



# Teachers Resource Kit

Produced by the Office of the  
Lake Macquarie & Catchment Coordinator

# Acknowledgements

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- Kevin Butler - Wyong Shire Council

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# contents

Syllabus Directories .....	4
Introduction.....	6
About The Office of the Lake Macquarie & Catchment Coordinator.....	7
<b>Section One:</b> Navigating the Pathway of Pollution .....	9
<b>Section two:</b> Dynamic Change in Lake Macquarie .....	13
<b>Section three:</b> Native Vegetation.....	17
<b>Section four:</b> Seagrasses.....	21
<b>Section five:</b> Sedimentation & Nutrients .....	25
<b>Section six:</b> Channel & Entrance Issues .....	29
<b>Section seven:</b> Estuary management - Maintaining Ecological Balance .....	33
<b>Section eight:</b> Sustainable Living For A Brighter Future .....	37
Glossary of Terms .....	41

## Primary School - Syllabus Directory

<b>Section &amp; Syllabus References</b>	<b>Page</b>
<b>Navigating the pathways of pollution</b> .....	<b>9</b>
S &T BE S3.1    Creates and evaluates built environments demonstrating consideration of sustainability and aesthetic, cultural, safety and functional issues.	
HSIE EN S2.6    Describes people’s interactions with environments and identifies responsible ways of interacting with environments.	
<b>Dynamic Change in Lake Macquarie</b> .....	<b>13</b>
S&T ES S3.6    Recognises that the Earth is the source of most materials and resources, and describes phenomena and processes, both natural and human, that form and change the Earth over time.	
HSIE EN S3.6    Explains how various beliefs and practices influence the ways in which people interact, change and value their environment.	
<b>Native Vegetation</b> .....	<b>17</b>
S&T LT S3.3    Identifies, describes and evaluates the interactions between living things and their effects on the environment.	
HSIE EN S3.6    Explains how various beliefs and practices influence the ways in which people interact, change and value their environment.	
<b>Seagrasses</b> .....	<b>21</b>
S&T LT S3.3    Identifies, describes and evaluates the interactions between living things and their effects on the environment.	
HSIE EN S3.6    Explains how various beliefs and practices influence the ways in which people interact, change and value their environment.	
<b>Sedimentation and Nutrients</b> .....	<b>25</b>
S&T LT S3.3    Identifies, describes and evaluates the interactions between living things and their effects on the environment.	
S&T INV S3.7    Conducts their own experiments and makes judgements based on the results of observing, questioning, planning, predicting, testing, collecting, recording and analysing data, and drawing conclusions.	
HSIE EN S3.6    Explains how various beliefs and practices influence the ways in which people interact, change and value their environment.	
<b>Channel and Entrance Issues</b> .....	<b>29</b>
HSIE EN S3.6    Explains how various beliefs and practices influence the ways in which people interact, change and value their environment.	
<b>Estuary Management – Maintaining the Ecological Balance</b> .....	<b>33</b>
HSIE EN S3.6    Explains how various beliefs and practices influence the ways in which people interact, change and value their environment.	
<b>Conclusion – Sustainable Living for a Brighter Future</b> .....	<b>37</b>
S&T LT S3.3    Identifies, describes and evaluates the interactions between living things and their effects on the environment.	
HSIE EN S3.6    Explains how various beliefs and practices influence the ways in which people interact, change and value their environment.	

## Secondary School - Syllabus Directory

<b>Section &amp; Syllabus References</b>	<b>Page</b>
<b>About the Office of the Lake Macquarie &amp; Catchment Coordinator</b> .....	<b>7</b>
Sc 5.10: A Student assesses human impacts on biotic and abiotic features of the environment.	
Geo 5A2: Changing Australian Environments. ONE study of the changing interaction between and community and its environment.	
Geo 5A3: Issues in Australian Environments. Issues relating to physical and human elements of environments.	
<b>Navigating the Pathway of Pollution</b> .....	<b>9</b>
Sc 4/5.10: Optional. Describe how the land management practices and techniques of Aboriginal and non-Aboriginal people have changed the environment.	
Sc 5.10 c): Describe some impacts of human activity on the ecosystem.	
Sc 5.10d): Strategies to balance human activity and the quality of the environment.	
Sc 5.11.2a): Relate pollution to contamination by unwanted substances.	
Geo 5A2I: Identify factors creating change in both the environment and the community.	
Geo 5A3I: Issues relating to physical elements of environment - land, water, coastal, waste management.	
<b>Dynamic Change in Lake Macquarie</b> .....	<b>13</b>
Sc 5.10 c): Describe some impacts of human activity on the ecosystem.	
Sc 5.10d): Strategies to balance human activity and the quality of the environment.	
Geo 5A3: Issues in Australian Environments. Issues relating to physical and human elements of environments.	
<b>Native Vegetation</b> .....	<b>17</b>
Sc 5.10d): Strategies to balance human activity and the quality of the environment.	
<b>Seagrasses</b> .....	<b>21</b>
Sc 4.10b): Describe how producers etc. are related using food chains and food webs.	
Sc 5.10 c): Describe some impacts of human activity on the ecosystem.	
Sc 5.10d): Strategies to balance human activity and the quality of the environment.	
Geo 5A2I: Identify factors creating change in both the environment and the community.	
Geo 5A3I: Issues relating to physical elements of environment - land, water, coastal, waste management.	
Geo 5A3II: Issues relating to human elements and the environment - biodiversity, urban growth and tourism.	
<b>Sedimentation and Nutrients</b> .....	<b>25</b>
Sc 5.10 c): Describe some impacts of human activity on the ecosystem.	
Sc 5.10d): Strategies to balance human activity and the quality of the environment.	
Geo 5A3III: Issues relating to human elements and the environment - urban growth.	
<b>Channel and Entrance Issues</b> .....	<b>29</b>
Sc 5.10d): Strategies to balance human activity and the quality of the environment.	
Sc 5.2: Describes the processes to test and validate models, theories and laws.	
Geo 5A3I: Issues relating to physical elements of environment - land, water, coastal, waste management.	
<b>Estuary Management - Maintaining the Ecological Balance</b> .....	<b>33</b>
Sc 4/5.2: Apply scientific processes to test the validity of ideas and theories.	
Geo (Outcome) 5.6: Analyses the impact of different perspectives on geography issues at local scale.	
<b>Conclusion - Sustainable Living for a Brighter Future</b> .....	<b>37</b>
Sc 5.10 c): Describe some impacts of human activity on the ecosystem.	
Sc 5.10d): Strategies to balance human activity and the quality of the environment.	
Geo 5A3I: Issues relating to physical elements of environment - land, water, coastal, waste management.	
Geo 5A3III: Issues relating to human elements and the environment - urban growth.	



# Introduction

This publication was produced on behalf of The Office of the Lake Macquarie & Catchment Coordinator, as part of the Living Lake Macquarie community education and reporting program.

As future residents and community leaders, students are key stakeholders in the environmental health of Lake Macquarie. Awareness of the major issues and an appreciation of the natural systems which interact in the Lake are major steps in addressing the problems.

This publication has been arranged into six main topic areas, with an introductory and summary section also provided. While the key issues deserve individual attention, it is important that they are not seen in isolation. The Lake is made up of many interacting systems, making the understanding of its ecology a complex task. This publication attempts to simplify the discussion of these relationships, without neglecting the accuracy or complexity of the issues.

The resource kit has been developed for the use of teachers to help bring a knowledge of local environmental issues, specifically in Lake Macquarie, into the classroom. The Office of the Lake Macquarie & Catchment Coordinator authorises copying of sections of this document for use in classroom activities.

