, have an evacuation plan and have prepared for livestock needs. If new to an area, become familiar with local flood levels and what this means for your property.

Acid Sulfate Soils

Acid sulfate soils (ASS) are soils that contain iron sulfides. They were formed in low-lying coastal floodplains over the past 10,000 years as the sea level rose. When acid sulfate soils are exposed to air, they oxidise forming sulphuric acid. If the soils are buried or waterlogged they are known as potential acid sulfate soils (PASS). There are maps available of all the ASS and PASS areas along the NSW Coast. These risk maps are available from the Department of Environment and Climate Change, Natural Resources Division. Information can also be obtained from Council environment officers who can help determine the risks of ASS exposure and how best they are managed.

What is their impact?

Acid Sulfate Soils, when exposed, can produce acid for well over 100 years. Water moving through an acid soil strips the soil of iron, aluminium, and dissolves heavy metals such as cadmium. The iron flocculates out of acid water when it reaches less acid water producing iron oxide (red) scums.

The acidification of waterways disturbs many natural ecological processes by interfering with normal chemical reactions and reacting with organisms such as fish and oysters. Water affected by ASS can drop from pH of 7.8 down to 2.4. The pH of your local waterways can be simply tested with a pH strip that can be purchased from any pool supply store, or hardware store.

Acidity, and especially sudden (after rainfall) changes in acidity is stressful to fish and may result in a fish kill. Plants and other organisms in the food chain (eg. small crustaceans and plankton) can die due to exposure to acid runoff. Oysters are particularly vulnerable to acid sulfate run-off as they are sedentary beings.

The best way of reducing the impact of ASS is to stop PASS from being exposed to the air. The ASS/PASS maps are useful for identifying which areas are most likely to be ASS. These maps are a guide to deciding which areas are best left undisturbed and waterlogged. ASS is dark grey in colour, very wet and can have a sulphuric odour. Exposed or drained ASS is very common on the Clarence Floodplain. Land which has been reclaimed by flood mitigation works, drained for farming and urban development are all prime contenders for ASS. Farmland that has been exposed can be re-flooded with the consent of the landholder and form extremely productive pastures. Reforming drains, so they are wide and shallow rather than deep and narrow avoids exposing ASS. (Dixon, 1999).

Further to this, the Clarence Floodplain Project (CFP) has been successful in addressing many of the known impacts of PASS and ASS exposure. Since the project began in 1997 more than 200 km of waterways have been opened up and restored. Some 250 landowners have been actively involved in the management of creeks and drains, and more than 60 drain and watercourse management plans have been put into operation. The CFP along with various other government and community organisations has worked with landowners to remove barriers to fish passage and improve drain management. See Chapter 6 project example The Clarence Floodplain Project and visit http://www.clarence.nsw.gov.au/cmst/cvc009/lp.asp?cat=211.

Main Beach Yamba during 23rd May 2009 storms.

Climate change

Human activity, particularly the burning of fossil fuels, has made the blanket of greenhouse gases around the earth 'thicker'. The resulting increase in global temperatures is changing the complex web of systems that allow life to thrive on earth, such as cloud cover, rainfall, wind patterns, ocean currents, and the distribution of plant and animal species. More of the suns energy is being trapped in the earth's atmosphere and much more of the world's carbon (in the form of carbon dioxide) is resting in the air rather than in trees, soil and subterranean deposits.

One of the consequences of climate change is that mean sea level will become significantly higher than it is today. Inevitably this means that low – lying land and coastal areas, particularly land within the tidal zone will change. The natural area and the built environment will be dealing with inundation by seawater, higher tides and higher storm surges, receding shorelines and salt water intruding into freshwater environments. The issue of planning to accommodate sea level rise in coastal communities will present complex challenges for local communities and all spheres of government. How much and when? Can we predict critical sea levels and dates and how accurate are the predictions? What will the social, environmental and engineering consequences be? (Source: A Snapshot of Future Sea Levels: Photographing the King Tide, DECC NSW publication, 2009).

Further information about sea level rise can be found on the CSIRO Marine and Atmospheric Research website www.cmar.csiro.au/sealevel/.

In principle, beach erosion is a natural process although it can and has been exacerbated in places by the influence of human activity. If erosion is allowed to occur naturally, the character and amenity of the beach is generally retained. The essence of erosion problems is therefore not so much that beaches erode, but that development has occurred within the zone of natural beach movements. Some forms of property protection can also exacerbate the erosion in adjacent areas and adversely impact the amenity of the beach. (WBM and Geolink, 2007).

The extent of residential and amenity development within erosion prone areas and associated issues vary along the coastline. Erosion may also threaten areas used for recreation or areas of ecological importance. The effects of climate change include a potential rise in mean sea level due to global warming. Such rises have the potential to increase the threat of inundation depending on the nature of the shoreline and its response to the rise. Scientists and environmental managers are confronting two major pressures on the coast: population growth and global warming. A rough rule of thumb is that for every 1 metre of sea-level rise there will be 50–100 m of horizontal erosion. (McInnes, K., CSIRO and ACE CRC (2006).

Some consequences of global warming are already apparent. The complexity of the climate system means predictions vary widely but even the minimum changes forecast could mean frequently flooded coastlines, disruptions to food and water supplies and the extinction of many species (UNFCC Climate Change Science).

Turners Beach Yamba near the break wall, 23rd May 2009.

How can we mange beaches better and what pressures are they under from coastal development and sea level rise? Two major factors affecting the Australian coastline are the orientation of the coastline and the wave climate. Modelling of weather patterns along the NSW coast indicates the potential for increases in the frequency of weather events that contribute to extreme winds and, subsequently storm surges (Hennessy et al., 2004b.) Modelling of coastal responses to sea level rise from various locations along the NSW coast indicates the potential for tens of metres of beach erosion in excess of 100m during severe storm events (Hennecke, 2004; Cowell et al., 2006).Beach erosion, shoreline recession and coastal entrance behaviour can markedly alter foreshore morphology and coastal bathymetry. If not properly catered for, such changes can imperil coastal settlements and reduce both natural and built amenity.

Records of coastal properties being affected by coastal erosion date back to the early 1900's. The NSW government has designed a new coastal reform package which focuses on appropriate actions for councils and communities that are adapting to these challenging circumstances. An established framework to manage coastal erosion risk is already in place through the NSW Coastal Policy and the Coastal Protection Act 1979. For more information on the key coastal reforms and future updates please go to www.environment.nsw.gov.au/coasts.

The photographs above and on the previous page were taken during the May 2009 Clarence River flood which coincided with a king tide and a storm surge on the north coast of NSW. Low lying lands along the estuary and river islands were inundated by floodwaters. Access from the Pacific Highway into the township of Yamba was cut off to major road access for 5 days and several local roads affected as well. Severe coastal erosion, damage to infrastructure, beach access and dune systems was evidenced in this extreme event which affected most of the NSW north coast.

Human impacts

Everyone who lives in the estuarine area will place stress on the aquatic environment. Being mindful of how we go about our tasks and leisure pursuits is imperative if we want to continue to enjoy and use these unique areas. Every time humans interrupt the natural water cycle there will be an effect. Our impact on water pathways occurs in two main ways; withdrawing and discharging.

We extract water out of the system to irrigate crops and pastures, provide water for our daily lives and for industry. When it rains, the water falling on the ground gushes into roadside kerbs, gullys, and rivers picking up all kinds of pollutants. These may constitute agricultural pesticides, herbicides and fertilizers, waste from faulty septic systems, loose soil from building sites and in urban areas, the mix can include petrol, oil, animal waste. What follows is a description of some of the ways human's impact on estuaries. As you read, consider how the natural estuarine processes will be affected.

Water Pollution

It is an offence for any person to pollute waters. Pollution includes introducing anything (litter, wash water, soil, debris, detergent, paint, cement slurry, building materials, etc.) into water. Some of the most critical types of water pollution include heavy metals, biotoxins, organic contaminants and sewage. The Healthy Rivers Commission's Independent Inquiry into the Clarence River System (1999) summarises the major water quality issues of concern throughout the Clarence Catchment. They include; suspended solids (during high flows), in both freshwater and estuarine locations, nutrients in small estuarine tributaries and high nitrogen levels in the estuary, pathogenic organisms around Grafton, pH – acid levels measured in the estuary and drains coming from farms and urban areas.

Nutrients

In small amounts, are required for plant growth but in large amounts they can cause excessive algal growth in waterways (including blue green algae) which can put natural ecosystems out of balance, harming water-life and animals. Blue-green algal growth can also seriously affect human uses of water for purposes such as drinking, recreation, stock water and irrigation.

Major sources of nutrients in the lower Clarence River Catchment are:

- run-off from urban and rural residential areas;
- erosion and run-off from grazing and cultivated land;
- discharges from sewage treatment plants and septic systems; and
- runoff water from irrigation areas.

(Source - Case Study 3; Waste Management in the Lower Clarence River Catchment).

Acid drainage from Acid Sulfate Soils (ASS) can contain dissolved heavy metals, leached from minerals in the soil. Monosulfidic Black Ooze (MBO) or acid discharge refers to sulphur and iron enriched organic sediments that commonly form in drainage channels in acid sulphate soil landscapes. These sediments are highly mobile and easily incorporated into the water column during floods where they can rapidly deoxygenate and acidify water (ASSAY, 2004).

Faecal contamination

Faecal contamination poses a risk for humans and animals. Most waterborne pathogens originate in human and animal faeces and include a wide variety of viruses, bacteria and protozoa (Rose et al. 1999 in Christy, 2004).
The transmittal of viral disease is a key health concern associated with the consumption of shellfish. Sanitation surveys conducted by the NSW Shellfish Program suggest that storm water runoff, failure of local septic systems, sewage reticulation system malfunctions, sewage treatment plant outfall and possibly pollution from passing vessels are all potential causes of contamination in estuaries. The potential for disease causing micro-organisms to enter estuaries via sewage is higher after heavy rainfall and flooding.

Construction waste and soil erosion

Soil that is exposed at construction sites can be washed from the sites into stormwater drains if measures to keep this soil at the site in place (sediment controls) are poor. This sediment is eventually deposited into the Clarence River or its tributaries and can even make its way into the ocean through the river mouth at Yamba. Although a single block of land may seem a small part of the river catchment, the cumulative (additive) effect of polluted sediment-rich runoff from a number of building sites can have a dramatic impact on water quality.

Floodgates can act as a barrier to fish. Image courtesy © Scott Johnson.

Changes that are made to natural land surfaces and drainage patterns during construction and urban development can result in natural watercourses becoming turbid, silted, littered and undesirably enriched with nutrients (eutrophication).Clarence Valley Council has sediment and erosion guidelines for building and construction works and approvals for these types of development generally require inclusion of sediment and erosion control procedures to be employed or are required as a condition of consent by Council.

A further consideration is that some soil types, in particular sodic and dispersive soils are highly erodible and have low wet bearing strengths which require careful management. Highly dispersive soils require additional management and design considerations during construction. Another potentially damaging activity is burning off. Fire can reduce ground cover and contribute to soil erosion. For further information The Resource Kit for Rural Landholders in the Northern Rivers has a chapter on soils and on fire management.

River impoundments

The construction of dams and management of water resources to meet town water supply, irrigation, riparian, environmental and other demands has influenced the magnitude and variability of freshwater inflows to estuaries. Dams and weirs have varying effects on downstream estuarine ecosystems, depending on the size and location of the structures and the uses made of the impounded water. Impacts include sediment and nutrient inputs; freshwater flow and flooding pattern; water quality, and barriers to fish migration.

Flooding is important to many freshwater wetlands, and is a stimulus to the breeding and migration of many fish species inhabiting coastal rivers and estuaries (Harris, 1984). Larger floods also flush accumulated sediments out of estuaries.

Many fish species use both estuarine and freshwater habitats. Weirs may be barriers to migration, although species differ in their abilities to swim, leap or even climb over barriers. Some low weirs may be passable to most fish when the river is in flood. A large number of New South Wales coastal rivers have weirs built around the tidal limit to limit saline intrusion. These are potential barriers to estuarine organisms which require access to freshwater for part of their life cycle (Harris, 1984). Drinkwater and Frank (1988) claim that 'a decline in some coastal fisheries with an overall impact on the biota is generally associated with reductions in freshwater inflow'.

Flood mitigation works

In the past, a variety of flood mitigation works were constructed along estuaries to protect agricultural and urban areas from freshwater and coastal flooding. The Clarence is a classic example of this. Such works included levees, drains and floodgates, together with the clearing and lining of stream channels to facilitate the passage of flood waters. These works can have a number of adverse impacts on estuarine habitats.

Creek, river and channel improvements aimed at facilitating the flow of floodwaters, quite apart from destroying habitat, can lead to erosion problems and downstream siltation.

Perhaps the most critical effect of flood mitigation works is the loss of wetland areas. In the past, many agricultural areas on floodplains were won by draining wetlands and restricting saltwater inflows to tidal creeks. In addition, levee banks were constructed to exclude floodwaters. All of these activities resulted in the loss of wetland areas or in markedly altered wetland regimes because of reduced replenishment by floodwaters. In addition, the loss of tidal storage led to a reduction in tidal prism with its accompanying detrimental effects of increased siltation and exacerbation of water quality problems.

