TABLE OF CONTENTS

SUMMARY AND RECOMMENDATIONS

Background

Lake Macquarie is a large estuarine lake some 110 square kilometres in area and with a total catchment area of approximately 605 square kilometres.

The ecology of the Lake is characterised by fringing mangroves, wetlands and seagrasses, and an abundance of aquatic life including fish and waterbirds.

The Local Government areas of the City of Lake Macquarie and the northern part of Wyong Shire support a population of approximately 190,000 and a variety of commercial operations including tourism, forestry, mining, minerals processing, power generation and fishing. This urban growth over many years, as well as some industries and commercial operators has placed the Lake's ecosystem under increasing stress.

In recent years through management initiatives and involvement of Councils, government agencies, industry and the community, the health of Lake Macquarie has improved significantly. The major initiatives include:

- ❑ reticulation of sewerage to approximately 97% of the catchment and virtual elimination of discharges of Wastewater Treatment Plants to the Lake;
- ❑ installation of sediment/erosion and stormwater control devices in the catchment;
- ❑ improved community awareness and involvement in Landcare and other environmental initiatives;
- ❑ improved planning and regulation by Lake Macquarie City Council and Wyong Shire Council; and
- ❑ major investment by power stations, mines and industry to eliminate and reduce stormwater and other discharges (particularly selenium and lead into the Lake).

The Premier of NSW, to address issues affecting the health of Lake Macquarie, established Lake Macquarie Taskforce in April 1998. Its terms of reference required it to:

- ❑ review the Lake Macquarie Estuary Management Plan and recommend a priority action plan and appropriate institutional arrangements for implementation;
- ❑ review and recommend strategies that would alleviate the impact of current planning, development and urbanisation on Lake Macquarie;
- ❑ review available evidence and seek expert advice to assess the likely causes of the problems requiring remediation under the priority action plan as a basis for determining and recommending appropriate price sharing arrangements. Consideration was to be given to identifying alternative sources of funding including the private sector and the Natural Heritage Trust; and

- review the Lake Macquarie fisheries and recommend action in relation to conflict between recreational and commercial effort, and give consideration to marine reservation and the potential for stock enhancement and aquaculture.

The Taskforce has drawn extensively on the considerable body of available information on Lake Macquarie, including:

- The Lake Macquarie Estuary Process Study (1995);
- The Lake Macquarie Estuary Management Study and Plan (1995);
- The Lake Macquarie Estuary Management Plan (1997); and
- the extensive volume of studies and monitoring carried out by various organisations in recent years.

The Taskforce established four (4) expert subgroups, as follows:

- Biophysical;
- Hydraulic;
- Fisheries; and
- Funding and Structures.

The purpose of the subgroups was to develop action plans and priorities for:

- Water quality;
- Lake health monitoring;
- Land use planning;
- Community education and participation;
- Biodiversity conservation;
- Fisheries and aquatic habitat;
- Estuary and tributary remediation;
- Entrance channel navigation;
- Entrance channel foreshore erosion; and
- Integrated management.

Outcomes resulting from the action plans were integrated to produce a three-year priority action plan for the Lake and its catchment. The priority action plans were developed for critical sub-catchments as well as for the whole of the Lake to ensure that all strategies for a sub-catchment could be integrated.

In developing action plans, it was recognised that to be sustainable, human activity needs to strike an appropriate balance between economic viability, environmental stewardship and social needs.

Program Expenditure

The priority action plan envisages total new expenditure of $12.5 million over the three-year period. This amount does not account for normal expenditure on the Lake by State Government, Lake Macquarie City Council and Wyong Shire Council.

In addition major industries, Hunter Water Corporation and power stations within the Lake's catchment are scheduled to spend over $29 million during the three-year period, some of which has been a result of their participation on the Taskforce.

Project Management

This document sets out a management framework based on the principles of ISO 14001 Standard for Environmental Management Systems, which provides a logical structure for planning, implementation of actions and review leading to best practice environmental management and continual improvement.

A management structure has been recommended, which consists of a Lake Macquarie Project Management Committee reporting to the Minister for Land and Water Conservation. A Lake Macquarie Estuary Co-ordinator will be employed to co-ordinate estuary and catchment management and remedial work proposed for the Lake. Community and Industry participation will occur through membership of the Lake Macquarie Estuary and Coastal Management Committee.

Taskforce Recommendations:

The Taskforce makes the following recommendations:

1. that the State Government, Lake Macquarie City Council, Wyong Shire Council, industry, authorities and the community accept the report as a comprehensive assessment and integrated plan for improving the conditions and maintaining the improved conditions of Lake Macquarie and its catchments;

2. that the State and Federal Governments, Lake Macquarie City Council, Wyong Shire Council, industry, authorities and the community accept the responsibility for and work together towards the remediation and maintaining those improved conditions of Lake Macquarie and its catchments;

3. that Lake Macquarie City Council contributes a minimum of $1.3m per annum towards implementation of the three-year priority action plan and consider introducing an environmental rate towards achieving this objective;

4. that Wyong Shire Council contributes a minimum of $100,000 per annum over three years towards implementation of the three-year priority action plan;

5. the State Government contribute over $7.7m over three years towards implementation of the three-year priority action plan;

6. the Minister for Land & Water Conservation, in conjunction with Lake Macquarie City Council and Wyong Shire Council, have carriage for the implementation of the three-year

priority action plan and set up a management framework that will be supported by a Lake Macquarie Estuary Co-ordinator;

7. that government and the community accept, as a long term objective, the removal of commercial fishers from Lake Macquarie through a voluntary buy-out scheme;

8. that the State Government and Lake Macquarie City Council accept the need from a recreational, boating, tourist and safety perspective, the need to maintain access into Lake Macquarie through Swansea Channel;

9. that the Department of Urban Affairs and Planning, Lake Macquarie City Council and Wyong Shire Council –

   (i) review existing urban settlement strategies within the Lake's catchments to confine the development of new urban areas to areas that are sewered and achieve the best water quality and visual amenity for the Lake. There is to be no net increase of sediments and nutrients from new development; and

   (ii) together with the Lake Macquarie Estuary Co-ordinator, develop a Strategic Environmental Impact Assessment and approval process for programmed Lake remediation works, in order to deliver an integrated and timely assessment approval process for these works.

10. that existing mooring strategies be reviewed by the Waterways Authority with a view to reducing the damage to seagrasses; and

11. that all parties accept that the task of remediation will not be complete after the three-year period and provision be made for ongoing remedial work.

1. BACKGROUND

1.1 Lake Macquarie and its Management

Lake Macquarie is a large estuarine lake some 110 square kilometres in area and with a total catchment area of approximately 605 square kilometres. The Lake is a marine dominated estuarine lagoon with limited tidal exchange. Activities within the catchment have a profound effect on the Lake which acts as a sediment (and hence nutrient) trap for catchment runoff.

The ecology of the Lake is characterised by fringing mangroves, wetlands and seagrasses, and an abundance of aquatic life including fish and waterbirds. There are a number of threatened bird species, which depend on the Lake and its littoral habitat.

The Local Government areas of the City of Lake Macquarie and the northern part of Wyong Shire support a population of approximately 190,000, in addition to a variety of commercial operations including tourism, forestry, mining, minerals processing, power generation and commercial fishing.

Lake Macquarie, because of its natural attributes and economy, is recognised as being of major significance to New South Wales and the region.

Some areas of the catchment have been designated to meet the future housing demands of a growing population. If Lake Macquarie is to provide a healthy place to live and work, a healthy local ecosystem is essential. Furthermore, the Lake and its tributaries are attractive areas for both passive and organised recreation. Therefore, any long-term management strategy for the Lake and its catchment must maintain and enhance the attractiveness of the area for residents and visitors.

Because of these interactions, maintaining water quality in the Lake whilst permitting development in the catchment, is a matter of some complexity. Over the past 100 years, the Lake's ecosystem has been placed under increasing stress by population growth resident within its catchment as well as the stresses imposed by industry, construction, commerce, fishing, tourism, recreation and other land uses. Recently, the rapid deterioration in the quality of the Lake has been arrested by a range of management initiatives, which include:

- Lake Macquarie Audit and subsequent annual reviews (1984 - 1991);
- the activities of the Lake Macquarie Catchment Management Committee;
- the activities of the Lake Macquarie Estuary and Coastal Management Committee;
- the activities of the Environment Protection Authority (and its predecessor, the State Pollution Control Commission) working with the Hunter Water Corporation, power stations, mines and other licensed industries to reduce the volume and improve the quality of discharges to the Lake; and
- the activities of Lake Macquarie City Council and Wyong Shire Council.

As a result, the health of Lake Macquarie has improved significantly in recent years. Specific improvements over the period include:

- reticulation of sewerage to approximately 97% of the catchment and virtual elimination of discharges of Wastewater Treatment Plants to the Lake;
- installation of sediment/erosion and stormwater control devices in the catchment;
- improved community awareness and involvement in Landcare and other environmental initiatives;
- improved planning and regulation by Lake Macquarie City Council and Wyong Shire Council; and
- major investment by power stations, mines and industry to eliminate and reduce stormwater and other discharges (particularly selenium and lead into the Lake).