The Office of the Lake Macquarie & Catchment Coordinator oversees the implementation of a broad range of communications and reporting tools. For more information, contact Loren Morgan on (02) 4921 0230 or visit our web site, [www.livinglakemacquarie.org](http://www.livinglakemacquarie.org)

**Living Lake Macquarie, Working to Revive, Renew and Protect the Ecology of Our Lake.**

# About The Office of the Lake Macquarie & Catchment Coordinator

The Office of the Lake Macquarie & Catchment Coordinator was established as a result of the 1999 Lake Macquarie Task Force formed by the Premier of New South Wales, Bob Carr MP. The Task Force devised a three-year action plan to address issues affecting the health of Lake Macquarie.

The project is a joint initiative of the NSW Government, Lake Macquarie City Council and Wyong Shire Council. Lake Macquarie & Catchment Coordinator, Jeff Jansson, oversees the project and reports to the Lake Macquarie Project Management Committee.

The Committee consists of community representatives, Regional Directors of the relevant State Government Departments, one Councillor from both Lake Macquarie and Wyong Council and

ex-officio members including Professor Bruce Thom, Mr. Bob Wilson and Mr. Ian Kiernan.

The primary role of the Lake Macquarie and Catchment Coordinator is to implement the recommendations contained in the Taskforce's report. The Office of the Lake Macquarie & Catchment Coordinator allocates funding for a range of physical works, scientific studies and monitoring and community education and reporting.

Some examples of the projects implemented by The Office of the Lake Macquarie & Catchment Coordinator, incorporating soft technologies and knowledge of natural systems include:

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## Physical Works

### Salts Bay

The preservation of land at Salts Bay, which separates Swansea Channel from wetlands in Black Neds Bay, was identified as a priority action in the Premier's Lake Macquarie Task Force Report.

It is estimated that some areas would have suffered a loss of up to 27 metres of foreshore land over a 10 year period had the stabilisation not gone ahead. In addition to the loss of the beach at Salts Bay, further erosion at this rate would place the sensitive wetland in Black Neds Bay at serious risk.

The remediation project involved a combination of beach nourishment and construction. An initial 32,500 m<sup>3</sup> of sand was placed and will require further maintenance approximately every 10 years. In addition, two new rock groynes have been constructed, with the existing groyne also extended by 25m.

### Foreshore Stabilisation and Revegetation

Foreshore erosion was among the key issues identified by the Premier's Taskforce Report. The problem of shoreline erosion is felt particularly during the stormy conditions experienced in late winter.

Projects designed to encourage the development of natural sloping beaches, and the use of shingles in beach construction have been implemented at sites including Warners Bay and Rathmines. The aim of this strategy is to encourage natural relationship between land and water based organisms, and natural processes such as the removal of dead seagrasses from shallow areas by wave action.

### Constructed Wetlands at Blackalls Park

The constructed wetlands at Blackalls Park are an example of the new soft-technologies being implemented in preference to the hard engineering solutions of the past.



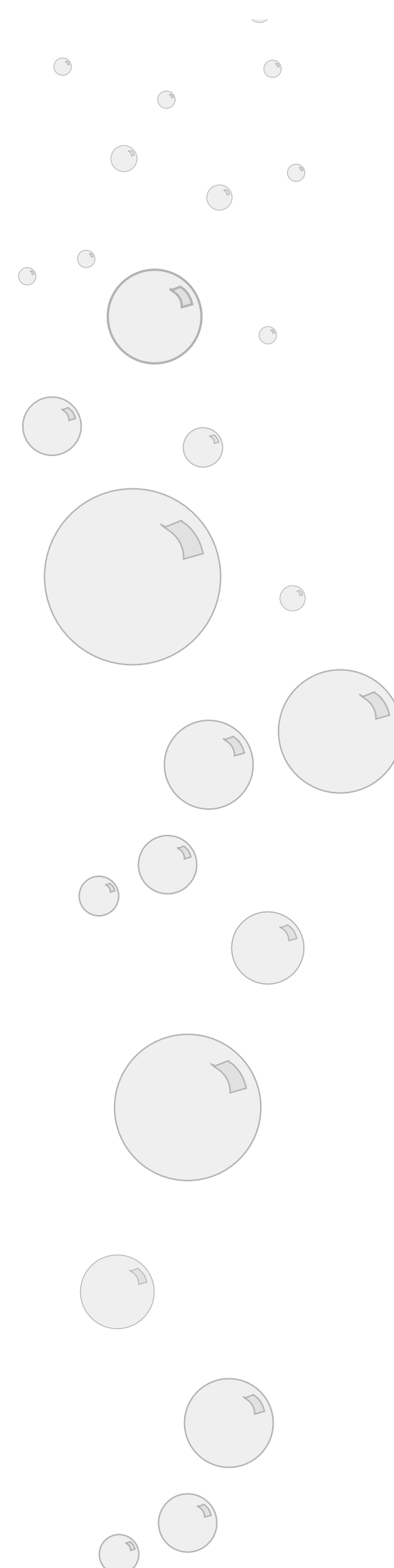
**Salts bay beach during sand nourishment**



**Rock groyne construction for stabilisation of Salts Bay**

# Scientific Studies & Monitoring

A comparison of the 2000 and 2001 results showed that the health of the Lake had become the most important issue in the local community. When asked to list the top three issues effecting the local community, 27.1% of respondents included the Lake, beach and waterways. The result was considerably different from the identical study carried out in 2000, where the Lake ranked third at just 10%. The response headed the list, equal with crime which also registered 27%.



# *Navigating the Pathway of Pollution*

# Navigating the Pathway of Pollution

The Paths of Pollution concept highlights the direct connection between sources like the home or school, industry, and the Lake environment.

The main factors which affect water quality in the Lake are nutrient enrichment and sedimentation. Some examples of things which accelerate the entry of sediments and nutrients into the Lake include:

- land clearing which causes dramatic changes to surface runoff areas
- excessive use of detergents and garden fertilisers
- organic soils
- pollution from industry
- disposal of pet faeces and refuse into drains

These diffuse sources are collected in stormwater, particularly after periods of heavy rain.

Over many years, natural systems which provided filtration of this stormwater, such as vegetated drainage lines and wetlands, have been lost due to land clearing for urban use and other factors. In many cases, they have been replaced with concrete drainage lines.

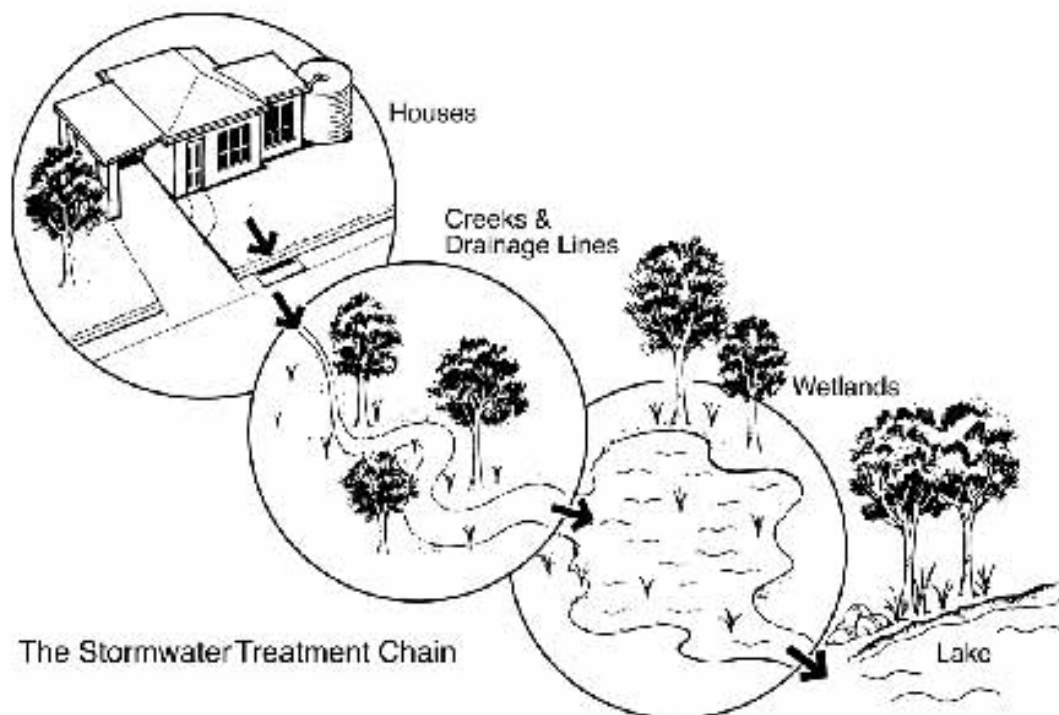
While these concrete systems tidy up the catchment's appearance, the concrete's hard impervious surface cannot provide the same filtration or absorption of stormwater. Instead, more water flows through the drainage channels and at greater speeds, often with little filtration being carried out before it ends up in the Lake.