The construction of tidal barriers, such as weirs and floodgates, eventually converts upstream reaches from a brackish to a freshwater environment. In addition, these barriers impede or prevent the movement of fish and prawns and can lead to prolific weed growth upstream of the barriers. This weed growth is caused by nutrient buildup in the largely stagnant waters upstream of the barrier and may require the use of herbicides for control.

Early photo of flood mitigation works in the Clarence – which was done on a massive scale. Image courtesy Clarence Floodplain project.

Blackwater discharging from floodgate. Image courtesy CVC.

All floodgates discharge as the river recedes and they discharge water automatically - but sometimes assisted by a winch. In some cases the water discharged is of poor quality - especially in systems where there are drained wetlands (black water), and where there are acid sulfate soils with high conductivity (acid discharge). The combination of acid and black water discharge is the main cause of fish kills on the North Coast and also has a major impact on all other aquatic life in the river system following high rainfall events. There is also evidence of a higher incidence of red spot disease in fish following these events (Foley, M. 2010).

These days, the potential adverse impacts of flood mitigation works are clearly recognised. It is unlikely that significant new areas of biologically significant wetlands will be drained for agricultural or other purposes. The appropriate design of new works can preserve existing wetland areas whilst providing flood protection. Where possible, the sympathetic operation of existing works can reduce their detrimental effects. The Clarence Floodplain Project is a good example of a cooperative approach to reversing the negative impacts of past flood mitigation works. The effects floodgated systems have on the floodplain and estuary have been improved to a large extent through better management in recent years(see Clarence Floodplain Project Chapter 6) by allowing water exchange between these systems and waters of the main Clarence estuary.

Groundwater use

Groundwater is an important, but hidden, component of the water balance of an estuary. Groundwater reserves can exist in both wind and water deposited sediments, i.e. in wind built sand dunes and in sand and gravel beds deposited by freshwater and the action of coastal waters. Groundwater can be an essential source of water in the coastal environment. Freshwater lakes and streams surrounding an estuary are often sustained by natural groundwater discharges from beach and dune sands. Some coastal rainforests and wetlands are dependent on groundwater, especially during drought periods.

The integrity and quality of the groundwater resources of an estuary can be compromised in a number of ways. Over pumping can lead to the intrusion of saltwater into the aquifer; high rise residential buildings and tourist complexes may require permanent de-watering of the water table to enable construction of basement carparks; sewage effluent from septic tanks and seepage from landfill sites can contaminate aquifers; mineral sand mining and extractive industries can also influence the recharge behaviour and quality of groundwater reserves.

Fishing

Over-fishing and habitat degradation adversely affect fish stocks. Commercial fishing has been a part of the Clarence since the 1860s and continues today to play an important part of the social and economic fabric of the local community and the region.

Commercial fisher's livelihoods are reliant on healthy fish stocks and healthy environments. Off-stream impacts can and do have a dramatic impact on habitat and fish populations. Without fish stocks there are no fisheries to manage. Industry driven initiatives like seasonal and permanent closures, improvements in nets, reduced effort, mandatory by catch reduction devices are just some of the changes introduced and supported by industry.

The Estuary Prawn Trawl Fishery operates in the Clarence River targeting school prawns. Prawns are caught using a trawl otter net, although a small proportion are also taken by pocket netting in the Estuary General Fishery.

The majority of prawns are caught during the dark of the moon on either run out or slack tides. Management controls include:

- restrictions on the number of trawlers fishing the river,
- the size and number of nets, and
- the times when fishing can occur.

The trawl seasons commences in October in Lake Wooloweyah with the main river opening in December. The season closes at the end of May the following year. Trawling is prohibited in the Broadwater and most of the Oyster Channel and upstream of the Ulmarra ferry. No river trawling is permitted at night or on weekends or public holidays. In recent years the fishery has taken on mandatory use of bycatch reduction devices which have reduced the amount of unwanted species caught in the net. There have also been recent closures of the Estuary Prawn Trawl fishery which have been self imposed by the fishermen. The Clarence continues to provide the majority of school prawn landings in NSW which is approximately 60% of total weight across NSW (A Socio-Economic Evaluation of the Commercial Fishing Industry, 2010).

The commercial fishing industry is constantly under pressure from a number of fronts in relation to continued access to resources and involvement in the supply of sustainable seafood. Economic modeling (as part of a report) has identified the following total (sum of the direct and indirect) flow-on impacts arising from the operation of the industry:

In the Clarence, the commercial fishing industry generates an output of $92.0 million, an income of $15.4 million and 431 employment positions currently.

Recreational fishing can have an adverse effect on fish stocks and habitat. Fishing hooks and bait packaging are a hazard when left in or near water ways. Plastic bags are mistakenly swallowed by some marine animals, suffocating them and fish hooks imbed into the beaks and bodies of marine birds and animals. Sticking to bag limits for catches and bait collection, using appropriate catch and release methods, not damaging riparian vegetation or aquatic habitats and removing any rubbish or discarded fishing line and hooks will help ensure the future of recreational fishing. Fishers must also make sure they comply with a range of rules and regulations including gear restrictions, closed areas to fishing as well as fish size and bag limits. A license is required for all types of fishing and must be carried on the person at all times.

Fishing is a popular activity on the Clarence coast and estuary.

Recreational and commercial boating

The estuarine waterways of the Clarence River are used extensively for recreational and commercial boating. Recreational uses include fishing, sailing, rowing, canoeing, sail boarding and water skiing. Commercial uses include various forms of commercial fishing, charter vessel cruises, vessel hire and ferries. Boating brings considerable recreational and commercial benefit, not only to the users themselves, but to the wider community.

Normally waterways are freely used for all forms of boating, but in limited situations, the NSW Maritime Authority can apply restrictions on the type of boating allowed. Conflicts of use can occur between different types of boats and between boating users and the local community. Such conflicts are best managed by the NSW Maritime Authority through the 'Boating Users Groups' which exist for all major waterways.

Some adverse effects of boating include pollution by unburnt exhaust gases from power boats, fuel spills and litter; disturbance to fish stocks; bank erosion, bank undercutting and increased turbidity levels caused by power boat wash; and damage to seagrass beds caused by propellers, anchors and digging for bait.

Boat users are in a position to make a valuable contribution to positive environmental practices through awareness of the activities that can have a detrimental impact on waterways and the industries and natural habitats they enjoy. The NSW Maritime is the regulator and administrator of a number of Acts of Parliament and also has responsibilities relating to the marine environment.

Boat Users Guide to the Environment + more, online at: www.bia.org.au/boat-users/index.html NSW Maritime www.waterways.nsw.gov.au

Aquaculture

As the global demand for fresh seafood increases, so does the pressure on the world's wild caught fish stocks. Aquaculture is promoted as a way to assist the survival of some fish species whilst providing a reliable supply chain for seafood wholesalers and retailers.

Prawn farms have been constructed on land adjacent to a number of NSW estuaries, including the Clarence at Palmers Island and Micalo Island. These farms generally consist of an interconnected series of large shallow ponds. Estuarine water is pumped through this system of ponds, return flows being discharged back to the estuary. Recently, a Mulloway fish farm has been established on Palmers Island.

Compared with the estuary itself, prawn farms represent an intense concentration of biomass. Hence, return flows to the estuary can have very high concentrations of organic matter and other pollutants (prawns are fed with food pellets). To preserve nearby estuarine ecosystems and habitats, it is essential that estuarine waters have adequate dilution and flushing capacity to handle these concentrated waste discharges or that discharges are adequately treated before return to the estuary.

In order to maintain the health of estuarine ecosystems and produce a safe product, Australian aquaculture farmers must adhere to strict environmental standards. In NSW, these environmental standards are enforced by the NSW Fisheries Department, the Environmental Protection Agency, Local Government and the NSW Food and Safety Authority.

Oyster farming, with the oysters raised on racks in shallow estuarine waters, can have adverse effects on the estuarine environment. If oyster racks are poorly aligned to the prevailing currents, the flushing of lease areas is restricted. Realignment of oyster racks in sympathy with ebb and flood - tide currents promotes both the flushing of lease areas and oyster growth.

Wake Up? Slow Down

True or False?

1. **Boat wake can't cause any more damage than wind driven waves.** Yes it can

Wind driven waves tend to travel along the length of waterway and directly approach the shore only at bends in the channel. However, boat wake may travel almost directly towards the bank and cause erosion along the entire length of the waterway.

2. **Most 'tinnies' are small and light enough not to cause any wake problems.** No they're not

Speed is just as important as size and both factors must be considered together. For their size, most outboard powered boats can travel much faster than almost anything on the water.

3. **On the plane, the smaller wake causes less damage.** No it doesn't

Even though a wake reduces in height as the boat planes, the waves are moving faster, further and travelling outwards from the vessel track. When the planning vessel travels parallel to a sheltered shore, the wave energy is directed towards that shore.

4. **You can see what your wake is doing from the boat.** No you can't

Even if you're fairly close to the bank (say 50 metres away) the peak wave impact of a boat travelling at 20knots only occurs as the first 5 – 10 waves hit. By that time, you're half a minute and 300 metres away. The only way to really observe the impact of wake is to stand on a soft shore and watch the impact of wake in all three phases of boat speed. If you do this you may be surprised a t what you see.

Source (DPI, TAS).

Agriculture and grazing

Changes wrought to estuarine draining catchments by clearing, burning, cropping and grazing all increase the rate of sediment production and the amount of sediment transported into estuaries. These activities also alter habitats to the detriment of both aquatic and terrestrial wildlife.

The clearing of riverbank areas commonly causes banks to erode and collapse. Clearing also affects the hydrological balance of catchments: the frequency and severity of flooding are increased; the distribution and duration of surface runoff across the catchment is altered; changes to the groundwater table may occur.

Burning can lead to highly increased nutrient levels in surface runoff, which may result in eutrophication and possible oxygen depletion in receiving waters.

Cropping increases sediment runoff because ploughing and tilling operations both destabilise the upper soil mass and expose it to the elements. Agricultural runoff, apart from sediment load, can also contain high levels of toxic materials (pesticides and herbicides) and nutrients.

Grazing causes a progressive loss of tree cover because seedlings are eaten by stock. Other detrimental effects include trampling of flora, the compaction of soils, increased nutrient levels in runoff (from faecal matter) and the destabilisation of river banks (unless these areas are fenced off) causing erosion and sediment input.

Another adverse effect of agriculture is the exposure to the atmosphere of acid sulphate soils, which are common along the lower floodplains of a number of estuaries in the north of the State including the Clarence. Leachate from these soils can be strongly acidic and contain high concentrations of aluminium (leached from clay soils). This runoff can severely affect estuarine water quality for short periods of time (if the runoff drains to an estuary). See Chapter 6 Lessening the Impacts – examples of local farmers and landowners adopting sustainable farm management practices.

Cows and Swans at Litttle Broadwater wetland. Image courtesy Clarence Floodplain project.

Forestry

Unless well managed, forestry operations adjacent to estuaries or in upstream catchment areas have the potential to cause significant soil erosion, with consequent increases in turbidity and sedimentation within an estuary. Forestry activities can also result in the loss of scenic amenity around an estuary. While forest roads can provide access for recreational activities, they can also act as wildlife barriers, preventing or inhibiting the movement of certain native animals in estuarine catchments and exacerbate the spread of exotic animals and plants.

Extractive industries

The extraction of sand, gravel or other materials from an upstream catchment area or from the floodplains or bed and banks of an estuary can have a number of adverse impacts on the estuarine environment.

Extractive industries located around the fringes or within the waterbody of an estuary can cause major damage to estuarine habitats. The tailings associated with sand and gravel extraction, whether windblown from land or discharged back to the estuary, may smother seagrass beds. Sand and gravel mining alter the cross-sectional area and storage characteristics of affected reaches of the estuary. This results in changes to the hydrodynamic, salinity and sediment transport processes of the estuary. In turn, these changes can lead to habitat degradation and bank erosion. Other possible adverse effects of sand and gravel extraction include the release of nutrients and changes to water levels. These days, such industries require planning approval under the Environmental Protection and Assessment Act, 1979. This procedure is aimed at limiting detrimental effects to acceptable levels.

Reclamation and dredging

Reclamation is the most damaging activity associated with the development of estuarine foreshores. More often than not, mangrove and seagrass areas, which are amongst the most productive and most important habitats of an estuary are destroyed or severely degraded. The existing foreshore is buried; intertidal areas may be smothered by fill operations, or destroyed if used as a source of fill. Reclamation of intertidal areas reduces the tidal prism (a volume of water exchanged between an estuary or a lagoon and the open sea during one tidal period), significantly at times. This in turn may alter the salinity regime and exacerbate water quality problems through reduced flushing.