Significant milestones affecting the environment of the Lake and Catchment are shown in Figure 1, Appendix 1.

The challenge now is to build on the achievements to date and to implement a program for the ongoing management of the Lake and its catchments based on Ecologically Sustainable Development principles.

1.2 Socio-Economic Issues

The natural attributes of Australia's largest coastal lake have contributed to the growth and development of important social and economic infrastructure. The combination of these factors ensures that Lake Macquarie's identity is of national significance. The current environmental stress and risks of further degradation to the Lake will have negative affects on the socio-economic trends unless the estuary and catchment are managed appropriately.

1.2.1 Population

The City of Lake Macquarie has a population approaching 180,000 people with an approximate annual growth rate of 1.04%. From 1996-97, Lake Macquarie had the 12th largest resident population increase in Australia of 2,197 people. By year 2011, population is anticipated to increase to 197,026 people. The North Lake Macquarie Planning Sector is expected to have the largest growth rate with an anticipated population increase by the year 2000 of 6,500 people.

The Wyong Shire local government area, which takes in approximately 35km^2 of the Lake's catchment, has a population of 8,300 people. Population will continue to increase gradually.

1.2.2 Recreation

The Lake Macquarie region is of high recreational significance. It is the largest seaboard salt-water lake in Australia, and is utilised for boating, sailing, swimming and fishing. There are 31 jetties and wharves and 35 boat launching ramps around Lake Macquarie for public use. The number of boat moorings in the Lake is approximately 2,300.

There are 6 amateur sailing clubs catering for dinghy-type craft, and 4 yacht clubs involved in yacht sailing on the Lake as well as ocean racing. The Lake Macquarie Yacht Club holds State and National Titles annually, which bring approximately 2,000 people to the Lake and up to $400,000 to the local economy. Belmont 16-foot Sailing Club also holds State and National Titles on an annual basis and other events. The Toronto Yacht Club is involved in powerboat racing, with a large regatta held annually in June.

There are nine charter-boat operators who are involved in the hire of yachts, houseboats, floating restaurant and cruise vessels. There are a number of fishing clubs associated with the Lake.

The Lake's catchment and surrounding lands support organised sport, bushwalking, sightseeing, bike-riding, orienteering and nature study.

The foreshore zone provides for picnic areas and parks and other passive recreation.

Together, these clubs and recreational activities account for a significant proportion of visitors to the City of Lake Macquarie and make a substantial contribution to the local economy.

1.2.3 Commerce and Industry

The City of Lake Macquarie has a labour force of 67,184 people. Significant proportions (16.4%) of these people are employed in retail trade. The sectors of manufacturing, mining and electricity, gas and water supply together account for almost 20% of employment in the area.

There are 6,350 small business (including home enterprises) in the city.

While the City of Lake Macquarie provides employment for a great number of people, it nonetheless has a high level of unemployment. The unemployment rate is approximately 10.9%, which is over 3% higher than that for NSW generally.

However, over the past 10 years, the City of Lake Macquarie has defied a national downward trend and actually expanded its manufacturing sector by more than 1,000 jobs. During the same period, 46% of all new jobs in the Lower Hunter have been created in the City of Lake Macquarie. The Cardiff Industrial Estate is the biggest industrial employment node in the Hunter.

The tourism industry is of great value to the City of Lake Macquarie. In 1995-96, there were approximately 836,000 visits to the City, generating a total expenditure of $169 million. This was the greatest number of visitors and the highest level of tourist expenditure of all Local Government Areas in the Hunter Region, indicating that the City of Lake Macquarie's unique characteristics make it an important tourist destination.

The Lake is also an important source of fish for the commercial fishing industry. In 1997, there were 35 commercial fishermen operating in Lake Macquarie producing a total catch valued at over $1 million.

There are 8 coal mines in the catchment of Lake Macquarie which provide employment for 1,716 people. The local industry has a total saleable production of 8.14 million tonnes of coal, which represents 55% of the total production for the Newcastle Coalfield, with an economic value of over $244 million. There are two power stations located on the edge of Lake Macquarie, which rely on the Lake for cooling water. In 1997, Eraring Power Station provided in excess of 20% of the State's electricity market demand while Vales Point Power Station provided 10.5% of this demand.

Pasminco Metals-Sulphide has been operating in the City of Lake Macquarie for over 100 years, producing 90,000 tonnes of zinc and 35,000 tonnes of lead per year. The plant employs 260 people and each year spends $50 million in the regional economy and a further $80 million on raw materials from elsewhere in Australia.

At the southern end of Lake Macquarie, the Wyong Shire portion of the catchment contains a mix of residential, industrial, commercial and agricultural land, which is currently vegetation.

1.2.4 Lifestyle 2020

In June 1997, Lake Macquarie City Council embarked on the Lifestyle 2020 Project. The project is a comprehensive strategic planning initiative for the City and will result in an integrated land use strategy and a detailed implementation plan.

For such a comprehensive project, detailed project management arrangements were established and specific technical studies identified and undertaken early in the process. During 1998, there has been ongoing information gathering through community participation workshops, and liaison with public authorities and the business community.

To integrate the results of the various technical studies and community inputs, Council has established a series of intensive Planning and Design Workshops for each Planning District.

Three main issues have become most apparent as a result of the workshops. These are the need to:

- stop further development which contributes to a decline in water quality in the Lake and, instead, to foster water sensitive urban designs;
- to generate more employment opportunities within the City; and
- to reduce the dependence on private vehicle usage and to make urban areas more livable by reducing crime opportunities, improving building aesthetics and regaining or strengthening community identity in the various villages and townships.

The results of these workshops have been of considerable assistance to the Taskforce.

1.3 Community Involvement in the Lake Macquarie Estuary and Catchment Management

During the preparation of the Lake Macquarie Estuary Management Plan in 1997, a community information and consultation strategy was implemented to provide information about the results of investigations into the Lake's physical and ecological character and about the Management Plan.

A series of short brochures was distributed widely within the community and two community discussion meetings were convened. The community was also invited to make written submissions on the draft document.

Seventy-three people attended the discussion meetings, and about 65 detailed written submissions were received on the draft Plan. At each of the community discussion meetings, people were asked to identify and to rank issues of concern to them. The community identified 30 different issues for the main body of the Lake, and a further 7 issues relating to the entrance channel and nearby foreshores. However, 8 issues were consistently identified as significant. Each was identified by more than 10% of respondents and the order reflects the number of times an issue was raised.

- ❑ Need to improve navigation in the entrance channel.
- ❑ Need for foreshore restoration at Pelican and at Salts Bay.
- ❑ Siltation of bays, tributaries and the nearshore areas.
- ❑ Threats to Lake water quality.
- ❑ Depletion of fish stocks.
- ❑ Need to protect wetlands.
- ❑ Improved recreational facilities (foreshore parks, jetties).
- ❑ Restoration of aquatic habitat.

The community remains actively involved in the management of the estuary and catchment through the Lake Macquarie Catchment Management Committee and Estuary and Coastal Management Committee. In addition, there are 24 Landcare Groups undertaking restoration projects, while 14 schools have Streamwatch programs that monitor the water quality of tributaries of the Lake.

1.4 Studies and Monitoring of the Lake

Over the years, Lake Macquarie has been extensively studied and monitored by a number of organisations including:

- ❑ Lake Macquarie City Council;
- ❑ Wyong Shire Council;
- ❑ Hunter Water Corporation;
- ❑ Pacific Power;
- ❑ Delta Electricity;
- ❑ Pasminco Cockle Creek Smelter;
- ❑ The Department of Land and Water Conservation;
- ❑ NSW Fisheries;
- ❑ Environment Protection Authority;
- ❑ Streamwatch Groups;
- ❑ The University of Newcastle and other universities; and
- ❑ Waterways Authority.

Reports of studies containing important baseline information and monitoring data are listed in Appendix 9.

1.5 Lake Macquarie Taskforce

The Lake Macquarie Taskforce was established in April 1998 by the Premier of NSW to address issues affecting the health of Lake Macquarie. Its terms of reference require it to:

- ❑ Review the Lake Macquarie Estuary Management Plan and recommend a priority action plan and appropriate institutional arrangements for implementation;
- ❑ Review and recommend strategies that would alleviate the impact of current planning, development and urbanisation on Lake Macquarie;
- ❑ Review available evidence and seek expert advice to assess the likely causes of the problems requiring remediation under the priority action plan as a basis for determining and recommending appropriate price sharing arrangements. Consideration was to be given to identifying alternative sources of funding including the private sector and the Natural Heritage Trust; and

- ❑ Review the Lake Macquarie fisheries and recommend action in relation to conflict between recreational and commercial effort, and give consideration to marine reservation and the potential for stock enhancement and aquaculture.