## Key Points

- The Paths of Pollution diagram highlights the direct connection between the individual's home and the environmental health of the Lake. Students should be familiar with the notion of the Paths of Pollution as a way of understanding how activities throughout the catchment have an impact on water quality and the health of marine life.
- The Paths of Pollution diagram highlights the importance of natural vegetation in regulating the flow and quality of stormwater entering the Lake, and the problems of installing hard engineering replacements such as concrete drainage lines as replacements.

## Vital Signs

- Prior to European settlement, the annual rate of sediment flow into Lake Macquarie was approximately 6,000 tonnes per year. Today, the figure is estimated at approximately 60,000 tonnes.



# Activity Sheet..... 1

**Topic: Navigating the Pathway of Pollution**

**Name:** \_\_\_\_\_

## Brainstorm

Students brainstorm a list of risk factors associated with sources of sedimentation and nutrient enrichment, as highlighted in the Paths of Pollution diagram.

The list could be separated into source categories, including the following:

- **The home**

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- **School**

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- **Industry**

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## Sketch a Pathway

Students to sketch their own home and the pathways of pollution between it and the Lake-front in their local area.



## Activity Sheet: 1 - Navigating the Pathway of Pollution

### 1 Mapping Your Treatment Chain

#### Aim:

1. To UNDERSTAND the treatment chain from the home to the Lake.
2. To IDENTIFY contributors to sedimentation along the path.

#### Equipment:

You will need:

1. Paper
2. Pencil and marker pen



#### Method:

- Map the path of urban run-off and storm-water run-off near your own home.
- Include things like guttering and drains, wetland areas, sediment traps and other points where stormwater is managed before it enters the Lake.
- Test the water quality of the main entry point into the Lake and compare with one other point in your local area. Conduct in-class brain-storm session.

### 2 Calculating Run-off Areas

#### Aim:

To identify the level of surface run-off in your own home.

#### Method:

- Calculate the following
  1. Hard surface areas eg. Concrete paths, roofed areas, driveways and paved areas on your block of land.
  2. Areas of absorption eg. Grass, garden areas on your block of land.
- Now calculate the entire surface area of your block of land.
- Express areas of hard surface as a % of the total area of your block of land.

#### Notes:

- Students should be able to identify the differences between hard surfaces and surfaces which are able to absorb stormwater run-off.
- Activities highlight the high amount of hard surfaces prone to increase stormwater run-off in urban areas.
- Additional activity: Teachers could run brainstorm of other alternatives to hard surface areas in the students' own home.

# **Dynamic Change in Lake Macquarie**

# Dynamic Change in Lake Macquarie

Lake Macquarie is defined as a 'barrier lagoon'. One of the characteristics of this type of estuary is that it will naturally seal off from the open ocean from time to time. This is a continuous process which happens very slowly and is one example of how the Lake is constantly changing.

These changes are the natural environment's way of maintaining a state of dynamic balance between the many elements which interact within the Lake system. It is important to note that this state of balance is not constant or stable, the Lake environment is constantly changing.

The problem is that human interaction with the Lake environment has the effect of accelerating the process of change. This

is because of the added stress caused by land clearing and development, interruption of natural systems like wetlands and the influx of many chemicals found in detergents, which are carried through concrete stormwater drainage channels into the Lake.

All of these factors contribute to poor water quality, loss of aquatic life (biodiversity) and the development of unattractive side effects such as smelly black ooze in shallow areas of the Lake.

Students should be encouraged to investigate ways to minimise human impact on Lake Macquarie. Adopting basic principles around the school will increase awareness of the issues and encourage students to carry similar practices into their homes.

## Case Study: Natural Change and Human Intervention

Lake Macquarie is defined as a 'barrier lagoon'. A typical characteristic of this type of estuary is that it will shoal up from time to time. Studies and history show that this is the case with Lake Macquarie.

The construction of training walls in the last century and the dredging of the channel to maintain navigable waters into the Lake has had repercussions on other features within the estuary.

It can be argued that by training the entrance and dredging to increase water depth, the speed (velocity) of tidal and flood water moving through the channel has also increased. This has

increased the rate of erosion of the channel and foreshore.

Salts Bay and Black Neds Bay also suffer. Sediment and sand from the Salts Bay shoreline is transported upstream and shoals up at the mouth of the Black Neds Bay wetlands. Increased movement of sand also creates further build-up on the 'drop-over' at the head of the channel, creating navigation problems all over again.

While we can see clearly how the solution actually recreates problems for navigation, ongoing dredging of the channel to maintain safety at the entrance has been carried out since the 1950s.

## Key Points

- Changes in the environment occur naturally. These changes are necessary for the Lake to balance the many systems interacting in the ecosystem.
- Humans accelerate these natural processes through land clearing for urban use, replacing natural systems like vegetated lines with concrete structures and adding to soils, chemicals and pollutants which are carried into the Lake in stormwater.
- Changes to one part of the environment will have an effect on other areas. For example, the dredging of the channel entrance to Lake Macquarie has led to increased wave action and erosion of Salts Bay over many years.

## Vital Signs

The two photographs on the right show Cockle Creek as it was in 1901 (top) and in 2001 (bottom). Note the stump in the foreground (bottom), a support for the original footbridge which provided access between Five Islands. Human and natural changes have led to dramatic loss of shoreline at this site through erosion.



# Activity Sheet..... 2

**Topic: Dynamic Change in Lake Macquarie**

**Name:** \_\_\_\_\_

## Research Task - Interviews

- Students to interview someone who has lived in the local area for a long-time (ie. Longer than 20 years) to ask them what Lake Macquarie was like in years gone by. Students should find out what changes the respondent has seen in their time living in the area.

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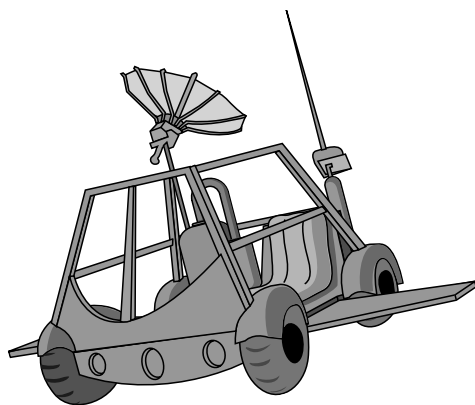
- Students to write a report on the interview, highlighting changes to the Lake Macquarie environment over 20 years.