Dredging can have a number of adverse effects on an estuary. Seagrass beds may be destroyed by mining the underlying sediment or degraded by increased levels of turbidity and sedimentation. Any deep holes and channels created by dredging can become stagnant or may adversely affect current patterns and can trigger bank instabilities nearby. Offshore dredging and sand mining near the mouth of an estuary can significantly affect tidal hydraulics and the movement of water and sediment into and out of the estuary. Of special concern is the reclamation and dredging of acid sulfate soils, which can generate acid runoff containing high levels of aluminium. Properly controlled dredging is sometimes carried out to facilitate safe navigation of shipping channels and to improve tidal flushing when it is considered to be ecologically beneficial to the long term health of a waterway.

Clarence river mouth and training walls. From the powerpoint Clarence River Journey, 2003. Image courtesy © G.Mackie.

Training walls

Training walls are commonly used to stabilise an estuary entrance or to confirm the location of a main channel. Whilst training walls improve the navigability of an estuary, they may have a number of adverse effects on estuarine habitats and ecosystems.

If training walls are constructed along foreshores, there is a loss of foreshore habitat and the disturbance and probable loss of intertidal habitat. Training walls may significantly alter the ebb and flood current patterns within an estuary. This may lead to certain backwater areas being poorly flushed. Altered current patterns may cause fish larvae to settle in inhospitable areas. Notwithstanding these adverse effects, training walls can increase the overall flushing of the estuary by promotion of increased flows through deep channels and also provide rock substrate habitat.

Waterfront developments

Waterfront land is a valuable commodity. Past demand for waterfront land has led to the piecemeal reclamation of extensive foreshore areas. In turn, this has led to the destruction of natural foreshore and intertidal habitats and has resulted in restricted public access to foreshores. In addition, significant pollution of estuarine waters has occurred from sullage, other domestic wastes and urban runoff from waterfront developments. Waterside caravan parks with septic tank and absorption trench facilities are also sources of pollution.

Waterfront developments can have a detrimental effect on wader populations: important habitat areas may be lost or reduced; nesting birds may be disturbed.

Well designed and sympathetic waterfront developments can increase public access to estuarine foreshores and enhance both passive and active recreational amenity.

Canal estates

Two common and often major adverse impacts of canal estates on an estuary are the initial destruction of estuarine habitat, often wetlands or saltmarsh, and the subsequent continuing pollution and disturbance of estuarine waters by urban runoff, boating activities, etc. Canal estates, like waterfront developments in general, may have adverse effects on wader populations (loss of habitat, disturbance of nesting birds).

Conversely, well designed and constructed canal estates can facilitate the flushing of nearby estuarine areas because of the greater tidal prism associated with the canal development.

Canal estates are generally constructed on low lying land adjacent to estuaries. Material from canal areas is excavated and used as fill to raise the residual land area. In the past, the dimensions and layout of canals were governed largely by commercial dictates: the need to maximise the number of waterfront blocks and the need to obtain sufficient fill to raise blocks above flood level.

Yamba Marina.

These days, it is recognised that canal dimensions and layout should be governed by the following considerations: retention of wetlands; minimisation of adverse effects on the adjacent estuary, including sedimentation and pollution; adequate tidal flushing of canals; and provision of public access to foreshores.

The construction of canals in acid sulphate soils is of concern because of the high acidity and elevated aluminium levels in runoff from such areas.

Most development includes tar seal roads, curb and gutters creating impervious surfaces which aids in the increase and velocity of run-off.

Marinas and recreational facilities

Estuaries are popular areas for active recreational pursuits, such as swimming, boating, water skiing and fishing. These activities require various shore based facilities, such as marinas, boat ramps and car parks. Often, these structures are built along the foreshore at the expense of mangroves and the natural fringing vegetation. In addition, dredging is sometimes required to improve boat access to marinas.

Marinas and recreational facilities can disturb the roosts and beach nesting and feeding areas of wader bird populations Marinas and recreational facilities provide a focus for boating and recreational activities. As such, they are a valuable management tool that can be used to shepherd these activities into appropriate areas of the estuary. By providing a focus for these activities they also facilitate the control of any resulting pollution, eg litter and fuel spills.

Pests and Weeds

Mosquitoes, midges and other insects are an irritation to nearby human populations. At times they can pose a health hazard, eg Ross River Fever, Barmah Forest Virus, which is caused by an arbovirus carried by mosquitoes whose numbers can increase to epidemic proportions in stagnant accumulations of brackish water.

Insects breed in the wetland areas, saltmarshes and tidal fringes of an estuary and are an important component of a healthy and balanced estuarine ecosystem. Often there is pressure on the local council to eliminate or reduce insect nuisance by filling or draining breeding areas or by use of pesticides. All of these activities have adverse effects on the estuarine environment. Some pesticides can decimate estuarine organisms. The management of insect populations in important or sensitive estuarine areas such as wetlands and salt marshes constitute a compromise between the expectations of the community and the requirements of the ecosystem.

Stormwater and flood events enable weeds to spread, some of which literally choke waterways. All weeds displace native flora through competition for space, light and nutrients. For example, Water Hyacinth (from South America) is a major problem in parts of the Clarence River system and on the floodplain's estuarine tributaries, modified creeks, drainage channels and wetlands. It is a troublesome plant that has spread worldwide, obstructing waterways, reducing fish production, harbouring mosquitoes, and seeds may remain dormant for up to 15 or more years. Bitou Bush (from South Africa) which was planted during the sand mining era has

Shallow Channel causeway, Yamba Road before and after construction of a causeway to reintroduce tidal exchange after it was blocked by road construction prior to the 1920s. Image courtesy CVC.

invaded coastal habitats and is a declared weed of national significance. Government funding has allowed local authorities, landowners and volunteer groups to work together in the control of invasive species in the Clarence catchment but the work continues.

Invasive marine pests degrade the environment and cost millions of dollars in damage to shipping and maritime infrastructure and losses to aquaculture. Early recognition of pests such as the Black - striped Mussel and the Pacific Oyster is critical.

Cane toads and Foxes

In addition to weeds and marine pest species, foxes and cane toads are also present in the Clarence. With regard to foxes (and wild dogs) any sightings or suspicious animal attacks should be reported so that their control can be targeted. Foxes have been known to predate Shorebird eggs and birds nesting on Dart and Hickey Island and other areas around the estuary. Cane toads breed in coastal wetlands and tributaries connected to the estuary and the damage they can do to native species is widely recognised.

Road and bridge construction

Roads and bridges across estuaries can have a number of adverse effects on estuarine habitats and ecosystems. Causeways across an estuary can severely restrict tidal flows and reduce the tidal prism. This in turn can lead to increased rates of siltation and deterioration in water quality, with consequent degradation of seagrass beds and other habitats around the obstruction.

From an economic point of view, long causeways with limited waterway openings are desirable. However, the smaller the waterway opening, the greater the loss of tidal prism and the greater the adverse effects described above. In addition, limited or unsuitable waterway openings may restrict the passage of fish past the structure.

Road construction along and across estuaries often involves wetland reclamation with dredge spoil and the destruction of foreshore vegetation. These activities result in the loss of foreshore, wetland, tidal and possibly intertidal habitat.

The long term adverse consequences of road and bridge construction can be quite dramatic. The reduced fluctuation in tidal water levels and velocities, together with highly reduced salinity levels, can lead to a progressive, but ultimately marked change to upstream habitat areas, including the loss of mangroves and the smothering of any upstream seagrass beds.

Careful and sensitive design that recognises the interactions between the various estuary processes can minimise these adverse effects.

Volunteers from Yamba Landcare Group who work in the Clarence Estuary Nature Reserve. Image courtesy Clarence Valley Review, October 2010.

Caring for the Coast

The beach and coastal dune system is also connected to the health of the estuarine environment. They supply the sand that is the basis for unique dune plant and animal communities. Coastal dunes are a buffer for wave attack on the land inward. They too require protection and careful management. The coastline can be degraded by many human activities including residential development, grazing, mining, weeds, recreational activities, excessive collecting of bait and shells, uncontrolled pedestrian and vehicle access, rubbish dumping, and the poisoning of native vegetation to maintain uninterrupted views.

Landcare is a nationwide program which facilitates community and volunteer activities in natural resource management. Each catchment has a Community Support Officer who can provide regular news on funding opportunities, workshops, field days, community groups, advice on NRM issues and further contacts. To find out how you can join or support a local volunteer group, be involved with caring for the land or coast, access sustainable farming opportunities and many other natural resource management projects

Contact Clarence Landcare on 02 6643 5009 or visit www.clarencelandcare.com.au

These impacts have a detrimental effect on dune stability and dune ecosystems including ability to withstand erosive forces. Habitat is needed to support wildlife, shorebirds and marine creatures that utilise the beach dune system to feed, breed and nest.

Clean beaches, clear water and a wide variety of marine life. Australians have come to expect these things from our coast. Aboriginal Australians have important cultural connections to places on the coast. The pressure that is being placed on our coasts each year is growing and impacts are increasing due to expanding coastal populations and tourism. The way that we use the coast will determine what is left for future generations. The guide 50 ways to Care for Our Coast shows ways that we can minimise our impact on coastal environments whilst enjoying what our coasts have to offer and is available from Clarence Landcare, Clarence Valley Council, NRCMA offices. If you want to help make a difference join a Coastcare, Dunecare or conservation group. Every little bit helps.

Resources and Contacts for Chapter 4

Pests and weeds

For information about local weeds and their control contact

Clarence Landcare
Phone: 02 6643 5009

CV Council weeds officers
Phone: 02 6643 3820 or visit the

Weeds Australia website: www.weeds.org.au.

Clarence Valley Conservation in Action Landcare Group (CVCIA). This Landcare group may be contacted to report suspected Cane toad sightings and is active in the monitoring and control of Cane toads and Indian Mynas in the Clarence.
CIA Headquarters: Phone: (02) 6647 3477
Email: sharon@cvcia.org.au www.cvcia.org.au

To report foxes contact the

Livestock Health and Pest Authority Grafton
Phone: 02 6642 3699
www.rlpb.org.au

If a pest population is discovered early on and reported there is a greater chance it can be brought under control. You can report the location of marine pests by contacting the
Industry and Investment NSW (formerly NSW DPI)
Phone: 02 4916 3877.

To learn more about marine pests and diseases visit
www.dpi.nsw.gov.au/fisheries/pests-diseases/marine-pests

Drought and flood

Information on planning for floods is available on the **Industry and Investments website** www.dpi.nsw.gove.a/agriculture/emergency and **SES** www.ses.nsw.gov.au.

If immediate assistance is required contact the
SES 132 500

CVC Flood Risk Management planning at
www.clarence.nsw.gov.au/cmst/cvc009lp.asp?cat=215

Water Pollution

To report suspected algal blooms or water pollution call the
ENVIRONMENT HOTLINE 131 555
Blue Green Algae Officer in Coffs Harbour
Phone: 02 6665 0120

For recorded information on algal alerts phone
Algal Information Line 1800 999 457
Environment Protection Authority – EPA

Climate Change

Information about Climate Change and the Northern Rivers Region can be found in the publication Climate Change in the Northern Rivers Region, prepared for the NSW Government by CSIRO and available from the Northern Rivers CMA offices or visit the following websites for the latest information on climate change, it's consequences and tools for managing risk;

www.csiro.com.au

www.greenhouse.nsw.gov.au

www.northern.cma.nsw.gov.au

www.environment.nws.gov.au/resources/climatechange/08501Northcoast.pdf

Up to date information about temperatures, rainfall, weather patterns, potential evaporation, prevailing winds, weather warnings and lots more can be found on the
Australian Bureau of Meteorology website
http://www.bom.gov.au

Flood mitagation works

For an assessment of a floodgated system, location of acid sulfate soils, planning controls and management contact the staff at the
Clarence Valley Council floodplain services - Grafton Office
Phone: 02 6641 7350.

Fishing

There are a number of guidelines published to guide you in fishing responsibly, whether it is from a boat or on land.

Recreational fishing licences call 1300 369 365 or online at www.license.nsw.gov.au

Licenses available at most bait and tackle outlets.
Rules and regulations guides at www.industry.nsw.gov.au

Maclean Clarence District Fisheries Office
18A River Street, Maclean NSW, Phone: 02 6645 0500

Fishing Guides 2010 NSW Department of Primary Industries

The NSW Recreational Saltwater and Freshwater Fishing Guides are produced by I and I NSW.
www.dpi.nsw.gov.au/fisheries/recreational/info/guide

Aquaculture information
www.dpi.nsw.gov.au/fisheries/aquaculture

Agriculture and grazing

Grazing the Coastal Floodplain a free NSW DPI Publication with case studies of north coast floodplain graziers who have adopted sustainable farming practices (available from Clarence Landcare and DPI Office Wollongbar).

Pest Control

Contact for information on the regulations regarding pesticide usage (Pesticides Act 1999) and water pollution.

INFORMATION LINE 131 555
Email: info@environment.nsw.gov.au
Website: www.epa.nsw.gov.au

Caring for the Coast

The Coastcare program website has information and other resources about caring for the coast.
www.coastcare.com.au

Other resources and websites

Australian Seabird Rescue www.seabirdrescue.org

Surfrider Foundation www.surfrider.org.au

The importance of native vegetation

Native vegetation in estuarine environments is critical to bank stability considering the constant wind and wave action that washes against the banks. It also provides habitat for fish by providing structures and shading of the water. Where banks have little or no vegetation the rate of erosion is accelerated, especially during floods.