In addressing the terms of reference, the Taskforce has drawn extensively on the considerable body of available information on Lake Macquarie, which details the various factors, which are relevant to the health of the Lake. These documents included:

- ❑ The Lake Macquarie Estuary Process Study (1995);
- ❑ The Lake Macquarie Estuary Management Study (1997);
- ❑ The Lake Macquarie Estuary Management Plan (1997); and
- ❑ The extensive volume of studies and monitoring carried out by various organisations in recent years.

The Taskforce established four expert sub-groups, viz. Biophysical, Hydraulic, Fisheries, and Funding and Structure to provide specialist advice to the Taskforce and prepare Action Plans and Priorities.

Membership of the Taskforce and the expert sub-groups is set out in Appendix 3.

Members of the Taskforce also inspected many areas within the Lake and catchment.

The establishment of a widely representative Taskforce makes it possible for State and Local Governments and the Community to have confidence in a process which will follow the principles of Ecologically Sustainable Development. The Priority Action Plan produced by the four expert subgroups of the Taskforce will facilitate ownership by urban planners, regulators, government operational organisations, industry and commerce as well as the general public of the principles and outcomes of the Plan and that their own actions support the Plan's objectives.

Considerable efforts were taken to ensure that the Community's opinions were integrated with the scientific research and members of the Taskforce inspected many areas within the Lake and catchment.

Advice from Community representatives and Councillors, with input from the Lifestyle 2020 and Estuary Management Plan consultative programs, was supplemented by two public meetings held at Belmont and Chain Valley Bay to discuss the Taskforce plan.

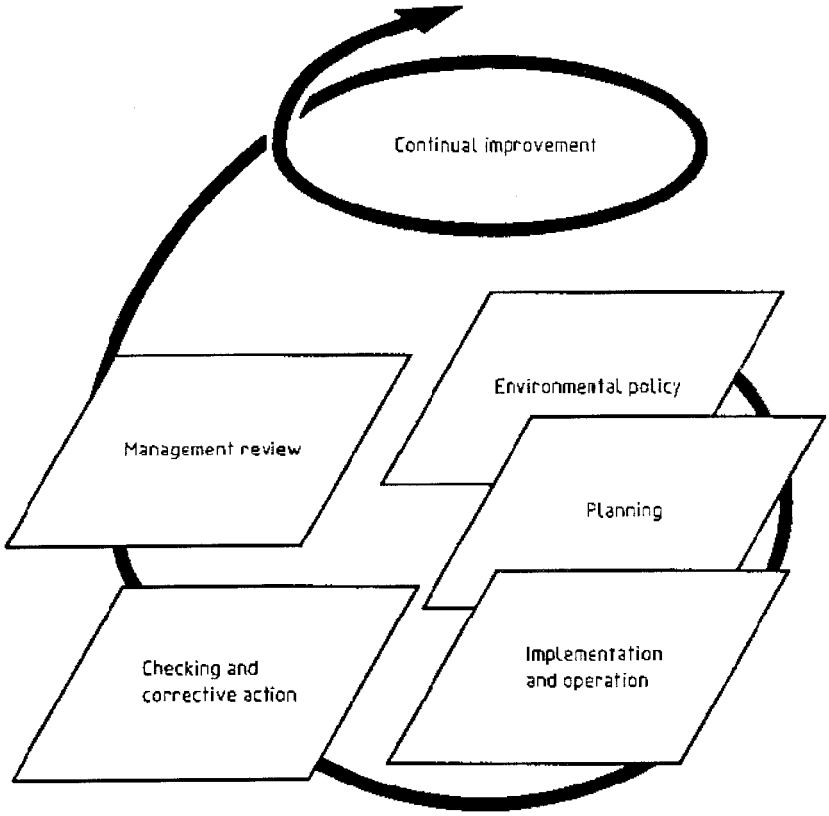
A document prepared for the public meetings, together with a summary of issues raised, is included in Appendix 8.

This document was formulated on the understanding that Councils, Agencies and Community will ensure that practices and approval processes do not reduce the substantial benefits that will be derived from the financial investment and human effort involved in the implementation of this Plan.

In order to assimilate the body of existing knowledge, address the terms of reference of the Taskforce and manage the actions, which flow from its activities, there is a need for a coherent management framework and funding arrangement to be established.

The Lake Macquarie Integrated Estuary and Catchment Management Framework sets out a management framework, which is based on the principles of the ISO 14001 Standard for Environmental Management Systems. The Standard provides a logical structure for planning, implementation of actions and review leading to best practice management and continuous improvement.

Environmental Management System Model



Reference: AS/NZS ISO 14001: 1996 ''Australian/New Zealand Standard. Environmental Management Systems - Specification with guidance for use''. Reproduced with the permission of Standards Australia.

The framework commits to broad and specific objectives, and prioritises action plans, which will be implemented by the Lake Macquarie Estuary Co-ordinator over an initial three-year period. A detailed Lake Macquarie Biophysical Monitoring Plan has already been prepared, which will allow measurement and evaluation of action proposed. The proposed review of the framework and the Office of the Lake Macquarie Estuary Co-ordinator will lead to the continual improvement of the Environmental Management of Lake Macquarie.

In reviewing the Lake Macquarie Estuary Management Plan, the Taskforce generally supported the methodology of preparation and recommendations of the Estuary Management Plan.

The findings and recommendations of the Estuary Management Plan were used as the basis for deliberation and subsequent recommendations of this Taskforce.

2. POLICY CONSIDERATIONS

2.1 Social Considerations and Sustainability

Lake Macquarie is significant to the State and region and as a result key social considerations of the Taskforce include residence, recreation and employment.

There is a clear recognition that the above social needs must continue to be met, and there is a growing understanding that social, economic and ecological objectives are interdependent but interact in complex ways.

To be sustainable, human activity needs to strike an appropriate balance between economic viability, environmental stewardship, and social needs. Excessive focus on any of these elements will ultimately be unsustainable.

The Lake Macquarie Integrated Estuary and Catchment Management Framework seeks to achieve a sustainable outcome by recognising the need for programs and solutions which achieve social and environmental objectives in an economically viable way.

2.2 Ecologically Sustainable Development

The principles of Ecologically Sustainable Development (ESD) have emerged as the fundamental framework of environmental planning and protection in NSW. In addressing environmental issues, the Lake Macquarie Integrated Estuary and Catchment Management Framework adopts ESD as a foundation.

ESD means using, conserving and enhancing our natural resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, is improved (COAG 1992).

ESD has been adopted as a goal by state, federal and local governments. In 1992, NSW along with other Australian governments signed the Inter-governmental Agreement on the Environment, which endorsed a National Strategy for Ecologically Sustainable Development.

A number of legislative initiatives of the government now specifically refer to the principles of ESD and include the:

- ❑ Environmental Planning and Assessment Act 1979;
- ❑ Protection of the Environment Administration Act 1991;
- ❑ Protection of the Environment Operations Act 1997;
- ❑ Threatened Species Conservation Act 1995;
- ❑ Native Vegetation Conservation Act 1997;
- ❑ Local Government Act 1993; and
- ❑ Fisheries Management Act 1994.

The Natural Resource Management Policies of the government, which include soils, water, riparian zones, rivers, estuaries and wetlands, also embrace these principles.

The Catchment Management Act 1989 underpins the concepts of Total Catchment Management (TCM) which is essential for the management of the natural resources of Lake Macquarie. Its objectives are to:

- co-ordinate policies, programs and activities as they relate to catchment management;
- achieve active community participation in natural resources management;
- identify and rectify natural resources degradation;
- promote the sustainable use of natural resources; and
- provide stable and productive soil, high quality water and protective and productive vegetation cover within each of the State's water catchments.

Catchment Management is a concept, which recognises catchments as natural management units. It recognises the linkages between people, landuse and physical processes in both rural and urban environments and promotes co-ordinated and sustainable use of land, water, vegetation and other natural resources. The key to protecting the environmental quality of the Lake lies in proper management of its surrounding catchment lands.

A fundamental element of TCM is the need for active community participation. Successfully managing the many issues relevant to Lake Macquarie will require actions by the community at large.

The Minister appointed the Lake Macquarie Catchment Management Committee in 1992.

Another key element is the New South Wales Government's Estuary Management Policy of 1991, the general goal of which is to achieve integrated, balanced, responsible and ecologically sustainable use of the State's estuaries which form a key component of coastal catchments. Specific objectives of the policy are to:

- protect estuarine habitats and ecosystems in the long term, including the maintenance in each estuary of the necessary hydraulic regime.
- prepare and implement a balanced long term management plan for the sustainable use of each estuary and each catchment, in which all values and uses are considered and which defines management strategies for:
  - conservation of aquatic and other wildlife habitats;
  - conservation of the aesthetic values of estuaries and wetlands;
  - prevention of further estuary degradation;
  - repair of damage to the estuarine environment; and

- sustainable use of estuarine resources, including commercial uses and recreational uses, as appropriate.

The process set out in that Policy has been followed by Lake Macquarie City Council and has involved establishing an Estuary and Coastal Management Committee in 1992 and developing an Estuary Management Plan in 1997.