## Story Task - Back to the Future

Students to write a story telling what the Lake will be like in the year 2020.

Ideas to include:

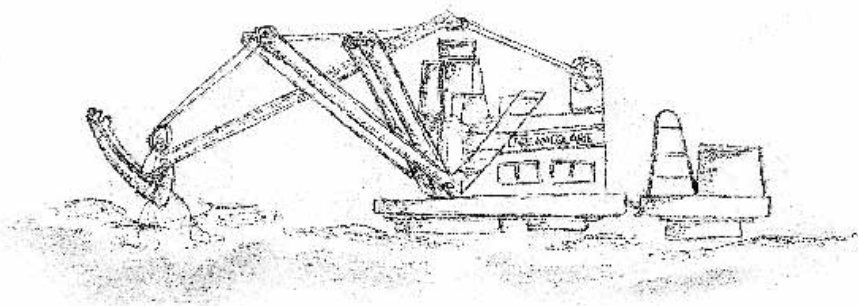
- The kinds of activities we will be carrying out on the Lake and the environmental health of the area.



## Activity Sheet: 2 - Dynamic Change in Lake Macquarie

### 1 Research Task

- Research a shallow bay in the local area. Ask students to sketch the appearance of the surrounding environment, paying particular attention to water depths, banks and native vegetation. Students then research the history of the bay to trace changes in the environment over a prolonged period.
- Compare sketch results with historical photos and set students the task of researching major events in the evolution of the area. (Option to include research of Awabakal history of the area.)
- Students to write a brief paper highlighting the changes in the local environment over time and explaining the causes of this change. Encourage students to differentiate between man-made changes, natural evolution of environmental conditions and reactionary changes to engineering solutions.



### 2 Mapping Changes to the Local Environment

- Teachers to provide students with an old copy of a map of Lake Macquarie, specific to the local area. These should be available from most public Council libraries.
- Students to visit the specific area and sketch the Lake waterfront profile as it is today.
- Students compare their sketch with the old map.
- Note changes to the profile. Brainstorm the reasons for any changes.

#### Notes:

- **The activities should highlight the ever changing nature of natural environments like estuaries. Further discussion about the effects of man-made changes to the balance of the environment are encouraged.**
- **Activities should encourage students to discuss the long term future in environmental terms, with population growth, natural processes and pollution in mind.**

# ***Native Vegetation***

# Native Vegetation

Native vegetation performs a number of roles in the Lake environment.

## (1) On the Shoreline of creeks and the Lake

ROLE	ISSUE
<ul style="list-style-type: none"> <li>Native vegetation binds banks and makes them strong to resist erosion. It also filters pollutants from stormwater.</li> <li>Riparian zones provide the primary food source for many species. Abundant native vegetation in these areas preserves biodiversity in ecosystems.</li> <li>Native vegetation allows for the gradual formation of natural sloping beaches, caused through tidal flows</li> </ul>	<ul style="list-style-type: none"> <li>With great expanses of foreshore vegetation often cleared during urban development, or planted with exotic grasses, the shoreline becomes weak and vulnerable to erosion. When heavy rain falls or waves wash against the shore, the land will erode because there is nothing to hold it in place.</li> <li>Lack of food sources for animal species can cause loss of bio-diversity around near shore areas.</li> <li>In areas where introduced grasses are mown up to the shoreline, there are no natural beaches and the vertical eroded bank causes the development of smelly black ooze in near-shore areas.</li> </ul>

## (2) In Drainage Lines and Wetlands

ROLE	ISSUE
<ul style="list-style-type: none"> <li>Vegetation filters pollutants from stormwater run-off, capturing nutrients and sediments before they enter the Lake. It also provides oxygen which helps nitrogen to be processed into the atmosphere, and plays a role in water absorption into the ground.</li> </ul>	<ul style="list-style-type: none"> <li>We are often too eager to replace vegetated drainage lines with concrete versions, to satisfy our desire to be 'neat and tidy'. While these substitutes are hydrologically highly efficient, they cannot provide the filtration benefits of the natural vegetation. The hard surfaces also result in faster water flow which impacts on water quality and the Lake habitat.</li> </ul>

## (3) At sites suffering erosion

ROLE	ISSUE
<ul style="list-style-type: none"> <li>The re-establishment of native vegetation helps stabilise eroding areas within the catchment. The plants prevent the escape of sediments and nutrients from the soil into the stormwater and also acts as a filter.</li> </ul>	<ul style="list-style-type: none"> <li>The problem without native vegetation to hold it in place, the land will wash away into creeks and the Lake, along with nutrients and pollutants contained within the catchment. This seriously effects the natural balance of the Lake ecosystem and puts marine and other plant life at risk.</li> </ul>

## Key Points

- More than 75% of all shoreline vegetation has been cleared from Lake Macquarie. Students should understand the functions that vegetation performs in the environment.
- Loss of native vegetation leads to soil erosion and increased surface run off during rain periods. This in turn increases the sediment load on the Lake and can lead to poor water quality, the loss of aquatic life (biodiversity) and unattractive side effects such as smelly black ooze in shallow areas of the Lake.
- The loss of vegetated drainage lines means that stormwater run off is not filtered effectively. Replacing these systems with concrete drainage lines means more water flows into the Lake and at greater speeds, accelerating the natural processes to a point where the Lake cannot cope.
- The Office of the Lake Macquarie & Catchment Coordinator works closely with government agencies as well as volunteer community groups like Landcare.
- Landcare volunteers perform many tasks to improve the local environment, such as tree planting and revegetation programs. There are more than 80 organised Landcare groups in Lake Macquarie alone. Landcare coordinators are available to give talks at schools throughout the Lake Macquarie catchment. For more information, contact The Office of the Lake Macquarie & Catchment Coordinator, Loren Morgan on (02) 4921 0230.

# Activity Sheet..... 3

Topic: Native Vegetation

Name: \_\_\_\_\_

## Words to Find

- nativevegetation
- drainagelines
- stormwater
- filtration
- waterquality
- wetlands
- erosion
- biodiversity
- foreshore
- banks

- sediments
- nutrients
- stabilise
- riparian
- littoral
- catchment
- ecosystem
- landcare
- planting
- environment

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

## Activity Sheet: 3 - Native Vegetation



### 1 Absorption & Filtration

#### Aim:

To examine the benefits of native vegetation in drainage lines.

#### Equipment:

You will Need: Measuring jug, 2 PVC pipes, sponges, native vegetation samples, 2 catchment tubs.

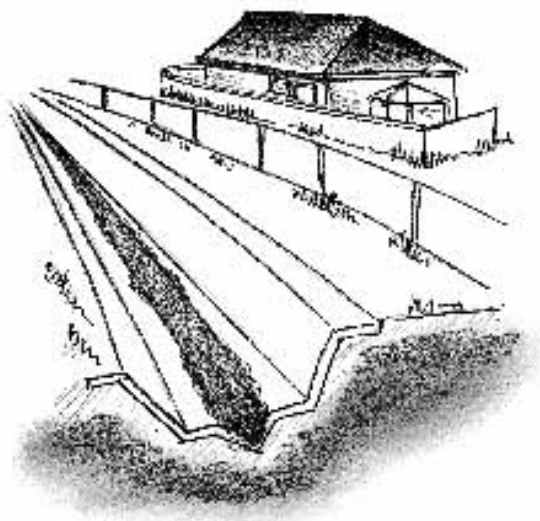
#### Method:

Set up two PVC pipes in the following way:

1. Line with sponges and native vegetation samples, soils.
2. Line with soils.

Pour equal amounts of water through each pipe and measure the following:

1. The amount of soil deposited in the catchment tub.
  2. The time it takes for all water to drain into the catchment tub.
  3. The amount of water drained into the catchment tubs.
- Compare results between the two test sites and discuss reasons for any differences.
  - Report on the experiment and how it relates to the natural shoreline environment around the Lake.