A range of different plant species occurs along the Clarence river estuary. Where they are located is largely dependent upon their geographic range and distribution as well as preferences for soil conditions and tolerances of different levels of inundation by salt or fresh water.

In the Clarence valley LGA, including lands within National Parks, State Forests and Crown Land, approximately 55% of the coastal plains are covered in some form of vegetation. About 38% of this vegetated area is within the public land estate, the rest is spread across private lands. About one quarter of private lands (about 30,000 ha) are covered in some form of vegetation (Biodiversity Management Strategy, CVC, 2010)

Significant freshwater and saline wetlands occur within the coastal floodplains, most commonly associated with the Clarence River and valley. Vegetation formations in the coastal plains landscape include dry sclerophyll forests, forested wetlands, freshwater wetlands, grassy woodlands, heathlands, wet sclerophyll forests and rainforests. Littoral Rainforest occurs only on the coast, is very rare and occurs in small stands. In total, it comprises less than one percent of the total area of rainforest in NSW. The largest known stand occurs in Iluka – a World Heritage listed rainforest which is about 136 hectares in size. Many areas of vegetation on the coastal plains are part of important north-south coastal migratory and east-west elevation corridors that link significant areas of habitat and link the midland hills to the coastal plains.

Ecological communities are important features of the floodplain, coast and estuary. Most of the vegetation remaining on the coastal floodplains has been listed as a threatened ecological community under the Threatened Species Conservation Act 1995. The coastal plains landscape supports 11 threatened ecological communities. These communities have all been highly cleared, with an estimated 10% (or less) remaining. Many of the estuarine and saline wetlands that occur on private land have been degraded.

The estuaries (Clarence, Wooli Wooli and Sandon) provide important habitat for a variety of waders, shorebirds, fish, crustaceans, other invertebrates and marine vegetation. In addition, this environment sustains a regionally significant recreational and commercial fishing industry.

Threatened Ecological Communities

The coastal plains landscape supports 11 threatened ecological communities. One of these is listed as critically endangered on the Environment Protection and Biodiversity Conservation Act 1994: Littoral Rainforest and Coastal Vine Thickets of Eastern Australia.

Another ten communities are listed as endangered under the NSW Threatened Species Conservation Act 1995.

Coastal Saltmarsh in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions.

Coastal Cypress Pine Forest in the New South Wales North Coast Bioregion (endemic).

Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions.

Littoral Rainforest in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions.

Lowland Rainforest on Floodplain in the New South Wales North Coast Bioregion.

Sub-tropical Coastal Floodplain Forest of the New South Wales North Coast Bioregion.

Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions.

Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions.

Themeda Grassland on Seacliffs and Coastal Headlands in the NSW North Coast,Sydney Basin and South East Corner Bioregions.

(Source Clarence Valley Council Biodiversity Strategy, 2010)

Currently, nine wetlands in the Clarence Lowlands (IBRA sub region) are listed in the Directory of Important Wetlands in Australia (DIWA). These include Alumy Creek/Bunyip Swamp, The Broadwater, Clarence River Estuary, Bundjalung National Park, Cowans Pond, Everlasting Swamp, Lower Bungawalbyn Creek, Tuckean Swamp and Wooloweyah Lagoon (Environment Australia, 2001).

Some of the remaining freshwater wetlands on the floodplains, although mostly cleared, still function as wetlands. However, most have been drained or cleared and filled and no longer function as water storage bodies.

Habitats of the Estuary

There are many different habitat types in estuaries, including: mangroves and saltmarshes, sea grasses and open waters, inter-tidal mud flats and mud basins, sandy shoals and beaches, rocky shores and reefs; and fresh water wetlands and floodplains.

The following describes some of the critical estuary habitats found on the Clarence Estuary. These habitats are important because they help maintain the health of the estuary. Many privately owned coastal properties and public foreshore areas contain these ecosystems. The existence of these area is already threatened and it is important that they are protected.

Sometimes funding assistance is available for managing these areas; for example as part of a sustainable farming enterprises - stock management fencing and weed control in riparian and forested areas.

The Mangrove Environment

The word Mangrove has evolved over the centuries to refer to at least 90 species of trees and shrubs (few of which are related to each other) and also the general habitat. Mangroves vary in size and appearance but are alike in that they occupy the fringe of intertidal shallows between the land and sea, and have the ability to withstand regular fresh water and salt water flooding. There are 29 mangrove species in Australia and five species of mangroves are found in NSW.

Mangroves are habitat for a rich and concentrated array of marine animals and birds. They act as a nursery for juvenile fish, help stop erosion of the shoreline, and produce large amounts of organic matter used in the food web of the estuary. The creeks which wind through mangrove forests are also important habitat to fish.

River Mangrove *(Aegicerus corniculatum)*

Grey Mangrove *(Avicennia marina)*

Mangroves of NSW

Common Name	Scientific Name	Distinguishing Features	Approx. NSW Range
Grey Mangrove	*Avicennia marina*	Large tree, peg roots, dull grey leaf under- surface	Entire Coast
River Mangrove	*Aegiceras corniculatum*	Shrubs in dense thickets, salt on leaves	Tweed River to Merimbula River
Blind Your Eye or Milky Mangrove	*Excoecaria agalllocha*	milky sap	Tweed River to Manning River
Red or Stilted Mangrove	*Rhizophora stylosa*	stilt roots, long curved, smooth fruit	Tweed River to Corindi River
Large – leaved Mangrove	*Bruguiera gymnorrhiza*	knee roots, long straight ridged fruit	Tweed River to Clarence River

Many mangroves are submerged twice daily by tidal salt water, and have evolved to grow in this harsh environment. Mangroves have evolved three main processes to cope with salt. Grey and River Mangroves, concentrate and exclude salt through special glands on their leaves. Rain then washes the salt deposits from the leaves. Salt excluders have special tissues in their roots and in their lower stems which act as barriers to salt. All mangroves of NSW exclude salt to some extent.

Some, such as Milky Mangrove, accumulate salt in older tissues which are then shed as they become laden with salt. The Grey Mangroves have peg roots (pneumatophores). These specialised structures protrude above the mud bottom as open- ended pipes that allow air to diffuse from the water to the shallow subterranean roots of the plant.

Samphire *(Sarcocornia quinqueflora).*

Saltmarshes

Saltmarshes generally occur on the landward side of mangroves, where tidal inundation is regular but infrequent. Both Mangroves and Coastal Saltmarsh are an endangered ecological community (EEC) in northern NSW and are found throughout the Clarence estuary including many of the river islands and public and private lands. Saltmarsh is mostly recognised by a low mosaic of salt tolerant grasses, herbs, and sedges which sometimes extends as groundcover into adjoining forests. On the north coast, salt marshes are characteristically dominated by a few plant species including Red Samphire (Sarcocornia quinqueflora), Saltwater Couch (Sporobolus virginicus) and Marine Couch (Paspalum vaginatum). Saltmarsh can include a mosaic of different habitat types (such as tidal pools, rush meadows, herb fields, and mudflats). The plant communities of saltmarshes often occur in distinctive zones, determined by a complex interplay of factors which includes tidal scour on seedlings in the lower limit of the saltmarsh, competition with mangroves for light, competition between species, soil type, salinity, gradient and inputs of freshwater (Clarke and Hannon 1967 – 1971).

Studies have shown that 19 species of estuarine fish used the saltmarsh habitat, eleven of these being commercial importance (Moreton et al, 1987).The most common fish were Yellowfin Bream, Flat tailed Mullet, and Fantail Mullet. Saltmarshes provide organic matter to estuarine food chains. They also help maintain estuarine water quality by filtering sediment from land based runoff.

Saltmarsh has a rich diversity of species.

The presence of insects and small vertebrates in saltmarshes attracts water birds such as herons, bitterns and egrets and waders to these areas eg; Bush Stone Curlew, Double banded Plover, Greenshank, Bar –tailed Godwit and Sharp – tailed, Pectoral and Curlew Sandpipers (Kingsford,1991). Some bush birds such as the White-fronted Chat also feed and nest within saltmarsh vegetation. Perhaps the greatest threat to saltmarsh areas is land reclamation. Saltmarshes have in the past been viewed as unproductive, unsightly and untidy areas that can be ‘put to better use’. Many saltmarsh areas have disappeared as a result of filling and urban development and reduction of area due to the impact of levees, roads, rural and agricultural industries.

Another possible threat to saltmarsh areas is sea level rise. A government funded project conducted by WetlandCare Australia identified that increased relative sea level is likely to pose an ongoing threat to saltmarsh. Some saltmarsh sites will be able to migrate into terrestrial habitat areas however other sites are constrained by natural topography or developments like roads, urban areas, agriculture, and levees. Some saltmarsh sites are already on the highest local land or on estuarine islands that will eventually submerge if sea level rise continues (Cibilic, A. 2010).

Swamp Forests

Swamp forests which are generally located adjacent to wetland areas, present the most inland habitat directly connected to an estuary. Swamp forests provide organic matter to the estuary (as detritus) and contain many terrestrial species of wildlife, as well as aquatic organisms. They also form buffer strips between the hinterland and the water. Swamp forest trees consist principally of Paperbark and Casuarinas eg; Broad – leaved Paperbark and Swamp Oak. Eucalypts such as Swamp Mahogany are also common.

Swamp Forest.

A number of ground dwelling mammals, aerial feeders such as bats and reptiles Red bellied Black Snake, Carpet Python and Land Mullet also live in Swamp Forests. The Broad –leaved Paperbark *Melaleuca quinquenervia* provides a significant food source for these animals. It is likely that Northern NSW stands of Paperbark are extremely important overwintering sites (Nix, 1976).

Wetlands

An area doesn't need to be permanently wet to qualify as a wetland. It just needs to be wet long enough for its plants and animals to be adapted to - or even dependent on - wet conditions for at least part of their life cycle. Many wetlands on the Clarence River, floodplain and estuary are seasonally wet or dry and can range from small or large, fresh, saline or brackish. This covers a wide range of habitats, including lakes, lagoons, estuaries, rivers, floodplains, swamps, bogs, billabongs and marshes.

Besides serving as important habitat for wildlife, the wetlands that fringe estuaries also perform other valuable services. Water draining from the catchment carries sediments, nutrients and other pollutants. As the water flows through the marshes, much of the sediments and pollutants are filtered out. This filtration process creates cleaner and clearer water which benefits both people and marine life.

Comb-crested Jacana. Image courtesy P. Kenway.

Wetland plants and soils act as a natural buffer between land and ocean, absorbing flood – waters and dissipating storm surges. This protects land based organisms as well as valuable real estate from storm and flood damage.

Seagrass

Most NSW estuaries have some cover of seagrass. Barrier estuaries (an estuary featuring a sand barrier at the mouth) contain the largest seagrass beds. The Clarence River, one of four such estuaries), accounts for 15% of the total area of seagrass in NSW. (NSW DPI Primefact 629 2007)

Generally, seagrass meadows occur in the intertidal and sub – tidal zones of relatively shallow, sheltered inshore areas, typically in bays, estuaries, saline lagoons and lakes. The substratum in which seagrasses grow is typically soft sediments consisting of any combination of sand and mud. The distribution of seagrasses is influenced by light intensity, which is required for photosynthesis. Therefore, depth and turbidity play an important role in the local extent of seagrass meadows.

The cycling of organic matter and nutrients by seagrasses especially via the detrital food chain is crucial to biological productivity and population numbers within estuaries. They also provide a variety of habitats, shelter for juvenile fish species and facilitate substrate stabilisation. Seagrass beds are quite fragile and are susceptible to many of the modern day pressures on estuaries Point source pollution, dredging, large scale removal or periodic harvesting can have a devastating affect on seagreass beds. Once seagrass beds are lost, they do not necessarily recolonise quickly. (http://www.dnr.nsw.gov.au/estuaries/index, 2006).

Coastal Wetland.

What is riparian vegetation and why is it important?

The riparian area is commonly defined as the land alongside creeks and rivers, including the riverbank itself. Riparian vegetation grows next to a waterway, whether it is a gully, creek, swamp, wetland, river, fresh or saline.

The riparian areas of the Clarence River floodplain and estuary were once 100-400 m wide and covered in Riverine rainforest. Within 10 years of European settlement, much of these areas were cleared during the late 1800's. The timber - getters cleared the cream of the timber along the Clarence River before moving on to the 'Big Scrub' along the Richmond River to the north. The cedar crews were followed by the settlers who established communities and cleared remaining vegetation for income whilst establishing grazing and agricultural enterprises.

Today, there is increasing pressure on riparian areas and land managers face the difficult task of balancing the needs of private landholders, industries and community whilst ensuring the integrity of riparian areas.