ESD is our legacy to future generations who will live, work and enjoy the amenity of the Lake and it surrounds.

ESD and the various resource management policies of NSW apply to the Management of Lake Macquarie and its Catchment, and a key element for success is the recognition that there is often no single way to solve a lake or catchment issue. The best solution will bring together a range of people and their skills to tackle the problems and identify solutions.

The implementation of urban planning in the past has led to an urban design which impacts adversely upon the Lake and its catchment.

The remedies for this poor design are expensive and must be undertaken. Those parts of the Lake which are zoned for future development must not be allowed to be designed in such a way as to pass remedial costs on to future generations. There are many parts of the catchment where a more sensitive approach can yield a mixture of social, environmental and economic benefits. These will only be realised if policies are put in place to ensure that all elements within the needs of the Catchment and the Community are properly recognised now and in the future. An outstanding example of areas in need of improved planning are the southern and eastern parts of the Lake's catchment.

2.3 Establishing Priorities

The Taskforce has developed a comprehensive framework for estuary and catchment management which is based on the scientific findings and recommendations of the Lake Macquarie Estuary Management Plan (1997).

The process of developing this framework involved extensive technical input by State and Local Government representatives, industry representatives and members of key environmental organisations. The importance of identifying actions, which would provide maximum benefit to the community and environment, was acknowledged as a key objective of the process.

In response to an economic objective defined by the State Government, the process was designed to include cost benefit assessment of economic viability, ecological sustainability and community quality of life for each of the recommended management actions.

Proposed actions were also assessed to determine the extent, to which they will produce longer term, flow-on benefits to the community and environment for the 'dollars' invested.

They were also assessed for impact and benefits (with consideration of technical and economic viability) in regard to:

- water quality;

- ❑ Lake health monitoring;
- ❑ land use planning and management;
- ❑ community education and participation;
- ❑ biodiversity conservation management;
- ❑ fisheries and aquatic habitat management;
- ❑ estuary and tributary remediation and management;
- ❑ entrance channel navigation management;
- ❑ entrance channel foreshore erosion management; and
- ❑ integrated management,

giving consideration to their technical and economic viability and benefits.

Cost/benefit considerations underlie the prioritisation process. The up-front and ongoing costs for each of the identified management actions have been assessed and reviewed by the Taskforce as part of the prioritisation process. The object of this review was to identify the benefits that would be produced by the project as both an individual action and as an integrated component of the overall project.

Through the prioritisation process completed by the Taskforce, cost/benefit factors and key performance indicators on action plans were refined. This process was based on the scientific and technical knowledge of Taskforce stakeholders and has served to produce an action plan, which will effectively and sustainably meet the challenges of protecting and enhancing the Lake Macquarie environment. That represents a sound basis for the expenditure of public monies.

2.4 Economic Benefits of Seagrass Beds

Lake Macquarie has a surface water area of approximately 110 square kilometres, of which approximately 13 square kilometres is covered by seagrass. Seagrass is recognised as one of the most productive aquatic habitats and in species diversity and abundance, seagrass beds rival coral reefs.

As a source of energy at the base of the food chain, the primary productivity of seagrass beds, particularly *Zostera* (up to 1300 grams/square metre/year dry weight of above ground biomass production), may be contributing up to several thousand tonnes of dry organic matter to the Lake each year. This is consumed in the detritus food chain (bacteria and fungi), which forms the basis of the fauna food chain, as few of the animals in the aquatic habitat can directly utilise the organic plant material.

The seagrass beds act as sources of food and shelter for a wide range of animals, containing two to three times more invertebrate species than bare substrate. Studies in southern NSW seagrass beds have recorded 80 to 100 fish species living in seagrass beds. Many important commercial and recreational fish (eg. bream, mullet, flounder, whiting, leatherjacket, luderick, flathead) and prawn (school, king and tiger prawns) species enter the seagrass beds as larvae and settle. These species feed there until they reach a certain size, before moving into other habitats.

The reliance on seagrass beds of fish species has been postulated for many years. However, there is a lack of opportunity to study the hypothesis that large scale increases in the extent of such habitats result in significantly higher recruitment, and therefore increased fishery yields. Loss of seagrass and the effects on scallop fisheries have been reported for North America and Europe.

In Victoria, massive loss of seagrass beds was reported from Westernport Bay between 1970 and 1984. About 75% of the total area was denuded, with an 85% reduction in density, leading to a 40% reduction in total fin fish catches (this total includes species that do not rely on seagrass beds). In contrast, Gippsland Lakes lost extensive areas of seagrasses in 1910 and the habitats subsequently recovered. Details of the extent and timing of this recovery are not well documented, but anecdotal evidence and fish catch data indicate that the black bream and luderick catches reflected the changes in habitat. Both these species are reliant on seagrasses during the juvenile phases of their life cycles. Species that have little association with seagrasses showed little change in catch statistics. Both of these bays are semi-enclosed estuaries, similar to Lake Macquarie.

The commercial fish catches from Lake Macquarie reflect the importance of the seagrass beds. More than 95% of the total commercial fin fish catch is composed of species that are reliant on the seagrass beds at different times of their life cycle. 75% of the commercial crustacean species rely on the seagrass beds as habitat.

The loss of the seagrass beds would have a major effect on the commercial estuarine fisheries, which return approximately $1 million per annum to the area's economy. The recreational fishing industry is reportedly to be worth far more to the community than the commercial industry and any loss would be proportionally greater.

2.5 Strategic Environmental Impact Assessment and Approval Process for Lake Environmental Restoration

The Priority Action Plan recommended by the Taskforce will need environmental impact assessment and approval processes required by the Environmental Planning and Assessment Act, 1979, to be met for certain works intended to restore the natural environment. The preparation of separate environmental impact statements for similar environmental rehabilitation works in different locations is not considered by the Taskforce to be the most efficient or effective way of satisfying these requirements.

The Taskforce considers that the detailed investigation, economic assessment and community participation, together with monitoring and modelling proposed in this Plan, should lead to greater integration of activities and enable a more efficient Environment Impact Assessment process to be developed. The concept of an umbrella EIS for similar works may be one approach to provide a Strategic Environmental Impact Assessment and Approval Process for the Lake.

It is recommended that the Department of Urban Affairs and Planning work with Lake Macquarie City and Wyong Shire Councils and other relevant State Departments to develop a Strategic Environmental Impact Assessment and Approval Process for programmed Lake remediation works.

3. KEY ISSUES

Based on the extensive body of knowledge regarding the Lake's ecosystem and its health, and the broad-based community involvement during the preparation of the Lake Macquarie Estuary Management Plan, the following issues have been identified as the key matters requiring management actions to ensure ongoing recovery and the sustainable health of the ecosystem. These issues are of varying importance to the ecological health of the Lake.

- ❑ Ecological impacts of sedimentation and nutrient input in runoff from urban growth areas, existing urban and rural development, and infrastructure (eg. road, rail and power easements) in the Lake catchment, including reduced ventilation of shallow embayments, smothering of nearshore habitats, elevated nutrient and algae levels in the water column and bacterial contamination after rain.

- ❑ The progressive loss of littoral and riparian vegetation around the Lake and its tributaries, and loss of estuarine and floodplain wetlands.

- ❑ Historical impacts associated with the accumulation and discharge of industrial waste.

- ❑ Reduced navigability of the Lake and its tributaries associated with accelerated sedimentation.

- ❑ Damage to seagrass beds caused by sedimentation, dredging, marina and wharf construction, boat moorings and propellers, thermal discharges from power stations, live bait digging, and removal by residents to create weed-free bathing areas.

- ❑ Increased community awareness of environmental issues which is not reflected in behaviour, and recognition of the link between their actions and the Lake's water quality. For example, fertilising lawns, dumping lawn clippings, pet droppings, washing cars in the street, etc.

- ❑ Retention and enhancement of natural ecosystem processes to minimise ecosystem degradation.

- ❑ Lack of co-ordination and integration of resources in dealing with Lake issues.

- ❑ Sewage and waste from recreational boating and fishing activities include bait bags and beverage and food containers.

- ❑ Conflicting views about the status of the Lake's fish resources, and appropriate management of the resource by commercial and recreational anglers.

- ❑ Infrequent sewage overflows and leakage from the sewerage reticulation system after heavy rain.

- ❑ Behavioural changes.

Whilst a significant number of engineering projects will be required to improve the problems of the Lake, these will not address the main causes of degradation within the catchment and the Lake itself. There is an urgent need to encourage behavioural changes within the expanding community to reduce the impacts of day to day human activity. In addition, effective land use planning and appropriate urban designs are required in order to cope with an ever-increasing population growth without a detrimental impact on the Lake catchment. Also, improvements to Lake water quality will rely on natural processes and involve repairing the natural ecosystem and appropriate use and management of wetlands and healthy vegetation buffers as filters for the removal of urban stormwater contaminants.