# Seagrasses

# Seagrasses

Seagrasses are important to the Lake ecosystem:

- They form a foundation for the food chain by photosynthesis, capturing and converting sunlight energy with carbon dioxide, nitrogen and phosphates.
- Seagrasses provide oxygen to the ecosystem and contribute to improved water quality. Oxygen levels are considered an important indicator of the health of the Lake.
- They have underground roots that hold the leaves in place and bind the Lake bed, slowing down the moving water and making the water clearer.
- Wind and waves carry some of the seagrass leaves to the beaches. Even when it dies, seagrass provides food and habitat for many animals. The dead vegetation can also be an important source of material for stabilising beaches and reducing wave erosion.
- Living meadows of seagrass trap and hold sediments including pollutants, and keep them from being released into the wider environment.
- Seagrasses provide safe habitat for animals, including prawns, crabs and many species of fish.

Seagrasses are considered a key indicator of the health of estuaries like Lake Macquarie, because they respond quickly to changing conditions. Changes in the amount of seagrass varies seasonally, but there are many other risk factors, including:

- Dragging of mooring chains and anchors by boats and boating traffic in shallow, near-shore areas can uproot seagrasses from the Lake bed.
- Excessive sedimentation and nutrient enrichment (known as eutrophication) can lead to algal blooms. These algal blooms smother seagrasses and cut off light penetrating the water's surface, which is essential for them to grow. Excessive sedimentation is increased by land clearing for urban use, replacing natural systems like vegetated lines with concrete structures and adding to soils, chemicals and pollutants which are carried into the Lake in stormwater.
- Pumping for bait by fishermen in seagrass beds, where many aquatic organisms take shelter can lead to the loss of seagrass as well as juvenile fish stocks.

## Key Points

- Seagrasses should be discussed in the context of the function within the ecosystem. For many people, particularly swimmers, seagrass is considered an unattractive element of the Lake. However, without healthy seagrasses there is no shelter for aquatic life, including juvenile fish.
- Students should be encouraged to investigate ways to protect seagrasses. Awareness of the Pathways of Pollution will highlight the connection between domestic and school activity, recreation, industry and sedimentation.

## Vital Signs

The losses to seagrass meadows can be rapid and recovery in some species is very slow, as young plants rely on larger plants for protection. In fact, damage to some seagrass meadows can last for over 50 years.



# Activity Sheet..... 4

**Topic: Seagrasses**

**Name:** \_\_\_\_\_

## Seagrasses in the classroom

- Present seagrasses to the class and ask the students to use words to describe them.

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- Explain the roles of seagrasses in the Lake environment and the risks associated with the loss of seagrasses.

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- Repeat the word description exercise again, this time encouraging students to include words which describe the role the seagrass performs



## Activity Sheet: 4 - Seagrasses

### 1 Seagrass Monitoring

Conduct seagrass monitoring in your local area.

#### Students to:

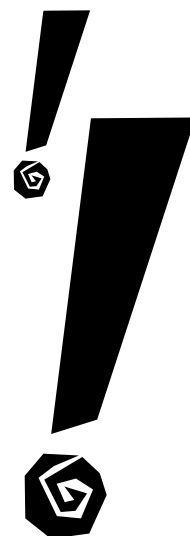
- Sketch seagrass and label features
- Observe and report on the abundance of seagrass meadows in the sample area.
- Measure water quality
- Observe aquatic life present in the area
- Summarise findings in a report.

#### Extension question:

- What conclusions can you draw between the health of the seagrass and these factors?
- *Caulerpa taxifolia* is a noxious aquatic weed which has been found in Lake Macquarie. Research the weed through press clippings and internet resources and report on some of the strategies being trialled to remove the pest from the Lake.

#### Web Reference:

<http://www.infohunt.nsw.gov.au/livinglakemacquarie/main03.html>  
[abc.net.au/news/australia/nsw/newcastle](http://abc.net.au/news/australia/nsw/newcastle)



# **Sedimentation & Nutrients**

# Sedimentation & Nutrients

Sedimentation is a naturally occurring process in the Lake environment. Stormwater run off collects loose soils and other materials as it flows through drainage channels and into the Lake.

In original natural systems, this water meanders through creeks and vegetated drainage lines, before flowing into wetland areas and into the Lake. Along its travels, many pollutants, silt and other materials are filtered out of the water, so that by the time the remaining stormwater reaches the Lake most of the harmful materials have been taken out. Before European settlement, this process resulted in approximately 6,000 tonnes of sediment entering the Lake each year.

Today, that figure is more than 60,000 tonnes. Due to the loss of native vegetation, the replacement of vegetated drainage lines with concrete versions, the rate of sedimentation has increased by around 10 times. It is this acceleration of natural processes which is the problem for the Lake. The added stress caused by human interaction means the Lake tries to keep pace with changing

environment by speeding up the natural processes. Eventually, the Lake cannot cope and flashpoints like algal blooms and smelly black ooze occur.

The nutrient balance is also regulated by natural systems. Nutrients are important for plant growth which in turn provide food for fish and other aquatic life. But the balance is important. The tendency is that the added stress and increased use of fertilisers, detergents and organic soils, makes the Lake environment nutrient rich, and this can have many negative effects on water quality.

The process of nutrient enrichment is called eutrophication and the imbalance can result in outbreaks of nuisance algal blooms. These algal blooms smother seagrasses and cut off light penetrating the water's surface, which is essential for them to grow. Decomposing algae also restricts the oxygen available in the water, and this lack of oxygen further effects the growth capacity of seagrasses.

## Key Points

- Understanding the Pathways of Pollution is the most important factor in discussing sedimentation and nutrients. Students should be familiar with the connection of the home, school and industry to the Lake environment.
- Potential measures to limit the problems of sedimentation should be discussed. Broader issues such as an appreciation of the natural systems over hard engineering solutions should not be ignored. Steps available to individuals should be encouraged. These include: limiting the use of garden fertilisers, sweeping driveways and pathways rather than hosing them down, responsible disposal of pet faeces and washing cars and other equipment on lawns instead of roads, so that soils and minor pollutants can be absorbed instead of flowing into the Lake.



# Activity Sheet..... 5

**Topic: Sedimentation & Nutrients**

**Name:** \_\_\_\_\_

## Water Testing

- Test the water quality in the following situations and describe your findings:

1. Straight from the tap. -

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2. Water flowing over the quadrangle.

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3. Water flowing over the school car park.

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4. An area of eroded land on school site or nearby.

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- Observe the differences in water quality and discuss the causes for any differences you identify.

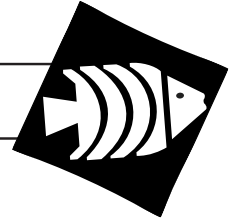
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## Activity Sheet: 5 - Sedimentation & Nutrients



### 1 Testing Water Quality

- Test water quality in the following situations:

1. Straight from the tap.
2. Water flowing over the quadrangle.
3. Water flowing over the school car park.
4. Water sample taken from Lake Macquarie.

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- Students to write a report on the differences in results between the different surfaces.

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- Relate the findings of the experiment to different levels of water quality found throughout Lake Macquarie.

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# **Channel & Entrance Issues**

# Channel & Entrance Issues

The ocean entrance to Lake Macquarie was named Reid's Mistake, after Captain William Reid mistook the island at the mouth of the 'bar lagoon' for that of Nobby's Island at the mouth of the Hunter River.

In 1801, a vessel called the Lady Nelson was nearly lost at the entrance as navigation through the area proved treacherous for many sailors new to the waters.