Riparian areas are widely recognised as being critically important to a range of terrestrial and aquatic ecological processes and the community's wellbeing. There are many threats to riparian condition on the floodplain and estuary due to an increase in population, clearing of vegetation for agriculture, weed encroachment, and urban development.

The main problems are associated with the lack of appropriate riparian vegetation and the management of what is remaining and the water quality available for agricultural use and fish habitat. Bank slumping, soil erosion, excess nutrient inputs, weed infestations, acid sulfate soils and stock management near water are common issues. Stock impacts and diminished vegetation contributes to bank slumping and erosion, the loss of land generates sedimentation and water quality problems. Good vegetation on waterways would include a mix of plant heights and species – one or two trees in a section of the bank is not sufficient for stabilising it.

A permit is required from the Department of Water and Energy and NSW Fisheries (see contacts section) for development of any kind on a riverbank/waterway or removal of vegetation including some weed species - a rehabilitation plan is required.

Landcare often works with landholders and in partnership with the various stakeholders on the floodplain and estuary projects. Many areas have a combination of private and public land use issues so a collaboration of expertise is often required to achieve the best outcomes for riparian management. There are many examples of landholders altering land management practices to benefit river health and potentially increasing farm profitability.

Measures have included rotational grazing and stock exclusion from riparian zones which can lead to increased pasture growth, increased dominance of perennial species, reduced weeds, reduced erosion and run off and improved stability of riverbanks (see project example in chapter 6).

There are excellent publications and fact sheets all about riparian vegetation but for specific assistance on management of your riparian areas it is best to contact the Northern Rivers CMA, Clarence Landcare Office or Clarence Valley Council. In April 2010 the Clarence Valley Council Riparian Action Strategy was adopted. Funding is sometimes available to assist landholders with riparian works, in the form of fencing and alternate watering points for stock, weed control and revegetation projects.

There are free species lists available to assist you in a replanting exercise, however, allowing an area to regenerate if possible is also an option. Plants used for revegetation should come from a reliable local source - propagated from seed collected in your area.

Riparian vegetation fringing Lake Wooloweyah, Forest Redgum in foreground.

To provide benefits, wherever practical, a vegetation buffer of at least 10 m wide should be maintained along streams. This should be fenced (plain wires, as barbed-wire is more likely to catch vegetation during floods and wash away the fence) and off-stream water supplies provided. This does not mean that stock can't graze the fenced-off area, but only that their access is controlled. Stock are useful to reduce grass and weed growth at appropriate times.

The Northern Rivers Catchment Management Authority (NRCMA) and other organisations provides funding opportunities to landholders for riparian management (fencing, off-stream water supplies, replanting, etc) and should be the first port of call to find out what is available. Your local NRM Community Support Officer can also put you in touch with others who have practical knowledge with riparian management, as well as inform you of current training and funding opportunities.

Why Fish Need Trees on the Clarence River Estuary

Estuarine habitats are dynamic and continually changing ecosystems. Essentially they are the junction of freshwater rivers and the ocean. Estuarine waters are generally described as saline or brackish and they are the habitats, spawning grounds, and nursery areas for many marine species including those that may even spend the majority of their adult lives out a to sea or well upstream in the freshwater reaches.

Mangrove Forests are permanent or temporary habitats for many aquatic animals. When the tide rises and submerges the mangrove flats, fish move in to find food and shelter amongst mangroves – species such as Herring, Mulloway, Bream, Luderick and Flathead. The mangrove forest floor is habitat for a large number of invertebrates such as prawns and crabs.

Undisturbed natural vegetation on rivers, lakes and streams has the capacity to:

- Trap sediment, nutrients and other contaminants before they reach the waterway.
- Reduce rates of bank erosion – the roots of trees and other vegetation work to bind and reinforce soils.
- Ensure healthy ecosystems.
- Provide a source of food and habitat for aquatic and terrestrial species.
- Provide important locations for conservation and movement of wildlife.
- Keep light and temperature at natural levels through shading – essential for healthy and productive aquatic ecosystems. Dissolved oxygen concentrations decrease as temperature increases – this can limit plant and animal life and possibly contribute to fish deaths.
- Provide recreation and aesthetically pleasing landscapes.

Microscopic fungi and bacteria break down mangrove leaf litter then detritus feeders such as Mullet, prawns and crabs eat this decomposing material.

Riparian areas are places where land, water, vegetation and animals - including humans, interact. Healthy vegetation is vitally important in all waterway situations whether it be a freshwater or saline environment.

The benefits of Undisturbed natural vegetation on rivers can only be achieved through careful vegetation management. Clearing of vegetation on waterways leads to degradation – fragmentation of habitat, increased nutrient and sediment loads, loss of biodiversity, bank instability, and invasion by exotic weeds. Removal of trees and other vegetation can also reduce the beneficial inputs of leaf litter, fruit and insects that are important to fish and other animals.

Mangrove and saltmarsh regeneration on private land along Shallow Channel.

Protecting, maintaining or restoring native vegetation

There are numerous proven incentives for protecting vegetation on your property. Maintaining ground-cover and riparian buffers increases soil productivity, water retention capacity and maintains soil nutrients and less chemicals are required for productivity or to suppress weeds. The Native Vegetation Act 2003 regulates all land clearing activities and The Fisheries Management Act 1994 and Rivers Foreshore Act regulate any activity in the riparian zone, refer to Chapter 7.

Landholders who wish to clear native vegetation on their land must apply for a Property Vegetation Plan (PVP) or Development Consent (DC) from the Northern Rivers Catchment Management Authority (NRCMA). These will outline the plans for the clearing of native vegetation on a property. Staff from the NRCMA can provide advice to landholders on their obligations under the Act. Clearing any land can have major effects on the catchment. You must also consult your local DECC officer about places of significance aboriginal and/or fauna and flora before applying for a permit to clear.

In October 2010 a Biodiversity Strategy for the Clarence local government area was adopted.

The Clarence Valley Biodiversity Management Strategy is an important strategic document which considers biodiversity at a broad landscape scale and aims to make clear what council is responsible for and what it plans to do to preserve the biodiversity of the region. It covers the full Clarence Valley LGA of approximately 10,500 square kilometres. The implementation of this strategy requires a change in the way we do things and the way we value ecosystem health within the Valley. While council and the wider community are active in some areas, the strategy proposes a number of new actions that will be required to prevent the decline in biodiversity. A net gain in native vegetation and education about the pivotal role biodiversity plays, are critical actions that council and the community will need to embrace if we are to protect our rich biodiversity for future generations. A comprehensive list of actions to stop the decline in biodiversity is contained in Part 3 of this strategy and maps of important wildlife corridors, threatened species lists and other information.

Resources and Contacts for Chapter 5

The importance of native vegetation

Aquatic ecosystems, river management, fish habitat, wetland management, native vegetation

Northern Rivers CMA
General enquiries Phone: 02 6642 0622
www.northern.cma.nsw.gov.au

Clarence Landcare Inc.
Phone: 02 6643 5009
www.clarencelandcare.com.au

Australian Government Land and Water Australia
www.rivers.gov.au

Clarence Valley Council
Phone: 02 6643 0200
www.clarence.nsw.gov.au/environment.

Wetland Care Australia
Phone: 02 6681 6069
www.wetlandcare.com.au

DECCW
Phone: 02 6641 1500
www.environment.nsw.gov.au

Fisheries and Aquatic Habitat websites

http://www.fisheries.nsw.gov.au/__data/assets/pdf_file/0015/5046/Saltmarsh-Fishnote-dec11.pdf

http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/veg1_home.aspx?name=Saline+wetlands

http://www.fisheries.nsw.gov.au/__data/assets/pdf_file/0015/5046/Saltmarsh-Fishnote-dec11.pdf

http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/veg1_home.aspx?name=Saline+wetlands

http://www.fisheries.nsw.gov.au/aquatic_habitats/aquatic_habitats/fishcare_-_saving_our_seagrasses_fishnote

http://www.fisheries.nsw.gov.au/aquatic_habitats/aquatic_habitats/fishcare_-_our_mangrove_forests

www.dpi.nsw.gov.au/primefacts

Habitats of the estuary

The NSW DPI publication 746, Mangroves and other aquatic habitat factsheets can be found at http://www.dpi.nsw.gov.au/fisheries/habitat/publications/protection/mangroves.

Wetland Resources

Aquatic and Wetland Plants - A guide for non tropical Australia, Romanowski, N.1998, UNSW press LTD.

Clarence Lowlands Wetland Conservation Assessment, 2008. A report on Wetlands in the Clarence Lowlands IBRA sub-region, DECC2008/564. ISBN 9781742320175.

NSW Natural Resources Departments website at http://naturalresources.nsw.gov.au/estuaries/what.shtml

http://www.environment.nsw.gov.au/wetlands/WhatAreWetlands.htm

Waterwatch http://www.environment.nsw.gov.au/waterwatch

What is riparian vegetation and why is it important?

Clarence Valley Council Riparian Action Strategy
http://www.clarence.nsw.gov.au/cmst/cvc009/

Australian Government Land and Water - publications at http://lwa.gov.au/products/tags/34

Industry and Investment Website fact sheets at http://www.dpi.nsw.gov.au/aboutus/resources

Trees for Cane Farms 2004 – 2008. Improving Native Vegetation on Sugar Cane Farms, Mousley, J., 2009. (booklet available from Clarence Landcare).

Northern Rivers CMA go to www.northern.cma.nsw.gov.au

Controlled Activity Permit - General enquiries line at the NSW Office of Water in Grafton Phone: 02 6641 6500

Protecting, maintaining or restoring native vegetation

Clarence Landcare works with private and public landholders to protect, maintain and restore native vegetation in all landscapes visit www.clarencelandcare.com.au

Northern Rivers CMA visit www.northern.cma.nsw.gov.au

Clarence Valley Council www.clarence.nsw.gov.au

Lessening the impacts - what you can do?

May 2008. Shows extent of erosion on channel bank (view low tide).

A project example - Romiaka Island:
fixing bank erosion and providing fish habitat

Accelerated river bank and channel bank erosion is a common problem in many of our estuaries. One of the main causes of this is the loss of the riparian forests that once fringed these waterways. These forests performed many functions including: Providing a wind break effect that reduced wind generated wave action; and providing roots that physically reinforced the banks. Perhaps most importantly, forests were a continuous source of large woody debris whereby whole trees and large limbs falling into the water created a screen of protecting 'snags' that absorbed wave energy in front of the bank and created the microhabitat required for mangrove seedling establishment.

In December 2008, a 50 metre trial site was established at Romiaka Island on the Clarence River estuary near Yamba on the NSW north coast that aimed to stop soil erosion and recreate fish habitat. This site demonstrated a technique of bank protection that provides a greater range of environmental benefits for fish and other aquatic species whilst addressing the loss of riverbank and other impacts of soil erosion.

The Romiaka Channel site was exposed to wind generated wave action. Sediment build up in the mid channel was also influencing the angle of wave energy and directing this more towards the exposed riverbank, particularly on the outgoing tide. Vegetation was limited to a few remaining trees, most of which were Camphor Laurel (which have shallow root systems) which were either in decline or had fallen into the estuary already.

December 2008. Construction of rock fillet 1 and 2 (view low tide).

Accelerated river bank and channel bank erosion is a common problem in many of our estuaries. One of the main causes of this is the loss of the riparian forests that once fringed these waterways.

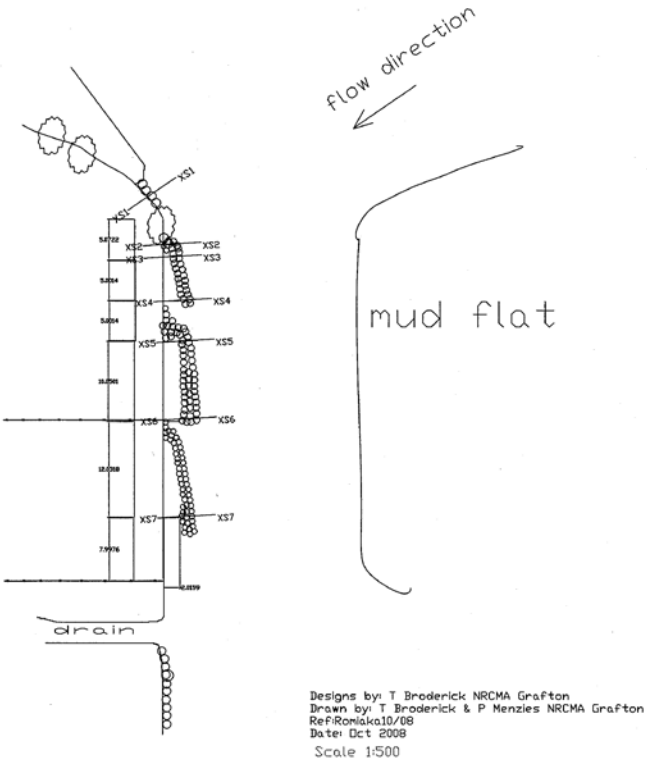
December 2009. Grey Mangroves established after construction of the wave dissipation rock fillet (view low tide).

August 2010. Rock fillets complete, mangroves establishing, riparian planting protected fish habitat and erosion control measures working (view mid tide).