4. OBJECTIVES OF LAKE MACQUARIE ESTUARY AND CATCHMENT MANAGEMENT

4.1 Broad Objectives

As well as being a significant ecosystem, Lake Macquarie and its subcatchments support a population of approximately 190,000 people, important industries and activities including recreation, tourism, fisheries, electricity generation, forestry, mining and minerals processing. In formulating the broad objectives of this management framework, it is recognised that the ecological wellbeing of the Lake needs to be viewed in its overall environmental, social and economic context. The following broad objectives for the environmental management of the Lake which have been adopted are:

- ❑ To contribute to a healthy environment for the community and a significant regional recreational resource
- ❑ To maintain a healthy ecosystem
  - Healthy and productive aquatic habitat
  - An abundance of healthy fish
  - Maintenance of water quality at a standard suitable for contact recreation
- ❑ To develop a relationship of stewardship between the people living within the catchment and the Lake itself
- ❑ To enhance sustainable economic activity working in harmony with the community and environment
- ❑ To integrate the management of the Lake and its catchment and related activities within a single coherent management framework

4.2 Detailed Objectives

To meet the broad objectives, detailed objectives have been identified under the following planning and management headings, which are linked to the management action plans and priority actions of Sections 10 and 11.

These detailed objectives are:

- ❑ **Water Quality**
  - To maintain water quality suitable for fishing, swimming, boating and visual amenity
  - To sustain a healthy and diverse habitat for aquatic animals and plants

- **Lake Health Monitoring**
  - To provide technical data to assist the management of the estuary and its tributaries
  - To measure the effectiveness of various management strategies
  - To provide information, which will help to develop the community's understanding of the Lake and its catchment
  - To provide information which will assist the development of a suitable predictive tool which models key biophysical processes of the Lake
  - To co-ordinate efforts of agencies undertaking monitoring of the Lake and catchment to achieve cost effective and comprehensive environmental information
- **Land Use Planning and Management**
  - To implement best practice in the management of stormwater and wastewater runoff
  - To conserve and enhance wetlands, littoral and riparian vegetation
  - To adopt land use and urban form which protects the Lake
  - To maintain water quality to protect environmental and recreational values
  - To achieve ecologically sustainable development
- **Community Education and Participation**
  - To involve, inform and foster stewardship in caring for the Lake and catchment
  - To facilitate community involvement and ownership of the environment
  - To influence community behaviour, awareness and attitudes to the environment and natural ecological processes
  - To identify specific issues and influence community behaviour
- **Biodiversity Conservation Management**
  - To protect the natural ecological processes within the Lake and its Catchment
  - To protect and enhance biodiversity
  - To protect endangered species and their habitats
  - To protect wetlands and their catchments
- **Fisheries and Aquatic Habitat Management**

- To maintain a healthy and diverse fish population within the Lake
- To protect and enhance aquatic habitat in order to maintain biodiversity of the ecosystem, species and genetic levels
- To manage the fishery resource allocation and resolve conflict between commercial and recreational fishers.

❑ **Estuary and Tributary Remediation and Management**

- To improve water quality
- To reduce sediment transport from within the catchment
- To reduce excess algal growth
- To reduce the availability of nutrients and heavy metals to the water column and ecosystem
- To restore water circulation and reduce water stratification
- To reduce incidence of fish kills in tributaries
- To maintain appropriate navigational access and implement appropriate mooring and berthing for recreational and commercial boating
- To improve public amenity

❑ **Entrance Channel Navigation Management**

- To improve and maintain the navigable access to Lake Macquarie
- To monitor boating usage of the Channel
- To monitor Channel sedimentation

- **Entrance Channel Foreshore Erosion Management**
  - To protect the recreational amenity of the foreshore
  - To protect environmentally sensitive foreshore areas
  - To reduce sedimentation within the Channel
  - To protect access along the foreshore
  - To protect public and private assets
- **Integrated Management**
  - To achieve integrated management and regulation
  - To achieve cooperative resourcing of sub-catchment programs with those above
  - To identify opportunities to streamline statutory approval processes
  - To identify funding opportunities and sources and promote cost effective investment in the Lake Macquarie Estuary and Catchment Management

Management Action Plans and an integrated Priority Three-Year Action Plan to progressively achieve these detailed objectives and continuous improvement are set out in Sections 8 and 9.

5. MANAGEMENT STRUCTURE, RESPONSIBILITIES, REPORTING AND FRAMEWORK REVIEW

5.1 Lake Macquarie Management and Structure

The employment of a Lake Macquarie Estuary Co-ordinator for the Lake Macquarie Estuary and its catchments is proposed, with the objectives of managing the development, implementation and administration of the Lake Macquarie Integrated Estuary and Catchment Management Framework to maintain a healthy ecosystem, and sustain economic activity and community recreational resource.

The Lake Macquarie Estuary Co-ordinator will be responsible to the Lake Macquarie Project Management Committee.

A range of decisions and activities of local government and a number of government organisations influence the management of Lake Macquarie Estuary and its catchments. The appointment of a Lake Macquarie Estuary Co-ordinator will provide a focus on the Lake Macquarie Estuaries and Catchments and will facilitate co-ordination of the Lake-based activities of government agencies and Lake Macquarie City and Wyong Shire Councils to achieve the best outcomes for the Lake.

The recommended Management Structure for Lake Macquarie and its catchment is shown on the next page.

5.2 Roles and Responsibilities

5.2.1 Role of Organisation

The Estuary Co-ordinator will be a newly created, externally funded, position within the Department of Land and Water Conservation. The initial contract for the position will be for three years. The geographical area of the Estuary Co-ordinator's responsibility extends over the waterways of Lake Macquarie and its whole catchment area in relation to the actions to be undertaken within the "Lake Macquarie Integrated Estuary and Catchment Management Framework".

The physical office and associated support facilities will be provided by Lake Macquarie City Council.

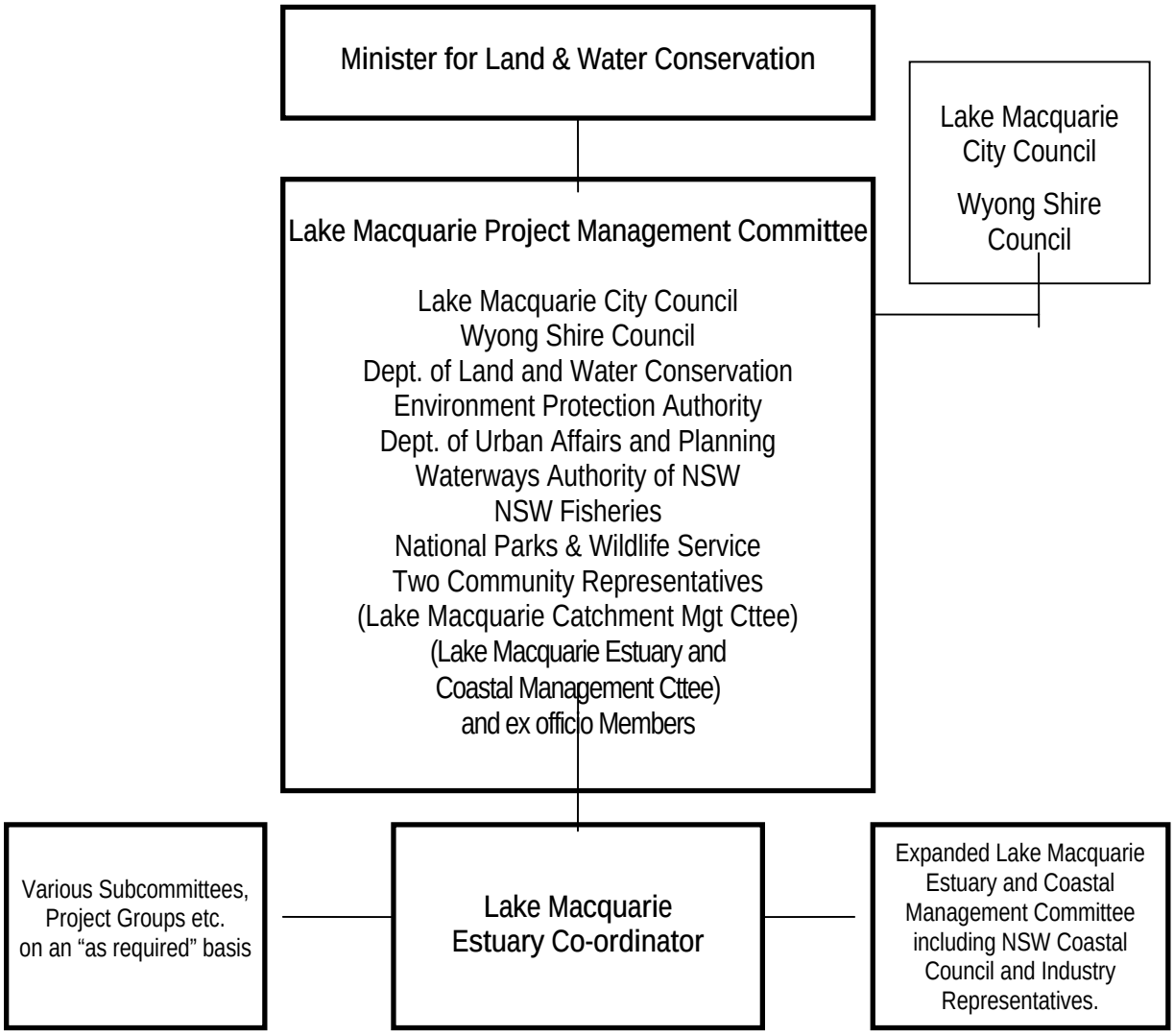
5.2.2 Lake Macquarie Project Management Committee

A Lake Macquarie Project Management Committee will be established to oversee satisfactory implementation of the "Lake Macquarie Integrated Estuary and Catchment Management Framework" and set the agreed work program for the Lake Macquarie Estuary Co-ordinator. The Project Management Committee will meet a minimum of four times per year.