There is a long history of attempts to maintain a navigable channel from the ocean into the Lake. Strategies to manage the entrance and channel were implemented with the construction of training walls and breakwaters. From 1878, the link between ocean and Lake can be described as a 'constructed channel'.

By 1914, the sand spit on the northern side of the entrance had been removed as a result of the breakwaters. The construction of the Swansea Bridge and breakwaters saw dynamic changes to the entrance and the expansion of the 'drop over' (an area of shifting shoals built up where water flow slows and drops sand), located between Marks Point and Coon Island. With increased boating activity, wave attack on the foreshore has also added to the problem.

Dredging of the channel began in the 1950s and continues today, in order to keep the channel open and safe for navigation. As we begin to realise the side effects of maintaining boating access through the entrance, the value of dredging and other measures requires careful evaluation.

## Key Points

- Lake Macquarie is defined as a 'barrier lagoon', meaning that it has a natural tendency to shoal up and be separated from ocean waters.
- Strategies to 'manage' the entrance and channel were implemented with the construction of 'training walls' and breakwaters. These efforts have indirectly resulted in some serious environmental issues in the local area, such as the erosion of Salts Bay and the threat to wetland areas in Black Neds Bay.
- Dredging at the channel entrance began in the 1950s and continues today, as a means of maintaining safe navigable waters for boating traffic.
- Debate on the dredging of Swansea Channel for boating access has been clouded by claims that the strategy will improve water quality. Studies show that any advantages of dredging are limited to navigation and would not noticeably improve water quality through increased tidal exchange. This is due to the massive volume of water present in the Lake. Even an extensive dredging program would mean little increase in the tidal exchange in the Channel, which currently remains stable at around 1%.

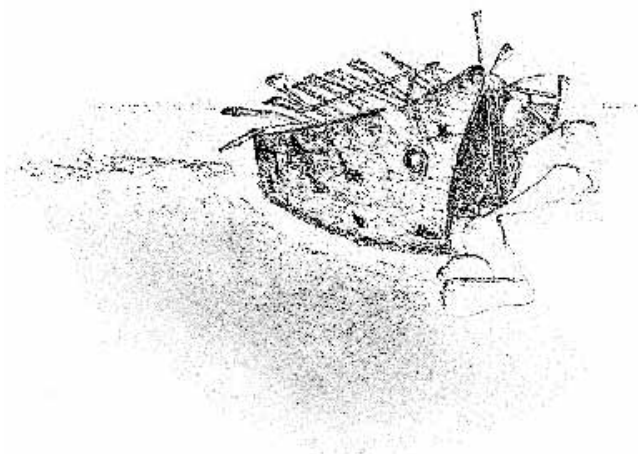
## Vital Signs

- Stabilisation works at Salts Bay have been completed, including beach nourishment and the construction and progressive extension of rock groynes located along the beach. 32,500 cubic metres of sand were used in the project.
- It is estimated that without the stabilisation works at Salts Bay, the area would suffer a loss of up to 27 metres of land from the foreshore over a ten-year period.

The Office of the Lake Macquarie & Catchment Coordinator recently committed more than \$600,000 to restoration works at Salts Bay, to address serious erosion issues which have been in part caused by the man-made changes to the ocean entrance. The issue at the centre of the debate is to what level the entrance is kept open at the risk of further degradation of the environment, which requires considerable funding to address in order to maintain amenity for the many local people who use the area.

Lake Macquarie has been a cornerstone of life in the local community for many years. Recreational benefits such as fishing and boating, as well as the importance of tourism and commercial fishing to the local economy are a feature of the area. This means the channel entrance issue is of great importance to the local community and there are strong feelings from people from both sides. The channel entrance debate is an example of a contemporary environmental issue where the challenge is to reconcile economic and recreational desires with what is good for the environment.

Children should be encouraged to investigate the history of the channel entrance and to appreciate the changes which have occurred in the local environment following engineering solutions to maintain safe navigation for boats in the area.



# Activity Sheet..... 6

## Topic: Channel & Entrance Issues

Name: \_\_\_\_\_

### Cloze Word Exercise - The History of the Lake

#### Word List

- Reid's Mistake
- Pelican Flats
- Swansea Channel
- Hunter River
- Lake Macquarie
- Coal
- Captain William Reid
- Governor Lachlan Macquarie
- Martha

### The History of Lake Macquarie

The discovery of \_\_\_\_\_ was an accident. The area was first known as \_\_\_\_\_, after \_\_\_\_\_.

Captain Reid was on his way to the \_\_\_\_\_ from Sydney in 1800, to collect cargo of \_\_\_\_\_. But instead of the Hunter River, he sailed his 30-tonne schooner \_\_\_\_\_ into a salt-water inlet a few miles south of his destination.

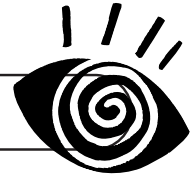
It wasn't until Captain Reid returned to Sydney that his error was uncovered, and the area was soon widely known as Reid's Mistake. The name lasted until 1826, when it was officially changed to honour \_\_\_\_\_.

The first bridge across \_\_\_\_\_ was built in 1883.

The original name given to the area now known as Swansea was \_\_\_\_\_.



## Activity Sheet: 6 - Channel & Entrance Issues



### 1 Case Study - The Changing Natural Environment

The ocean entrance to Lake Macquarie has always presented difficulties for European navigators. Swansea Heads was first known as "Reid's Mistake", after Captain William Reid mistook the island at the mouth of the "bar lagoon" for that of Nobby's Island at the mouth of the Hunter River. In 1801, the Lady Nelson was nearly lost at the entrance and thus the scene was set for navigation problems over the next 200 years.

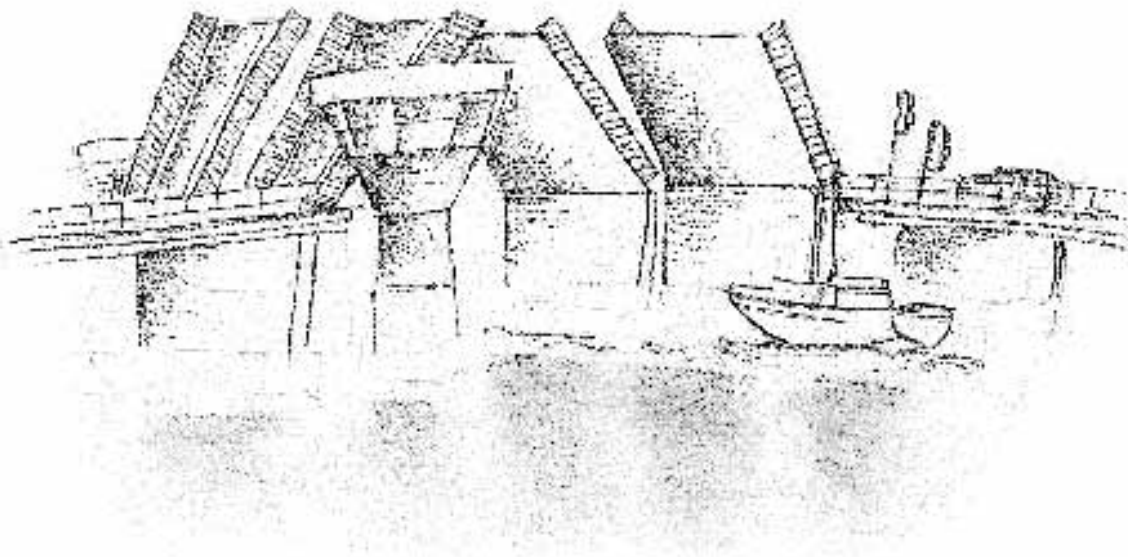
The entrance has undergone many changes which have resulted in changes to the natural environment. Investigate two major (man-made) changes to the entrance and trace the effects they have had on the natural environment.