Despite stock exclusion for a number of years to allow the mangroves to grow back, the bank erosion was accelerating due to the constant wave action which also washed any mangrove seedlings away, before they could establish adequately.

A mixture of large and medium sized quarry rock was used to build wave energy dissipation barriers, sometimes referred to as rock fillets. The rock fillets were constructed to the height of the mean high water mark in this case, 2 – 3 m high and about 2 m in front of the eroding bank. The rock walls absorb wave action and create an area of still water between the eroding bank and the wall which creates a suitable environment for mangrove establishment. The three rock fillets were also left open to allow water movement behind the walls and allow fish to move freely in the newly created fish habitat. Within months of the installation and having withstood the May 2009 flooding on the Clarence River, dozens of mangroves had self-seeded behind the walls. The upper bank which was previously planted out with trees and shrubs to create a 12 m buffer was also now protected from further erosion along with the stock exclusion fencing that had been shifted landward to accommodate the erosion situation.

This method of estuarine river bank protection effectively stops accelerated bank erosion and, where a seed source exists, mangroves will readily self establish. The inclusion of upper bank planting underlines the importance of aiming at full riparian rehabilitation, not just physical bank protection. The final result provides habitat for a range of aquatic and terrestrial fauna. (James, 2003)



Example Plan: a controlled activity permit and an approved site plan are required before any work can be done on riverbanks, estuaries or other watercourses. Removal of riparian weed species is also a controlled activity - a permit or a plan is required for strategic removal of weeds and appropriate revegetation of the area.

Northern Rivers CATCHMENT MANAGEMENT AUTHORITY

Clarence Landcare

clarence VALLEY COUNCIL

June 2008. Old stock and vehicle access areas through the saltmarsh; before rotational grazing fencing and the new stock crossing were built.

A project example - Romiaka Island Sustainable grazing: protecting saltmarsh, replanting riparian areas, protecting threatened species

Romiaka Island has been in the Burns family since the early 1900's. The first homestead on Romiaka was built close to the foreshore of the Clarence River estuary side of the Island. The family later relocated to the present home site on higher ground and closer to the dairy which was started in 1925 and operated up until the mid 1970's.

Yamba Road dissects Romiaka Island, located between the Romiaka and Shallow Channel bridges. As traffic to and from Yamba increased from the 1970's onwards, moving the livestock herd to the Clarence riverside paddock had become increasingly risky and difficult. Eventually this practice was ceased which also allowed grazing pressures to be alleviated from this part of the island. Effectively, this simple act of ceasing to graze the riverside paddock became the very first step towards recovery of the natural values of the island, a consequence of the changing social and economic landscape of the day and the Burn's acceptance of the situation at hand. The dairy no longer operates but cattle raising is still a viable farming enterprise on Romiaka.

After many decades of continuous traditional grazing regimes, the island's natural resources were however, facing serious problems if change was not implemented soon. The quality of pasture, the viability of fish habitat on the 80 ha island's perimeter; the important vegetation communities were becoming weed infested and the coastal wetlands were in decline. Erosion was also occurring at an alarming rate on the Romiaka Channel.

August 2009. Old crossing area; 12 months after stock exclusion.

Increased land clearing elsewhere in the catchment was also contributing to siltation and sediment movement into the river channels. This created new patterns of wave energy distribution onto the riparian areas of the Romiaka Channel which now had little vegetation in some areas, to withstand erosion.

In 2005 Bill Burns sought assistance in assessing the various problems and a range of actions have steadily been implemented. To prevent cattle from eating the mangroves the island perimeter was fenced. This allowed the regeneration of mangroves, salt marsh and other riparian vegetation and consequently the rehabilitation of fish habitat and improved riverbank stability on much of the island. Bill joined Clarence Landcare and developed an understanding of sustainable farming practices through attending courses, field days and talking to other landowners who were implementing changes to their floodplain grazing enterprises.

December 2010. Old stock crossing area recovered.

In 2007 a plan was developed with support from the NRCMA and Landcare with the aim of achieving a balance between land capability and production. By December 2008, conservation zones were fenced off from livestock, rotational grazing paddocks were set up, a stock crossing was built across sensitive salt marsh areas and a camphor laurel and weed management control program was established. In addition to this, a fish friendly erosion repair method was established on the Romiaka Channel with support from CVC, NRCMA and Landcare where the worst erosion was occurring.

At the same time Romiaka Island was undergoing repair CVC, NRCMA and WetlandCare completed the Shallow Channel opening project which saw tidal water flows returned to the estuary along with many ecological benefits perceived for the health of the tidal waterways on Romiaka Island as well as many other parts of the Clarence estuary including Lake Wooloweyah.

As a result of all these changes in land management the mangroves have grown back on the edges of the island, the salt marsh and coastal forest communities are regenerating, weed infestations have been reduced. Local native trees have been planted for stock shade and shelter or to link remnant forests and improve riparian condition, stock management and pasture condition has improved. Most importantly, the landowner is very happy with how Romiaka Island is responding to these changes and that with continuing sustainable natural resource management this will be of benefit to present and future generations on the Lower Clarence.

December 2010. Managing stock access; the new stock crossing was built in November 2008.

Trees planted in April 2010 as part of a Caring for our Country Community Action Grant.

Soil runoff into the Clarence River.

Turbidity - managing soil runoff

Extreme rainfall events carry runoff from the land to the estuary, lakes and lagoons, causing aquatic life to be inundated with high nutrient and sediment loads. This has major implications for areas of the north coast where there is high climate variability, heavy rainfall events and prolonged periods of drought are common. Depending on the type of activity there are a number of ways to stop soil and other material washing off into waterways. Whilst erosion and deposition of sediment are natural river processes, the accelerated rates of erosion today have resulted primarily from the removal of native vegetation over time. The examples presented here are directly related to the section on riparian vegetation but can extend to any exposed or vulnerable areas of bare earth.

If you are building, a sediment and erosion control plan can include a number of practical on site measures to stop run-off into waterways. You can limit the entry points on the building site to one point and stabilise this area; strip and stockpile topsoil; install sediment fences below the site; re-spread topsoil and vegetation on all bare areas are just a few of the components that should be included in a sound erosion control plan. Contact the Clarence Valley Council for information on erosion control plans.

Dumping unauthorised material into a waterway in an attempt to prevent bank erosion can lead to friable material being washed away, causing pollution and damage to natural ecosystems. It is important to ensure that the design of any bank stabilisation works is appropriate for the site and all relevant approvals are obtained before undertaking any work. You are breaking the law if you do not have a permit and an approved design to carry out bank protection works. Dumping material on the riverbank, within the river or any part of the estuary is illegal. This also applies to dune landscapes in the coastal zone.

On farm: there are a number of successful techniques that have been trailed in the estuarine environment for stabilising the river bank. It is always advisable to seek advice and in some cases funding opportunities before proceeding with any kind of stabilisation works.

Managing weeds in riparian areas

Riparian corridors are particularly susceptible to weed invasion and are often invaded by multiple weed species. This susceptibility to invasion is a result of the natural disturbance processes associated with flooding, favourable environmental conditions and the continued input of weed propagules from upstream and adjacent areas. The impacts of human activities have also increased the likelihood of weeds establishing in riparian areas. However, well designed weed management programs can achieve positive outcomes in riparian areas.

Why care about weeds?

28,000 plant species have been introduced to Australia since European settlement. This is more than the total number of native plant species - 25,000 (source Weeds CRC, 2005). Over 2500 of these introduced plants are now established in the wild, and this is increasing at 10% per year, 65% of these established invasive plants have escaped from parks and gardens, and many are still traded. Of the 460 pastures and legume species trialled in northern Australia between 1947-1985, 21 proved useful and 60 became weeds – 13 of these are now serious crop weeds. Others have become serious threats to the ecology of Australian landscapes. The cost of weeds to Australian agriculture now exceeds $4 billion per year - no estimate has been made of the cost to the environment.

Environmental weeds are plants that invade natural areas. Some of the effects of environmental weeds are that they: impede or suppress natural vegetation; prevent regeneration of indigenous plants; disrupt or displace native animals; and create habitat for pest animals. Environmental weeds are the major threat to conserving, restoring and rehabilitating native vegetation on the north coast. Generally, plant communities will naturally regenerate if weeds are suppressed: weed management is a primary tool for conserving native vegetation.

Invasive plants and pests are second only to clearing as a cause of biodiversity loss. Invasive plants out-compete natives, change the habitat, and force out the Australian animals and birds. This can lead to local extinction of rare plants and animals. Invasive plants threaten the integrity of some of our most valued places.

The Northern Rivers Invasive Plant Action Strategy is one of the first documents of its type to pull together the needs of various weed managers; and to facilitate a coordinated and catchment approach to invasive plant management. It recommends actions which will enable a strategic approach to the management of weeds, and their capacity to rapidly establish, travel downstream of catchment's headwaters, and spread across regions. This strategy emphasises the importance of preventing new weeds from establishing and the need to respond quickly to incursions as these are the most cost-effective techniques for managing weeds. The document is available from local councils and the NRCMA offices and website.

Giant Arundo (Arundo donax), pictured which does little to prevent bank erosion is a tall, reed like ,non-native species. Phragmites australis is a smaller, native, reed species that is beneficial to have growing at the toe of the bank.

There are no guides that cover all the weeds of the north coast. Hence, it is often most efficient to have one of the following advisors identify the weeds and provide management advice:

- Agronomists and horticulturists in NSW DPI (agriculture) for pasture and cropping weeds;
- Noxious Weeds Officers located in councils for noxious weeds CVC 02 6643 3820
- Private consultants (see "Environmental and "Natural Resource Consultants" in the yellow pages)
- Landcare Community Support Officers for all types of weeds www.clarencelandcare.com.au or call 02 6643 5009

Bush regenerators removing invasive vine weeds from native vegetation at the start of the The Lower Clarence Riparian Rescue project, 2004.

A project example - The Lower Clarence Riparian Rescue: vine weed infestations on the Clarence Estuary

This project which tackled massive vine weed infestations on the Clarence Estuary and at Shark Creek on the South Arm of the Clarence commenced in 2004 as a combined Landcare and local council approach to recover riverbank vegetation. A major challenge was to remove invasive vine species such as Morning Glory and Madiera Vine that were smothering and pulling down riparian vegetation on the Clarence Estuary near the Harwood Bridge, James Creek. The project engaged a contract bush regeneration team to carry out the initial weed control and a community planting day was held to establish locally grown riparian plants to fill the gap and aid natural regeneration of the site.

At the South Arm project site, extensive weed control and riverbank revegetation was carried out by the Shark Creek Landcare group. The Landcare group also collected local native seeds and propagated the majority of plants used in the projects.

Bush Regeneration

Bush regeneration involves the control of weed species in situations where the recovery of native vegetation (rainforests, riparian areas, remnant bushland etc.) requires careful treatment and specific outcomes. Bush regeneration is usually carried out by experienced operators who are able to assess and implement the required weed control, usually in accordance with a management plan that is prepared for the areas rehabilitation. Bush regenerators often work in teams of 2 – 4 people depending on the extent of the work and will use various methods to achieve the weed control without harming the native vegetation or causing erosion. Initial work often requires follow up treatment to control emergent weeds – the soil beneath large weed infestations (eg; camphors, cockspur coral tree, privet, lantana, vine weeds, etc.) can be full of weed seed or propagules along with native species.

Vine weeds such as cat's claw creeper have a serious network of underground tubers that can grow back even when the vines are removed or cut. Other weeds may have varying survival mechanisms - making their control difficult and costly eg; Mother of Millions can grow from a single leaf that falls to the ground. Be sure to remove all weed seed and potential growth from the site to help prevent the re establishment of weed species.

A local community planting day helped to establish native trees after the initial weed control work was completed.

If you have noticed certain plants are taking over your patch of bushland, wetland, rainforest, river or creek bank then seek advice on the situation as soon as possible. There are various funding opportunities available for landholders who wish to undertake activities that control the spread of invasive plant species.

For bush regeneration advice and contacts see Landcare offices or Local Councils. There are various publications which cover how to identify and control weed species (available on the websites listed in the Resources and Contacts section).

The same riparian area in 2010 with trees well established.

Invasive weed Maderia vine *(Anredera Cordifolia).*

North Coast Floodplain Network field day at Lake Wooloweyah. Image courtesy Simon Walsh, NSW I & I.

A project example - The Clarence Floodplain: floodgates, drains and fish passage restoring the balance

The Clarence Floodplain Project was established in 1997 with the aim of improving the environmental management of Council's flood mitigation infrastructure and addressing some of the past impacts of flood mitigation on floodplain ecosystems.

Flood mitigation works have been carried out for over a century on the Clarence, particularly in the 1960s and 1970's. Over the years many extensive drainage systems and hundreds of floodgates and other structures have been constructed. Their purpose is to provide protection from floods in both urban and rural areas. Better drainage has also increased agricultural productivity on the floodplain.