The Lake Macquarie Project Management Committee will be appointed by the Minister for Land and Water Conservation for an initial term of three (3) years. The Minister will appoint the Chairman of the Committee.

LAKE MACQUARIE

ESTUARY AND CATCHMENT MANAGEMENT STRUCTURE



The Committee will comprise the Regional Directors from the Department of Land and Water Conservation, the Department of Urban Affairs and Planning, the Environment Protection Authority, NSW Waterways, the National Parks & Wildlife Service and NSW Fisheries; one representative from each of Lake Macquarie City Council and Wyong Shire Council, and one community representative each from the Lake Macquarie Estuary and Coastal Management Committee and the Catchment Management Committee.

It is appropriate that the Chairperson and Deputy Chairperson of the Taskforce, and the Chairperson of the NSW Coastal Committee, be ex officio members of the Committee.

5.2.3 Lake Macquarie Estuary Co-ordinator

The Lake Macquarie Estuary Co-ordinator will be responsible to the Lake Macquarie Project Management Committee. The role covers a variety of functions, including planning, administration, public relations and negotiation.

The Lake Macquarie Estuary Co-ordinator will:

- ❑ Prepare for approval by the Lake Macquarie Project Management Committee, an annual implementation program for the "Lake Macquarie Estuary and Catchment Management Framework" and review progress for reporting requirements;

- ❑ Develop a longer-term action strategy for the Lake beyond the initial 3-year Action Plan;

- ❑ Regularly review Lake and Catchment monitoring data and the effectiveness of actions; identify gaps and develop new strategies to address shortcomings and emerging issues;

- ❑ Act as a point of contact for the community with regard to environmental management matters concerning the Lake and implementation of the "Lake Macquarie Integrated Estuary and Catchment Management Framework";

- ❑ Examine the development of a Lake Model to strengthen environmental monitoring and databases and to aid Lake management and decision-making;

- ❑ Establish an inventory of information/data systems relevant to the Lake, to be made available on request to the community, councils and agencies;

- ❑ Through the Project Management Committee, facilitate the co-ordination of the activities of agencies with interests relative to the Lake to ensure programs achieve the best outcomes for the Lake;

- ❑ Investigate and obtain supplementary capital and recurrent funding from other sources to implement Lake improvement programs;

- ❑ Provide high quality and timely advice to the Minister for Land and Water Conservation and Lake Macquarie City & Wyong Shire Councils;

- ❑ Manage the operational budget;

- ❑ Undertake program reporting as specified to key stakeholders and the community;

- ❑ Develop and maintain strong linkages with the Lake Macquarie Catchment Management Committee and Estuary and Coastal Management Committee and other relevant community groups; and

- ❑ Ensure that all outcomes associated with management of the Lake are consistent with Government policies for natural resource management.

5.2.4 Community and Industry Involvement

The involvement of the community and industry in the estuary and catchment management issues will be achieved through the existing Lake Macquarie Estuary and Coastal Management Committee. This Committee already has strong representation of relevant stakeholders but will require expanded representation to include the NSW Coastal Council and business representatives.

It is expected that the Estuary Co-ordinator will maintain links with key industry and the community.

5.3 Reporting

The Estuary Co-ordinator will be responsible for the implementation of appropriate reporting including the following:

- ❑ A quarterly progress report to the Lake Macquarie Project Management Committee.

- ❑ A quarterly progress report to the Lake Macquarie Estuary and Coastal Management Committee.

- ❑ Six-monthly reports to Lake Macquarie City Council and Wyong Shire Council.

- ❑ A six-monthly Community Newsletter to inform the general community on Lake-related issues.

- ❑ An annual progress report and program evaluation for submission to Lake Macquarie City Council, Wyong Shire Council and the Minister for Land and Water Conservation. This report will be circulated to all stakeholders and be publicly available. It will provide relevant information to assist the "State of the Environment" reporting process of Councils.

5.4 Lake Macquarie Integrated Estuary and Catchment Management Framework

The management structure, responsibilities and reporting and review processes put in place by the Framework document to implement the various Action Plans and the 3 Year Priority Action Plan, reflect the principles of the ISO 14001 Standard for Environmental Management Systems. Adoption of those principles will lead to the achievement of the Plan's objectives and continual improvement in the environmental management of the Lake and its catchment.

5.5 Framework Review

The position of Lake Macquarie Estuary Co-ordinator and the effectiveness of the "Lake Macquarie Integrated Estuary and Catchment Management Framework" will be independently reviewed prior to the end of the three-year program to assess achievements of the Office and the program and the value of it continuing. The report of this review, accompanied by input from both Lake Macquarie City Council and Wyong Shire Council, will be submitted to the Minister for Land and Water Conservation for decision on the future of the Lake Macquarie Estuary Co-ordinator and the Lake improvement program.

6. FUNDING ARRANGEMENTS

The issue of funding was the most complex and therefore the most difficult issue addressed by the Taskforce.

This issue was also the most contentious in the public meetings held at Belmont and Chain Valley Bay as well as in the majority of correspondence received. Some of the arguments advanced by the community (see Appendix 8) and the members of the Taskforce included:

- industry, the power stations and/or Hunter Water Corporation have been the major contributors to the pollution in the Lake;
- the responsibility of Council is to the shore line;
- the State Government was responsible for water based remediation; and
- the cost of remediation was $40m and any funding less than that amount was inadequate.

These issues and many others were discussed at length, both from the point of view of the accuracy of the statement and from moving the debate forward to achieving an outcome of lake remediation.

The counter and more accurate arguments to the above-mentioned positions are as follows.

- The major problem for Lake Macquarie has and still comes from sedimentation and nutrients and is a result of urbanisation
- Industry and power stations, as a result of increased community expectations, have greatly improved their performance as it relates to outflows into the Lake. An example would be Pacific Power, which has injected almost $8m and Delta Electricity $10m over the last five years. Hunter Water Corporation has invested (with State Government support) $189M into reticulated sewer systems and 97% of the Lakes catchment is now connected
- To work towards remediation and ensure ongoing improved performance, all parties must adopt a total catchment management approach. This requires a properly planned and co-ordinated approach that is followed by all sections of the community, including state and local governments and industry. Division of responsibility (either at water lines or any other method) was rejected as not being the best approach for the future
- All high priority actions (see Section 9) were extracted and accurately costed. The actions were costed at between $12m and $13m (see 6.2). Lower priority actions are subject to further investigation and the costings are indicative only at this stage.

To outline a feasible approach to this, the task of remediation needs to be undertaken in a planned and strategic fashion to avoid compounding problems.

6.1 Existing Government Agency Funding

State and Commonwealth Agencies currently fund a number of natural resource related programs. These can be accessed by Councils and community groups and would be available for the proposed action plan. They have been taken into account.

While the Federal Government has many programs, to date little funding has been accessed to assist in the Lake Macquarie program.

Councils and the Lake Macquarie Estuary Committee should continue to pursue specific sources, such as:

- Department of Land and Water Conservation
  - TCM Enhancement
  - Salt Action
  - NSW Rivercare
  - Wetlands Action
  - Estuary Management Program
  - Catchment Management Committees
- Environment Protection Authority
  - Stormwater Trust/Solution to Pollution
  - The Environmental Trust
    - Restoration and Rehabilitation
    - Education
    - Research administered and serviced by the EPA
- Natural Heritage Trust (Commonwealth)
  - Clean Seas
  - National Landcare Program
  - National Vegetation Initiative
  - National Rivercare Initiative
  - Waterwatch
  - Fisheries Action Program
  - National Wetlands Program
  - Farm Forestry Program
  - National Weeds Strategy
  - National Feral Animals Control Strategy

- Endangered Species Program
- Marine Pollution Reduction
- Coastcare

6.2 Priority Action Plan

The Taskforce has prepared a three-year priority Action Plan (see Section 11).