#### Suggestions:

- Change One
  - Effect
  - Change Two
  - Effect
- Erection of Swansea breakwalls
  - Erosion of beach at Salts Bay
  - Building of Swansea Bridge (Northern Approach)
  - Narrowing of channel impacting on the tidal prism and the 'drop over' at Marks Point

#### Web Reference:

<http://www.infohunt.nsw.gov.au/livinglakemacquarie/main05.html>



***Estuary Management -  
Maintaining Ecological  
Balance***

# Estuary Management - Maintaining Ecological Balance

“Beautiful in its natural condition... Waters teeming with fish, and large stocks of good timber awaited exploitation.”

(N.M Clout, *The Child of Bahtahbah: A Brief History of Belmont, Lake Macquarie, New South Wales*)

In many ways, one word from the above quote summarises the way we have approached Lake Macquarie for much of the time since European settlement - exploitation.

However, as we have become increasingly aware of the interactive nature of natural systems we have begun to appreciate that such exploitation is not sustainable in the long term.

Along with the idea of exploitation, much of the thinking throughout the history of European settlement in the region has been concerned with conquering nature. Hard engineering solutions were implemented to address environmental issues,

mostly without a real understanding of the natural systems they sought to replace.

One main example is the installation of concrete drainage lines throughout the catchment, used to replace naturally vegetated drainage lines. The loss of vegetated drainage lines means that stormwater run off is not filtered effectively. Replacing these systems with concrete drainage lines means more water flows into the Lake and at greater speeds, accelerating the natural processes to a point where the Lake cannot cope.

In an effort to make stormwater management systems more efficient and to achieve more of a landscaped appearance, the balance of the natural system is destroyed. Only in recent years, as our awareness and appreciation of natural systems has grown have we realised the misdirection of the hard engineering approach.

## Key Points

- An understanding of natural systems and how they interact with each other within the Lake environment is the key to estuary management. The Treatment Chain explains the connections between the family home and the Lake environment and familiarity of this concept should be encouraged in the classroom. An understanding of the causes of environmental problems will prove to be more effective than a list of *édois* and *dontsí* in the longer term.
- Addressing issues in estuary management requires physical works, continued studies and monitoring to direct future programs, and measures to increase awareness and understanding of the issue within the community.



## Vital Signs

- The Office of the Lake Macquarie & Catchment Coordinator carries out an annual survey to measure the awareness and perceptions of environmental issues in the Lake. Surveys are considered an important tool in measuring the effectiveness of community education programs. By comparing results from different years, it is possible to trace improvements in awareness and identify issues or community sectors that require more attention in future strategies.
- In the first survey carried out in 2000, respondents were asked to list the top three issues concerning their community. The Lake ranked third with 10% of respondents including it in their

top ten. When the survey was repeated in 2001, the response was very different. 27.1% of respondents included the Lake, beach and waterways in the top three issues, making it the most important issue in the community, alongside crime. From this it can be seen that the community is becoming increasingly aware of local environment issues.

# Activity Sheet..... 7

## Topic: Estuary Management - Maintaining Ecological Balance

Name: \_\_\_\_\_

### Research Project - Community Survey

The Office of the Lake Macquarie & Catchment Coordinator carries out an annual survey to measure community awareness and perceptions in relation to the environment in Lake Macquarie. The official reports of both 2000 and 2001, are available on the Living Lake Macquarie web site - [www.livinglakemacquarie.org](http://www.livinglakemacquarie.org)

- Students are to conduct face-to-face or telephone surveys on five family members or friends and write a summary report.
- List below some questions that you might be able to be used in the survey:

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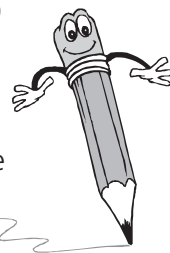
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## Activity Sheet: 7 - Estuary Management, Maintaining Ecological Balance

### 1 Write Your Own Summary Report



The Office of the Lake Macquarie & Catchment Coordinator carries out an annual survey to measure community awareness and perceptions in relation to the environment in Lake Macquarie.

- Students are to conduct face-to-face or telephone surveys on ten people and write a summary report. The report should also compare results with the official reports of both 2000 and 2001, which are available on the Living Lake Macquarie web site - [www.livinglakemacquarie.org](http://www.livinglakemacquarie.org)

OR

- Students are to refer to the data collected during the 2000 and 2001 surveys. Selecting 3-4 separate questions, write an interpretative report on the data and compare any changes or shifts evident between the 2000 and 2001 results.

***Sustainable Living  
For A Brighter Future***

# Sustainable Living For A Brighter Future

Lake Macquarie is a site of constant environmental change. This change includes natural evolution of the interacting elements in the ecosystem, as well as reactionary changes to human interaction.

Natural change within the Lake system is constant and inevitable, as the ecosystem works to maintain a state of dynamic balance. This type of change is very slow, and is often invisible to the naked eye. Only by comparing photographs from different eras is it possible to clearly identify many of the changes that take place around the Lake.

Human interaction with the Lake ecosystem can have potentially negative effects in two ways. The first is by increasing the rate of sedimentation and nutrient enrichment of the system. Things like land clearing associated with urban developments, industry and even the average home are all diffuse sources of pollutants which can be carried into the Lake in stormwater.

The second type of human interaction is the use of hard engineering solutions within the environment. Many of these solutions fail to recognise the complexity of the natural systems they replace, and while they achieve their aesthetic aims (making the local area appear neat and tidy) they have potentially greater far reaching effects on the Lake ecosystem.

The installation of concrete drainage systems throughout the catchment is one example of this type of hard engineering

thinking. These systems are very efficient in moving stormwater from the home or industry site, but the hard impervious surfaces do not achieve the same levels of filtration or absorption which are performed by natural, vegetated systems.

Similarly, the erection of vertical sea walls on foreshore private property limits the interaction between aquatic life and land animals, as well as stopping the natural process where dead seagrass can be washed onto sloping beaches. Instead the seagrass is stuck in shallow areas, which not only destroys the natural beauty of our area but also harms the growth of new aquatic life.

Throughout the catchment, The Office of the Lake Macquarie & Catchment Coordinator is supporting programs which attempt to manage stormwater, such as the construction of wetlands and the use of native vegetation and naturally sloping beaches to stabilise foreshore areas. These initiatives are a deliberate shift away from the hard engineering thinking which has dominated past generations. As our knowledge of natural systems and the complexity of the Lake system develops, we are more capable of achieving development and population growth which is less invasive on the local environment.

What we need to do as a community is to appreciate that natural environmental change is healthy. At the same time, we need to find ways to limit the impacts which accelerate this natural change.

## Vital Signs

- Governments and regulatory authorities are developing new controls over the development of land to improve the way we live with our local environment. These principles are broadly known as Water Sensitive Urban Design principles. Instead of eliminating natural features such as wetlands and vegetated waterways drainage lines, Water Sensitive Urban Design looks at ways that these features can be incorporated into land development.