Flood mitigation has had some adverse impacts on coastal floodplains. A combination of drainage and blockage of natural creek systems has often led to poor water quality, fish kills, and reduced habitat for fish and other aquatic species. In some areas over-drainage has resulted in acid problems in waterways, and the loss or drying out of some natural wetland areas.

Management of the project

The project is coordinated by a steering committee made up of members who represent landholders, the fishing industry, the cane industry, community groups, the Council, the Catchment Management Authority and NSW government agencies with a role in resource management on the floodplain. The Clarence Floodplain and Estuary Partnership group meets around four times per year to discuss any issues and prioritise future actions.

Clarence Valley Council staff work closely with landowners to develop management plans for creeks, drains and wetlands. Landowners often become authorised 'floodgate operators' and manage the systems once works are completed.

The success of this project has largely been due to the help and cooperation of landowners, who have made a major contribution towards this project.

Before and afters photos of an acid scald at Edwards Creek remediated by ponding. Images courtesy CVC.

Benefits of the project

Benefits from active management are usually a combination of the following:

- increased tidal exchange to improve water quality
- improved passage, habitat and breeding areas for fish and other aquatic species
- reduced risk of fish kills
- better control of introduced aquatic weeds
- reduced incidence of algal blooms
- neutralisation of acid water in creeks with salt water from the river
- raised watertables in acid sulfate areas (limiting further oxidation)
- improved drainage following floods
- better water retention and water level control on wetland areas
- increased grazing productivity on previously drained wetlands during drier months of the year
- improved waterbird habitat
- better control of ground water levels
- stabilised bank erosion
- stabilised stock access points and exclusion of stock from unstable banks (areas where they are likely to bog)

Who to call if Acid Sulfate Soils are a problem

Your first contact should be with your local council to request some advice as to how to proceed if you believe you are dealing with an acid scald or potential problem.

On-ground works

Recent advances in floodgate engineering have allowed flood mitigation structures to be modified to reduce impacts on watercourses in non-flood times, while still providing flood protection.

A wide range of structures have been used to open floodgated watercourses to the river or manage water levels. These include tidal floodgates, winches to lift floodgates, 'fish flaps' in weirs, and a range of water retention structures that can be used to raise water levels.

Since the project began in 1997 more than 200 km of waterways have been opened up and restored. Some 250 landowners have been actively involved in the management of creeks and drains, and more than 60 drain and watercourse management plans have been put in operation.

For more information on this project please down load the following document - Clarence Floodplain Project Overview at http://www.clarence.nsw.gov.au/content/uploads/Clarence_Floodplain_Project_Overview.pdf

For assistance in restoring or protecting your floodplain property, contact Clarence Valley Council and/ or the Clarence Landcare office.

Australian Bass captured and tagged for fish track project. Image courtesy D. Repschlager.

A project example - Clarence River Fish Track: effects of flows and barriers on the distribution of freshwater fish in the Clarence River system.

Many Australian native freshwater fish move within their rivers at different times of the year. Movements can include large scale migrations from fresh to saltwater to spawn or smaller movements within river reaches as individuals locate to alternate habitats or feeding areas. Many of the species present within the Clarence system need to move to complete their life – cycle. It is important to understand the seasonal distribution and movements of key species in relation to barriers, flows and spawning to ensure they are managed effectively. The Clarence River Fishtrack project involves seasonal (summer and winter) sampling of fish communities (since 2006), radio tracking of Eel-tailed Catfish habitat use and acoustic tracking of five freshwater fish species to learn more about fish movements and behaviour. An array of acoustic receivers or 'listening stations' extending from the lower Clarence estuary to the upper reaches of various freshwater tributaries have been monitored to track the movements of Australian Bass, Eel-tailed Catfish, Freshwater Mullet, Sea Mullet and Eastern Freshwater Cod.

The project has already revealed that seasonal migrations were undertaken by Australian Bass and the two Mullet species tagged, with a number of individuals travelling up to 300km downstream to the estuary before returning to upstream reaches, some months later. Some Bass were found to have travelled over 1,000 km in less than 2 years. Most Bass were found to return to the same system, with some individuals returning to the same pool where they were first caught and tagged. Generally, the larger scale migrations and movements of all five species were triggered by increases in river flow, but not in all cases. Movements upstream and downstream were also often impeded by instream barriers, with fish using increases in flow to move over or around waterfalls and a man- made weir (Source NRCMA Clarence River Fish Track brochure, 2010).

For further information on this project contact:

Catchment Officer NRCMA Grafton office
Tony Broderick: Phone 02 6642 0622

Aquatic Ecosystems Research NSW land
Brad MacKay: Phone 02 6640 1680 or
Gavin Butler Phone 02 66 401671

Managing Salinity

Human activities in the upstream reaches of coastal catchments can alter critical components of the marine and freshwater flows which are essential for maintaining healthy estuaries. Reservoirs and diversion structures such as dams, weirs and barrages, and direct pumping of water from the stream channel for domestic, industrial and agriculture can directly alter the magnitude and variation of water flows. The removal of riparian buffers, clearing of native trees and expansion of urban areas can also change the rainfall run-off. These are the elements which can contribute to high salinity levels within the estuary. Good farm management makes sense, protecting the systems that support the estuary help to nurture your land and protect the health of the environment.

Preventing water pollution what you can do?

'Pollution, the difference is you' and 'the drain is just for rain' are familiar government slogans for what appears to be self evident. But perhaps you have not considered whether all your daily activities are sound.

Wash your car on the grass: If you wash your car in the street or on your driveway, detergents, mud, oil and grease can wash directly into the stormwater system. Many detergents contain phosphates which over- fertilise waterways and can lead to a build up of toxic algae which is harmful to fish and humans too. Try and use environmentally friendly products in the household and dispose of any chemicals correctly Check the council website for advice or visit http://ww.cleanout.com.au.

Sweep them up before they wash away: Even natural things like leaves, garden clippings and soil can harm our waterways. In bushland or in our gardens, leaves are scattered and decay where they fall. But when they are washed into the stormwater system they become concentrated – imagine the impact of all the leaves and dirt in all the streets from five kilometres around washing directly into your local waterway. When leaves and clippings decay in water, they use up oxygen. Taking oxygen away from the water can kill plants, fish and other animals that live in our waterways. Soil is a problem too. It makes waterways cloudy and can silt them up. Silt can suffocate fish by clogging their gills - see the section on turbidity.

Put leaves in the compost or on the garden as mulch. Rake up grass clippings then mulch or compost them. Cover piles of soil, sand or mulch to stop them washing into drains.

Build barriers around your garden beds to contain the soil (and any fertilizers you are using). Plant grass or groundcovers where soil is exposed.

Making your business fish friendly

As a local business owner, is imperative to dispose of wastewater to reduce the risk of pollution and give your business a cleaner, greener image. Under the Protection of the Environment Operations Act 1997, you can receive an on-the-spot fine of $1500, if you allow anything other than rainwater to enter a gutter or stormwater drain. Portable bunds can be used to direct wastewater away from stormwater drains. Bunds are textile tubes filled with sand or other impermeable material. For suppliers see under 'Oil and Chemical Spill Recovery or Dispersal' in the Yellow Pages.

Biodegradable products, like certain detergents are designed to breakdown in the sewage treatment process. They should never be allowed to run into the stormwater drain.. It pays to be informed about all chemicals that you use for the home, garden, on your pets or your business. As an example, when washing a pet dog, many flea rinses contain diazinon, chlorpyrifos or an anticholinesterase compound which should never be allowed to drain into a waterway. These chemicals do not break down in the sewage treatment process and kill aquatic organisms. Half a teaspoon of these compounds can kill everything in an area the size of an Olympic swimming pool. It pays to be informed about all chemicals that you use in your garden, home, on your pets or in your business.

Wastewater Management

Wastewater enters rivers and estuaries from many different sources. It includes run off from urban and agricultural areas, overflows from septic systems, discharges from sewage treatment plants, and sewage overflows, sewage discharges from boats (HRC, 2000).

If you are intending to install or upgrade an existing on site sewage management system, there are a number of factors that need to be considered. These include soil type for potential dispersability, and permeability; soil depth due to shallow soils limiting soil residence time and ability to absorb, transform and promote vegetation uptake of nutrients; soil sodicity and reactivity; slope; flooding frequency; and water table depth, amongst other things (Chapman, 2004). Seek advice from your local council.

Sunset over Lake Wooloweyah. Image courtesy Debrah Novak.

Something to consider when developing land

The science of ecology teaches that all living organisms are connected via a network of trophic relationships. Internal mechanisms of an ecosystem will evolve to maintain life by managing fluctuations and perturbations with unique phenomena, like predator/prey relationships. Change in one part of ecosystem will alter other parts of that system over different spatial and temporal scales. Human planning and management strategies could attempt to emulate these natural processes in order to ensure the health of the ecosystem under developmental pressures. The principles of Landscape Ecology as described by Lyle (1999) are based primarily on this concept of interconnectedness and scale combining the disciplines on landscape architecture and ecology. Lyle proposes that humans emulate the natural processes as closely as possible in their construction designs and management plans to create the 'human ecosystem'. The human ecosystem concept recognises the 'merging and interacting of human and natural processes' (Lyle 1999, p.15). Humans have been designing and altering the landscape without considering how and to what extent the natural ecosystems are altered.

Controls are required when the land is being used for intensive large-scale development, but the controls put in place should attempt to follow natural contours of the land and work with the existing topography wherever possible. An example might be aquaculture ponds to be built in the path of the natural watershed run-off as a filtering step before it flows into a water body. Designers or planners should intentionally incorporate natural processes, (water flows; planting trees that reflect solar radiation) into design plans. This type of approach will tend to protect ecological relationships at different scales.

Bar – tailed Godwit feeding. Image courtesy P. Kenway.

Shorebirds

In September each year about 40 species of migratory shorebirds - nearly 2 million birds, arrive in Australia to spend the summer months feeding and resting. The path the shorebirds fly is called the East Asian –Australasian Flyway. Migratory shorebirds travel through more than 20 countries along the flyway. The journey of up to 12,500 km one way, takes about 2 months. Flying at approximately 70 km kph, some birds can cover 1500 km in a day. It's no wonder they need to rest when they get here!

The Clarence estuary is an important destination for birds that breed in the Northern hemisphere during our winter. Shorebirds, also known as waders are either migratory or resident. Most waders frequent coastal and inland wetlands and can be seen feeding around the edges of ocean beaches and intertidal areas, rocky shorelines, estuaries and mudflats or inland lakes, lagoons and dams.

The Clarence estuary has the largest species diversity and second highest population density of wading birds in coastal NSW (Clancy, GP, 1992). A report prepared by DECCW in June 2010 compared average and maximum summer populations and species diversity for the larger northern NSW estuaries and found that the Clarence has the highest maximum population and 2nd largest total species diversity of shore birds in the Northern Rivers region. Both migratory and resident shorebirds are found in the Clarence. The eastern Curlew is the largest shorebird – during migration they can travel a 20,000 km round trip. They weigh around 800 – 900 grams but increase to about 1.3kg before migration

What you can do to help

- Keep dogs on a lead and close to you - avoid activities that disturb shorebirds
- Observe bag limits when collecting shellfish or bait
- Drive 4WD vehicles where they are permitted and preferable at low tide on the hard wet sand, close to the water's edge.
- Keep your distance from shorebirds to avoid disturbing them
- While launching and landing boats be aware of shorebirds and try to minimise disturbance
- Learn about the shorebirds that share your local beach and wetlands – grab a field guide and some binoculars and enjoy birds.
- Be aware of developments in your local area that may impact on shorebirds and their habitat
- Fact sheets on shorebirds are available at www.wwf.org.au
- Join a local shorebird monitoring group – in the Clarence visit Clarence Valley Conservation in Action Landcare Group (CVCIA) www.cvcia.org.au. This Landcare group may also be contacted to report suspected Cane Toad sightings and is active in the monitoring and control of Cane toads.
- Join the Clarence Valley Bird Group. Contact email: gbwhale@bigpond.net.au

Ruddy Turnstones are Long distance travellers that love the mangrove habitat of the river islands in the Clarence estuary where they can forage for sand worms, crabs and little fish at low tide. Image courtesy P. Kenway.

Pied Oyster Catcher. Image courtesy Terry Evans.

Some resident shorebirds nest on beaches during our summer, laying their eggs in a simple scrape in the sand or shell – grit. Eggs and chicks are vulnerable to trampling by people or being crushed by vehicles. For both migratory and resident shorebirds the loss or degradation of habitat is a major problem. Threats to habitat include; filling in of wetlands, changes in water flows to wetlands, weed invasions, introduced pests such as foxes, pets (cats and dogs), human related disturbance including off road vehicles and boating as well as inappropriate coastal development.

Shorebirds need to rest and re fuel in order to travel the large distances during migration between their breeding and non – breeding grounds. Shorebirds that are disturbed spend less time feeding and resting and more time fleeing. Landcare groups and other community organisations along with government departments are helping to raise awareness about waders and other wetland bird's conservation needs. Individual landowners in the community are assisting with the monitoring of shorebirds and protection of habitat.