A breakdown of the expenditure is as follows:

Area	FY 1999/2000 ($)	FY 2000/2001 ($)	FY 2001/2002 ($)
Fennell Bay	805,000	1,312,000	1,262,000
Monitoring	402,600	334,200	334,200
Warners Bay	217,000	362,000	57,000
Lake General	2,062,000	896,500	1,317,000
Channel	676,000	56,000	56,000
Swansea Flats	160,000	250,000	450,000
Cockle Bay	440,000	545,000	536,500
Total	**4,762,600**	**3,755,700**	**4,012,700**

The total budget for all actions, as listed, amounts to $4.76 million in 1999/2000, $3.75 million in 2000/2001 and $4.12 million in 2001/2002 financial years. This totals $12.53m and does not include $472,000 for dredging Swansea Channel, which is jointly funded by Lake Macquarie City Council and the Department of Land and Water Conservation.

Based on the principle of shared funding, the following proposals are recommended to Lake Macquarie City Council, Wyong Shire Council, the New South Wales Government, the Federal Government, agencies and industry.

6.3 Recommended Contributions

The Taskforce makes the following recommendations about contributions:

Lake Macquarie City Council –

The recommended contribution by Lake Macquarie City Council is to be a minimum $1.3m, to be raised by an environmental rate of 3% for the initial three-year period from 1999/2000, 2000/2001 and 2001/2002 financial years.

It is further recommended that these funds be used strictly in accordance with the priorities determined in the three-year Action Plan within the report.

Wyong Shire Council -

The recommended contribution from Wyong Shire Council is a minimum of $100,000 per annum for the initial three-year period 1999/2000, 2000/2001 and 2001/2002 financial years.

The lesser request to Wyong Shire Council reflects the smaller impact of that Shire on the Lake because the shoreline in the Wyong Shire Council area is only 15% of the total shoreline with the level of urbanisation substantially less than in the Lake Macquarie City Council area.

New South Wales Government -

The recommended funding contribution by the New South Wales Government as indicated in the three-year Action Plan for the financial years 1999/2000, 2000/2001 and 2001/2002 is as follows, with the major funding break-up as shown:

Department	FY 1999/2000 ($)	FY 2000/2001 ($)	FY 2001/2002 ($)
Land and Water Conservation	2,162,100	2,258,100	2,434,600
NSW Waterways	241,000	41,000	41,000
Stormwater Trust	600,000	0	0
Total	**3,003,100**	**2,299,100**	**2,475,600**

Allocation of Stormwater Trust funding would be subject to applications by Lake Macquarie City Council and Wyong Shire Council and successful evaluation by the Trust.

For this request to be met, Treasury will need to supplement the budgets of the Department of Land and Water Conservation by $1.55 million in 1999/2000, $2.175 million in 2000/2001 and $2.175 million in 2001/2002 financial years.

In general terms, NSW Treasury supplementation represents:

- matching funds for amounts raised and contributed by Lake Macquarie City and Wyong Shire Councils;
- the Councils' share of the contributions for major capital works; and
- the cost of the Lake Macquarie Estuary Co-ordinator.

Federal Government –

The recommended contribution from the Federal Government for immediate work is $194,000. Lake Macquarie City Council has applied for these funds.

Due to the importance of Lake Macquarie, it is further recommended the Federal Government consider providing ongoing support for lake remediation.

The power companies, Hunter Water Corporation and industry around the Lake will contribute to the remaining funds necessary to balance out the $12.53m in section 6.2.

6.4 Major Additional Contribution

In addition to the funding noted in section 6.3 Hunter Water Corporation, the power stations, major industry and the NSW Government have either commenced or are expected to contribute $29.04m on works associated with the Lake and its catchments over the next three years. These projects, while not listed in the three-year Action Plan, are part of the integrated actions for the Lake. They include:

		$m
Hunter Water Corporation	Upgrade of existing sewerage systems around Lake Macquarie including Cardiff, Boolaroo, Warners Bay, Valentine, Belmont and Swansea. 50% upgrade of sewerage transportation in the Windale area, finalisation of sewerage reticulation at Fishing Point and provision of sewerage to Wyee Point.	11.41 3.05
Delta Electricity	Ash dam management, coal plant drainage and containment, erosion and sedimentation control, revegetation and oil hazard material containment	4.30
Pacific Power	Selenium stripping plant, ash dam capping and management, micro filtration plant, oil/water separator and other environmental work	3.55
Powercoal	Environmental improvement program, regarding the Lake Support for Landcare tree plantings and threatened special conservation	0.50 0.25
Pasminco	Stormwater management improvements	2.00
Department of Land & Water Conservation	50% of sewerage work in Windale, Fishing Point and Wyee Point, see above. Waterways program for jetty and boat launching refurbishment Coastal Program for Swansea Breakwater and Lucy's Groyne	3.05 0.60 0.33
TOTAL		**29.04**

6.5 Limitations of Funding Proposal

While the Taskforce has completed a detailed Priority Action Plan for three years with costing as accurate as is possible, it is not suggesting that the entire task of remediation of natural systems or works necessary to prevent further deterioration will be completed in that three-year period.

The Taskforce wishes to highlight that the task before the authorities is a long one and the Councils and State and Federal Governments need to make provision for additional expenditure beyond that three-year period.

The Management Framework and Action Plan were prepared with a clear understanding that a substantial co-ordinated investment, financial and human effort would be required by governments, councils and the community. It is therefore important that this investment is recognised in future planning and approval decisions affecting the Lake.

7. INTEGRATED MANAGEMENT ACTION

7.1 Co-ordinated Management of Sub-Catchments

To facilitate holistic project planning for the estuary and catchment and to allow clearer identification of resources and the integration of complementary actions by various stakeholders, it is proposed to manage key programs within the Lake Macquarie Catchment on an appropriately scaled sub-catchment basis.

An interactive management approach, which results in improvements in one sub-catchment and embayment will provide a feedback loop for continuous improvement and reflect across the whole of the Lake. It will permit the development and trial of management methods, which can be more broadly applied. High risk and critical impacts on the health of the Lake can also be addressed as a priority.

The Lake Macquarie Catchment has been divided into 18 main sub-catchments, as shown on Figure 2 of Appendix 1.

Many of these catchments and embayments have a diverse range of land and community uses occurring within them, which affect the Lake both beneficially and detrimentally.

The catchments and embayments with immediate potential for management by this approach are Fennell Bay/Edmunds Bay, Cockle Bay, Swansea Flats and Warners Bay.

The Fennell and Edmonds Bay Catchments have a high priority but actions and remedial works will occur concurrently in the nominated catchments. Priority action plans foreshadow major remedial works commencing in Cockle Bay and its tributaries within the three-year program period.

- **Fennell / Edmunds Bay**

  - catchment are of 47 km^2, 74% of which is forested and 14% urban;
  - is drained by LT, Mudd and Stony Creeks;
  - catchment contains:
    - Urban areas of Awaba, Toronto West, Blackalls Park and Fassifern
    - Great Northern Railway
    - Coal mines
    - Power line easements
    - Light industrial / commercial development of Toronto West
    - Natural bushland
    - Rural
  - is typified by the embayments with significant sediment build-up and extensive areas of seagrass beds; and

- is closed to commercial fishing because it is considered a significant nursery area for fish.

The Fennell and Edmunds Bay catchments and embayments have received a higher priority in the integrated priority action plan because of the following characteristics:

- The catchment contains a range of land uses (urban, light industrial, mining, natural bushland) and the embayment contains valuable wetlands and seagrass beds.

- There are active bushcare and community groups in the catchment and business and industry support these community initiatives.

- The area is a micromodel of the Lake itself in that the Bays have narrowed entrances and restricted water movement.

- Remedial works in the Fennell and Edmunds Bays will provide a model for the treatment of the rest of the Lake and experience gained in the planning, design and implementation phases will be able to be replicated in other subcatchments and embayments.

- Outcomes of actions and remedial works will be monitored to ensure those that are most cost effective are adopted elsewhere.

❑ **Cockle Bay**

- has a catchment area of 115 km^2, of which 60% is forested and 34% urban

- catchment contains:

  * the urban areas of Charlestown, Cardiff, Edgeworth, Glendale
  * light industrial/commercial development
  * coal mines
  * the Pasminco Smelter
  * rural properties
  * Charlestown Mall and Glendale Shopping Centres
  * natural bushland

- is drained by Winding, Cocked Hat and Cockle Creeks
- has a buildup of sediments containing heavy metals.

- is home to an extensive complex of mangrove and mangrove flats acting as important feeding areas for commercially important fish species

- is closed to commercial fishing

❑ **Swansea Flats**

- has a catchment area of 1.35 km^2, if which 18% is forested and 70% urban
- catchment contains:
    - Urban areas of Swansea
    - Natural bushland
- provides ten stormwater outlets, which are located to the west of Swansea Township and release sediments over seagrass beds
- encompasses migrating sands
- has islands, which were formed in 1960 by dredging and inhibit natural water circulation
- majority is closed to commercial fishing, primarily due to importance as a nursery area for fish. The Flats are the first refuge and settlement area for larval fish entering the Lake. The largest area of *Posidonia sp.* seagrass beds is found in this area. This seagrass is currently under review as a Threatened Species under the Fisheries Management Act 1994.