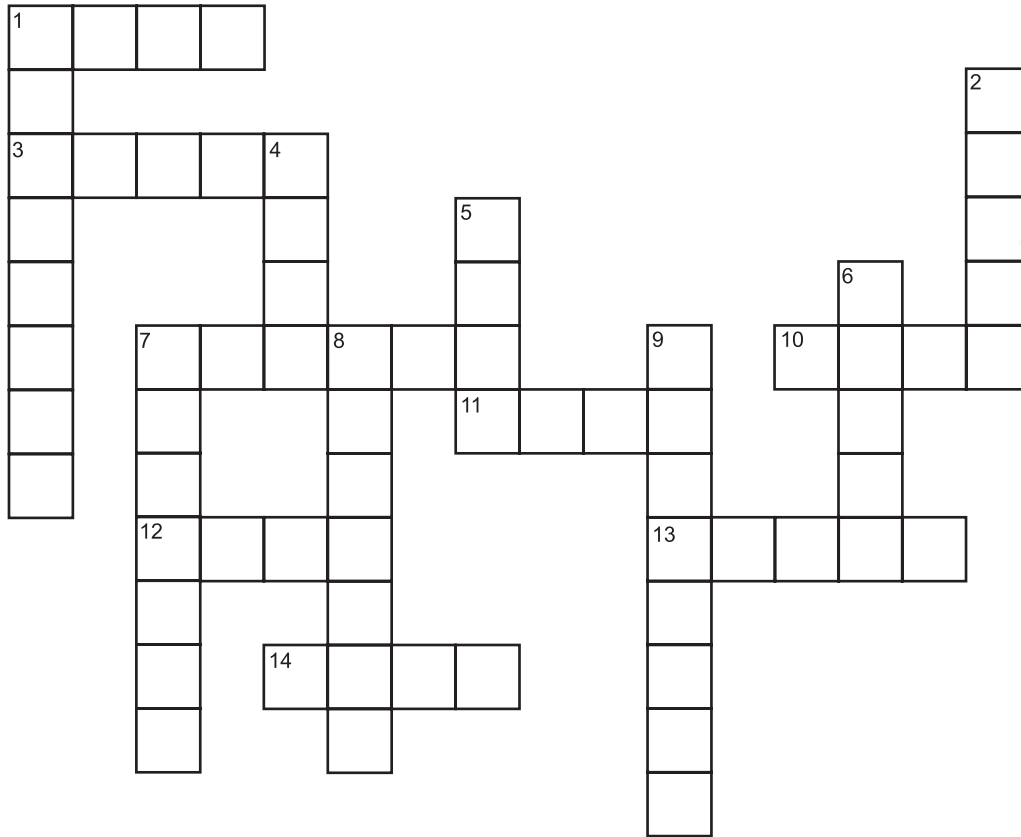
Not only does the natural environment add to the aesthetic qualities of land development, but the environmental health of the surrounding areas (the catchment) is improved. Another phrase used to describe the 'new thinking' in land development and environmental management is environmentally sustainable development.



# Activity Sheet..... 8

## Topic: Sustainable Living for a Brighter Future

Name: \_\_\_\_\_



### Across

1. The Lake is a popular place to do this.
3. \_\_\_\_\_ Blooms
7. Salty, Cold Tea and Cockle are what?
10. Warners, Fennell and Edmunds are what?
11. The treatment chain starts in your \_\_\_\_\_.
12. Black \_\_\_\_\_ Bay.
13. Plants need this to grow.
14. Watercraft used on the Lake.

### Down

1. Type of plant life found in the Lake.
2. \_\_\_\_\_ Mistake. The original name of Swansea Heads.
4. \_\_\_\_\_ Macquarie.
5. Poor water quality can make it hard for these to live.
6. \_\_\_\_\_ment. Large area of land which catches and collects water for a stream, creek or Lake.
7. Swansea \_\_\_\_\_.
8. This can happen to shorelines where there is no vegetation.
9. Swampy areas

ANSWERS:  
ACROSS: 1. Swim 3. Algal 7. Creeks 10. Bays 11. Home 12. Neds 13. Light 14. Boat  
DOWN: 1. Seagrass 2. Reids 4. Lake 5. Fish 6. Catch 7. Channel 8. Erosion 9. Wetlands

# Activity Sheet: 8 - Sustainable Living For A Brighter Future

## 1 Sketch a Sub-division

Water sensitive urban design (WSUD) is an integrated approach to incorporating water management systems into urban development.

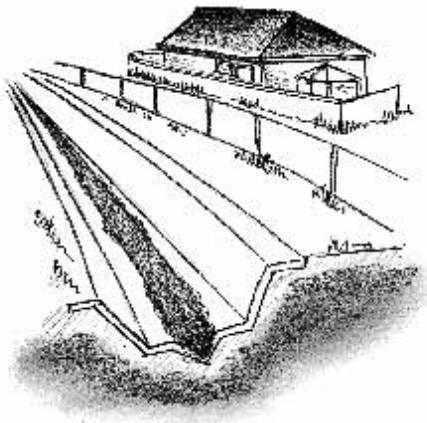
WSUD is based on the principles of water efficiency and reuse and steers away from the hard impervious surfaces like concrete drainage lines favoured by past generations.

Most importantly, water is treated as a resource rather than a waste product. The focus is on addressing pollution problems at the source rather than constructing expensive engineered add-ons downstream.

WSUD attempts to create new solutions and efficient systems that are more attractive to prospective purchasers, increase the value of adjacent land, and avoid expensive new infrastructure or augmentation costs.

The images below represent the differences between traditional development and water sensitive urban design.

- Research examples of water sensitive urban design on the internet.
- Sketch a housing sub-division which incorporates natural features as part of the development.



Standard Urban Design



Water Sensitive Urban Design

Standard Urban Design	Water Sensitive Urban Design

# Glossary of Terms

**Catchment:** A large area of land which catches and collects water for a river, stream, creek or lake.

**Nutrient cycle:** The constant transfer of essential nutrients from living organisms to the physical environment and back to the organisms in a cyclical pathway. This sequence is achieved by the physical processes such as weathering and/or biological processes such as decomposition.

**Sedimentation:** The deposition of sediment. Sediment in the soil particles and rock fragments transported and deposited by the action of rivers, glaciers, sea and wind.

**Eutrophication:** The process of nutrient enrichment of an aquatic system. In water environments like Lake Macquarie, occurrence of eutrophication has increased in frequency due to urban development and agricultural production. The nutrients accumulate at a greater rate than can be recycled by decomposition or used in photosynthesis, often resulting in algal blooms.

**Riparian Vegetation:** Vegetation in areas around the edge of streams.

**Littoral Vegetation:** Vegetation in the area around the edge of the Lake.

**Delta:** The flat area, normally fan shaped, at the mouth of some water courses and creeks where the main stream divides into

several distributaries. Examples of deltas can be found throughout Lake Macquarie, such as Five Islands at Speers Point. Deltas occur where there is an accumulation of sediment deposited in the Lake. This happens when fast flowing waters meet with areas of still water. While the fast running water is able to carry sand and sediments along with it, this material is deposited once the velocity of the current slows. The sand and sediments are dropped to create the delta. Wave action and currents may work with sedimentation to shape a delta.

**Algal Blooms:** The temporary rapid growth of algae in water. During the early part of the growing season an abundance of nutrients in the surface waters combined with an increase in water temperatures allows algae to rapidly multiply, until one nutrient becomes scarce or limiting, usually nitrogen. The phase of rapid growth is followed by the algae dying off very quickly and it rises to the surface of the Lake forming a green scum. The decomposing algae consume large quantities of oxygen dissolved in the water causing the waters to become anaerobic, killing most of the aquatic life (primarily fish). These are often more prominent in shallow areas and enclosed bays, where there is often high nutrient input from nearby urban development.

**Estuary:** semi-enclosed coastal body of water which has a free connection with the open sea, but within which the salinity level of the ocean is considerably diluted by the addition of fresh water brought in by a river system.

## On-Line Resources

<http://www.livinglakemacquarie.org/>

<http://www.epa.gov/airmarkets/acidrain/experiments/index.html>

<http://www.epa.gov/>