Resources and Contacts for Chapter 6

Lessening the impacts - what you can do

Clarence Valley Council
Phone: 02 6643 0200 (general enquiries – planning)

NSW Office of Water
www.water.nsw.gov.au

Controlled activity approvals/advice (3A Permits)
General enquiries line at the NSW Office of Water
Grafton Phone: 02 6641 6500

www.naturalresources.nsw.gov.au/estuaries/factsheets

Weeds

For information on managing weeds in riparian areas (and links to riparian management advisors) visit the NRCMA website www.northern.cma.nsw.gov.au/publications_project_report_library and download "*Habitat Management Guide: Weed Management in Riparian Areas*" and other useful publications or contact your nearest
NRCMA Phone: 02 6642 0622 or
Clarence Landcare Phone: 02 6643 5009.

The Resource Kit for Rural Landholders in the Northern Rivers Region of NSW is available at Clarence Landcare Phone: 02 6643 5009 for a hard copy or go to www.clarencelandcare.com.au to download.

Whether a weed is declared a noxious, environmental or agricultural weed will depend on the location or district within each state.

Clarence Valley Council Weed Officers
Phone: 02 6643 3820
www.clarence.nsw.gov.au

A range of weed information sheets and booklets are listed in the *"NSW DPI publications catalogue"*

Various organisations run "Weed Identification and Management" field days.

Some of the most useful weed identification and management websites (containing photos) are;

North Coast Weeds Advisory Committee
www.northcoast weeds.org.au

NSW Department of Primary Industries
www.agric.nsw.gov.au/reader/pests

CRC for Australian Weed Management
www.weedscrc.org.au

Weeds Australia
www.weeds.org.au

Making your business fish friendly

NSW EPA Controlling erosion and sediment fact sheet at www.environment.nsw.gov.au/small_business/landscaping

www.naturalresources.nsw.gov.au/care/soil/

Septic safe website and Australian New Zealand Standards No. 1547

NSW Department of Local Government. 2000. *The Easy Septic Guide*, developed by Social Change Media for the New South Wales Department of Local Government. The Easy Septic Guide may be downloaded in PDF format from the SepticSafe web site: http://www.dlg.nsw.gov.au/ssfpub.htm

Local government and legislation

Pelicans. Image courtesy D. Novak.

You should be aware of the role of local government and the existing broader legislation that governs management of the coasts and estuaries in NSW and the policies that relate directly to development of any kind in the coastal zone. Whether it is clearing trees or moving soil, there are strict guidelines set out in the Development Application process available from your coastal council.

The role of local government

Local government has a prominent role in the management of the estuary. In recognition of the need for future sustainable use of high value public assets, the NSW Government is implementing a number of key strategic initiatives, one of which is the Estuary Management Program. The Estuary Management Program commenced in 1992 to assist local government to better manage estuaries through a strategic process outlined in the NSW 'Estuary Management Manual'. The Department of Environment and Climate Change, coast and estuaries division, works with local councils to establish an Estuary Management Committee, which includes representatives from the local community, industry, environmental interest groups, researchers, and state and local government. The committees work together to identify problems in the estuary and create and implement a formal management plan.

These plans aim to: Improve the environmental health and condition of estuaries; protect important coastal habitats, features and heritage items; rehabilitate degraded areas; improve public access and amenity; accommodate sustainable population growth and resource utilisation.

The Clarence Estuary Management Plan was developed in consultation with various stakeholders and was adopted in 2003. An Estuary Management Plan for the Wooli Wooli River was completed in 2009. Both plans can be viewed from the Clarence Valley Council (CVC) website: www.clarence.nsw.gov.au along with other management plans and strategies that have been adopted for the Clarence River Catchment and Clarence Valley local government area.

Catchment Action Plan for the Northern Rivers

The Catchment Management Authorities Act 2003 provided for the establishment thirteen Catchment Management Authorities in NSW. Each Catchment Management Authoritiy (CMA) was required to prepare a Catchment Action Plan (CAP). To view the Northern Rivers CMA plan go to www.northern.cma.nsw.gov.au or visit the NRCMA office in Grafton.

Environment Protection and Biodiversity Conservation Act 1999

This Act governing protection of the environment especially in relation to matters of national significance (e.g. World Heritage Areas). It also lists threatened species and prohibits the export of native species without a permit.

Environmental Planning and Assessment Act 1979 and the associated **State Environmental Planning Policies** or SEPPS of which there are a number that are specific to the coastal/estuary environment, including SEPP 14 'Wetlands' and SEPP 71 'Coastal Protection'. This Act specifically controls the extent and conditions of development on all land in NSW. Administered by local councils, this is your first port of call to discuss any kind of building, structure or activity that will alter the condition of a piece of land.

Department of Environment, Climate Change and Water (DECCW)

Grafton office Phone: 02 6641 1500 or http://www.environment.nsw.gov.au/.

DECCW operates under a number of well-recognised 'brands' and legislative authorities. The National Parks and Wildlife Service logo remains associated with our national parks. In regulatory matters for environment protection, DECCW acts under the powers of the statutory Environment Protection Authority (EPA). DECCW also administers programs on behalf of the statutory Environmental Trust and supports the Marine Parks Authority and Catchment Management Authorities. The Office of Water is responsible for the water management functions (including legal, policy and regulation) undertaken by the former Department of Water and Energy reporting to the Minister for Water.

Rivers and Foreshores Improvement Act 1948

DECCW administers the Rivers and Foreshores Improvement Act 1948 (RandFI) on all land in NSW except that controlled by Port Authorities. Part 3A of the RandFI Act is designed to control activities in or near rivers and lakes that have the potential to cause instability, obstruct or detrimentally affect the flow of protected waters. Part 3A of the Act applies to 'protected land', which includes the bed and banks of these waterbodies and adjacent land within 40 metres of the top bank or shore. A part 3A permit (controlled activity approval) is required for any excavation, removal of material such as rock or soil, or anything that might obstruct or detrimentally affect water flow (e.g. structures or fill). Each permit has conditions that are specific to the type of activity being undertaken.

Typical developments include:

- Sand and gravel extraction from a river or floodplain
- Stream restoration (bank erosion stabilisation works)
- Stream crossings (e.g. bridges, culverts, causeways)
- Subdivisions involving roads, stormwater control measures, drainage or earthworks, dams or weirs;
- Laying of cables or pipelines across streams; and
- Foreshore structures on freehold land (e.g. seawalls, boat ramps, boat sheds, marinas).

Contact the Department of Environment Climate Change and Water (DECCW) for more information or visit NSW Office of Water www.water.nsw.gov.au

Controlled activity approval (3A Permits). General enquiries line at the NSW Office of Water in Grafton 02 6641 6500.

Water Management Act 2000

The Water Management Act 2000 and Water Act 1912 control the extraction and use of water, construction of dams and activities in or near water courses in NSW. However, local environment plans also place controls on what activities can be undertaken. Hence, it is always best to contact the resource access officer in the Office of Water at Grafton and local shire council to obtain the latest information and determine what approvals are needed for activities that extract or use water or occur near water sources (including floodplains). As part of the national water reform process, the Water Management Act 2000 is gradually replacing the Water Act 1912. Only a brief summary of the Acts implications for landholders is provided here. The latest copy of the Water Management Act 2000 is available from the NSW government legislation site and NSW DWE website at http://www.dwe.nsw.gov.au./water/leg_policy.shtml

The Water Management Act provides for NSW to be divided into areas, each of which will have a water management plan. Currently, there are several water sharing plans in place on the north coast.

Water management plans address water sharing, drainage and floodplain management and water source protection.

Fisheries Management Act 1994

This act is administered by NSW (DPI) Industry and Investment Fisheries and aims to ensure that fishing activities remain sustainable. Permits may be required for a number of fishing activities. A recreational fishing license is required for recreational fishing (including bait gathering) in all public waterways – some exemptions apply. There is a fishing guides available for all recreational fishers which outline rules including size limits, bag limits, allowable methods, gear and areas. Contact the fisheries Office Port Macquarie on 02 6581 4084 and for recreational fishing licences call 1300 369 365.

The fisheries ecosystem branch of the Department of Industry and Investment (formerly DPI) based at Wollongbar (in NSW) are concerned with the protection and conservation of marine habitat such as marine vegetation like macroalgae, mangroves and sea grass beds as well as the protection of fish passage. Certain species of fish need to be able to migrate up stream to breed. The Fisheries Ecosystem branch deal with Part 7 of the Fisheries Management Act which covers any activity that may harm marine vegetation and or block fish passage. Such activities might include, dredging, reclamation, placing materials in the water way, building jetties or boat ramps. Any riparian works or activities that may inhibit fish passage or potentially harm habitat require a permit under this Act. The Act covers all waterways in NSW and includes water-lands, areas that are conducive to water inundation like salt marshes which are extremely sensitive. Fisheries has a concurrence role with the DECCW and the NSW Office of Water who administer the Rivers and Foreshore Act. Bank stabilisation or bed control activities are primarily the jurisdiction of DECC and the NSW Office of Water however fisheries will have some say in the project proposed.

It is advisable to contact the Senior Conservation Manager at Wollongbar to discuss any preliminary ideas that you may have. Phone: 02 6626 1269.

Crown Lands Act 1989 and Crown Lands (Continued Tenures) Act 1989

Covers the lease and use of crown land established local land boards. There are several areas of crown land on the Clarence coast and estuary and these are often managed in association with Clarence Valley Council as the trust manager of coastal reserves. Permission is required to carry out activities on crown reserves and leases. Contact the crown lands division of Land and Property Information for more information.

Coastal Protection Act 1979

This act is to provide protection of the coastal environment of the State, including the environment, benefits to urban communities, fisheries, industry and recreation, culture and heritage and benefits to the Aboriginal people in relation to their spiritual, social, customary and economic use of land and water. Certain coastal development will need the approval of the Minister for Planning this is governed by State Environmental Planning Policy No. 71. (NSW Department of Planning-regional office North Coast: 76 Victoria Street, Locked Bag 10, Grafton NSW 2460, telephone 02 6641 6600

Protection of the Environment Operations Act 1997

This legislation administered by the The Environment Protection Authority (EPA) which is part of DECCW, issues licences to control air, noise, water and waste impacts primarily to large industrial operations. Local council can issue Clean-up notices, Prevention notices and prohibition notices if private individuals are in breach of the pollution laws. EPA can be contacted on 131555. Under the Protection of the Environment Operations Act 1997 (POEO Act), it is an offence to pollute any waters unless permitted under a licence issued by the DECC. Waterways Authority officers can issue on-the-spot infringement notices of $750 for an individual or $1500 to a corporation where cases of pollution from vessels are detected.

The POEO Act is complemented by the Marine Pollution Amendment (Waste Discharge and Oil Spill Response Plans) Regulation 2003, which became effective on 1 July 2003. This Regulation prohibits the discharge of untreated sewage from vessels into navigable waters, requires that treated sewage not be discharged within 500 meters of aquaculture and includes a requirement for the installation of sewage holding tanks in certain types of vessels. There are no specific requirements for private recreational vessels other than a general requirement to avoid polluting the waterway. Of the commercial vessels, only specific types of class 1 (passenger carrying) and class 4 vessels (hire and drive, e.g. houseboats) are required to have holding tanks for sewage effluent. Contacts (www.maritime.nsw.gov.au).

'Waters' is defined very broadly and includes natural waterways such as rivers, creeks and wetlands as well as artificial systems such as the stormwater system.

`Pollution' also includes placing anything where it could be blown or could fall or wash into a drain, gutter or local waterway. For landscapers this could mean storing materials in a location where they could wash into a road gutter, or failing to install adequate sediment controls.

Native Vegetation Act 2003 and Local Environment Plans

The Act regulates the clearing of native vegetation on all land in NSW outside of urban areas, national parks and state forests. Under the Native Vegetation Act (NVA) it is an offence to clear native vegetation except in accordance with development consent or property vegetation plan (PVP) or unless an exemption in the Act applies. You should also note that the clearing of native vegetation may also require approval from your local council. The NVA does not remove the requirement for a landholder to obtain development consent from local council where such approval is required under the Local Environment Plan (LEP) and including under an existing Tree Preservation Order. If you have any questions in relation to this you should contact the planning section of your local council Clarence Valley Council general enquiries 66430200. Contact the Northern Rivers Catchment Management Authority for more information about the NVA. Phone - 66420622 Grafton Office. Online NVA Info sheets
www.environment.nsw.gov.au/vegetation/publications.htm
http://www.northern.cma.nsw.gov.au/programmes_natives_vegetation.php

North Coast Regional Environmental Plans 1988

Several Clauses within the NCREP address specific considerations relating to developments near waterways or environmentally important or culturally significant areas, for example Clauses 15, 29A, 32B, 33, 36A and others.

Threatened Species Conservation Act 1995

It is a criminal offence to harm a threatened species or its habitat, sell a threatened species or have one in your possession. National Parks has the power to issue stop work orders if any activity is considered likely to harm threatened species or their habitat. Contact the National Parks division of the Department of Environment and Conservation for more information.

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Clarence Landcare

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