❑ **Warners Bay**

- has a catchment area of 12 km^2, of which 27% is forested and 70% urban
- contains:
    - Urban areas of Warners Bay
    - Light industrial area
    - Commercial area of Warners Bay
    - Rural Properties
    - Natural Bushland
- is drained by North and South Creeks
- is home to commercial fishing, which targets bream and mullet in the Bay
- is characterised by historic foreshore reclamation, which destroyed much of the existing seagrass beds.

7.2 Future Management

The four embayments, listed above, directly or indirectly support up to 80% of the commercial fishing in the Lake.

Whilst management activities will continue in all embayments and catchments of Lake Macquarie, Fennell/Edmunds Bay has been targeted as the priority for the integrated management approach.

Other bays such as Chain Valley, Bonnells and Mannering Bays will be investigated during the three-year program to ensure that systems developed within that period can be applied to these catchments. Fennells/Edmunds Bay encapsulates the processes occurring in other Bays and the Lake itself, and its Management Action Plan is an example which can be applied to other catchments and embayments.

8. MANAGEMENT ACTION PLANS

Management Action Plans have been developed to meet the objectives of the Lake Macquarie Estuary and Catchment Management Framework.

They reflect the views expressed by the community about biophysical issues during the preparation of the Estuary Management Plan, and as summarised in Section 1.3. Specific Action Plans, which have been prepared, are:

- ❑ water Quality Action Plan;
- ❑ lake Health Monitoring Action Plan;
- ❑ land Use Planning and Management Action Plan;
- ❑ community Education and Participation Action Plan;
- ❑ biodiversity Conservation Management Action Plan;
- ❑ fisheries and Aquatic Habitat Management Action Plan;
- ❑ estuary and Tributary Remediation and Management Action Plan;
- ❑ entrance Channel Navigation Management Action Plan;
- ❑ entrance Channel Foreshore Erosion Management Action Plan; and
- ❑ integrated Management Action Plan.

The Action Plans give community support and involvement a high priority, both in terms of individual projects, and by taking a strongly integrated, catchment based approach to key restoration programs. A high level of community understanding and a willingness to make difficult decisions about the environment will be necessary for the long term health of the Lake and the regional economy which depends on the area's natural assets.

Management actions identified in the Plans have been reviewed by the Taskforce and ranked in order of priority. Ranking is based on the consensus view of the Taskforce and the costs and benefits to the Lake Community.

Responsibility for each of the actions contained in Action Plans has been assigned to the most appropriate key agency or individual within the Lake Management Structure.

The requirements for funding have been identified, and are the subject of arrangements discussed in Section 6.

8.1 Water Quality Action Plan

Environmental problems/issues

Lake Macquarie operates for most of the time as a virtually closed system. Pollutants in stormwater and in industrial discharges tend to accumulate in the Lake waters and sediments unless flushed out by major rainfall events. Water quality in the Lake is therefore dependent to a large extent on how well land use in the catchment and around the Lake foreshore is planned and managed. Lake Macquarie is surrounded by a rapidly expanding urban area and is heavily used for water based recreation. The three most important issues for water quality in the Lake are therefore:

- Rapid accumulation of fine and coarse sediments in shallow bays, near the shoreline and at the mouth of tributaries - contributing to poor water circulation, smothering of seagrass beds and high nutrient levels, which promote algal blooms.

- Nutrient accumulation in bays and tributaries, resulting in algal blooms, organic sludges replacing clean sand on the bed of shallow bays, occasional fish kills and the generation of odours.

- After heavy rain, high levels of bacteria are often recorded in the nearshore area and swimming is not recommended for 48 hours afterwards. The sources are faecal pollution from domestic and native animals, humans (sewer surcharges and septic tank overflows) and sewage discharges from boats.

It is estimated that the annual average nutrient load to the Lake, from sources including runoff from established and developing urban land, is some 360 tonnes of nitrogen and 23 tonnes of phosphorus per year.

In addition to nutrients, sediment yield to the Lake has been estimated at 57,000 tonnes per year. Significantly, existing sediment traps around the Lake are only capturing around 2,000-3,000 tonnes per year of sediment, which is less than 5% of the computed catchment yield.

Arising from the monitoring program, the Lake Macquarie Estuary Co-ordinator will develop an Action Plan and set goals to reduce sediment loads in the tributaries and Lake in general.

The potential health effects of elevated concentrations of selenium in fish from Lake Macquarie raised strong community concerns in 1996-97. Selenium enters the Lake primarily in licensed discharges from Pasminco and power station ash dams and other sources. In response, NSW Health carried out a study of selenium and heavy metals in fish from the Lake. The study concluded that fish were quite safe for human consumption unless consistently eaten in very large quantities over many years.

Historical discharges of heavy metals to the northern part of the Lake in particular have led to significant heavy metal contamination of sediments in the Lake bed. Significant reductions in these discharges have now been achieved and cleaner sediments overlie the contaminated sediments. However, the impact of heavy metals on the health of the Lake biota has not yet been quantified, and the shallowing of affected areas such as Cockle Bay means that long term management of contaminated sediments remains an issue.

Who it affects and how

All Lake users, residents and visitors to the City contribute to and are affected by changes in the health of Lake Macquarie. Aspects of poor water quality such as excessive algal growth, poor clarity, excessive bacteria and accumulation of ooze, reduce the suitability of the Lake for recreational uses such as swimming, boating and fishing. These activities are enjoyed not only by local residents, but underpin the Lake's tourism industry, worth $200 million annually.

The commercial fishing industry, whose productivity and marketability are heavily dependent on good water quality, is worth $1.4 million per year.

The Lake's water quality, visual amenity and environmental health are also important factors in attracting and adding value to new urban development. The Lake Macquarie local government area is one of the fastest growing urban centres in New South Wales.

How can we fix the problem?

Because the environmental issues in Lake Macquarie are primarily the result of the cumulative actions of many people, an effective strategy for the future health of the Lake must integrate activities, which attract the support and involvement of the entire community. The range of measures will include improved land use planning, upgrading stormwater treatment, implementing targeted community education programs, increasing commitments to street sweeping, stricter enforcement of sediment and erosion controls, improved performance by industry, business and commerce, and the grassing of road verges. Some existing problems, such as excessive sediment accumulation in shallow bays, may require significant capital investment to understand the complexities of the issue and restore natural ecosystem functioning.

Why is it worth taking action?

The results of several community consultation exercises over the last three years have clearly demonstrated that the local and regional community values the health of Lake Macquarie very highly. People expect to be able to swim and fish in the Lake with no risk to their health, and they also value the beauty of the Lake's clean water and shoreline.

These values, and significant aspects of the regional economy, would be jeopardised if the health of the Lake were to deteriorate. Although some actions recommended to protect and enhance the Lake's water quality have a high cost, the benefits to the community in terms of lifestyle, recreation and employment are expected to be far greater.

WATER QUALITY ACTION PLAN

OBJECTIVE:

- To maintain water quality suitable for fishing, swimming, boating and visual amenity
- To sustain a healthy and diverse habitat for aquatic animals and plants

Code	Priority	Specific Objective	Short Term Actions	Long Term Actions	Funds Already Committed	Funds Needed for Future Actions	Responsibility for Action	When	Status	Comments
WQ/A (Water Quality)	High	Develop an integrated catchment and estuary management model of nutrient, sediment and faecal pollution interactions, to predict impacts of land use/ management changes on the health of the estuary.	Use available land use information and broad based catchment indicators to develop crude values.	Refine model with more sophisticated techniques - to improve estimates of subcatchment yields and pollutant dispersion in the estuary.	--	$30,000 $100,000 (Integration)	EPA (in kind) Lake Macquarie Co-Ordinator LMCC WSC	Jun 1999		Enhanced ability to make the planning and control/remediation decisions . Model outputs compared with monitoring data.
WQ/B	High	Improve foreshore amenity and ecosystem functioning in the nearshore area of Croudace Bay.	Rehabilitate riparian/ foreshore vegetation and create wetlands in the Lakeshore flats at Croudace Bay.	Use this constructed wetland as a demonstration site, with monitoring of wetland processes and performance, and nearshore quality. Information used to refine treatment technique and management systems, for application elsewhere in the Lake catchment, such as Warners Bay (H), Cockle Bay (H), Swansea Flats (H), Belmont (M), Chain Valley Bay (M) and Bonnells Bay (M).	$420,000 for wetlands on public land at Croudace Bay. (Federal Govt - $500,000 and LMCC - $290,000 to address stormwater around the lake.)	See Monitoring Action Plan.	LMCC	Work commenced August 1998. Complete Dec 1998		Stormwater from rapidly expanding urban area treated to meet ANZECC guidelines in nearshore waters. Trial and refine 'soft' options for managing catchment runoff. Enhance/restore littoral vegetation.

WATER QUALITY ACTION PLAN

OBJECTIVE:
- ❑ To maintain water quality suitable for fishing, swimming, boating and visual amenity
- ❑ To sustain a healthy and diverse habitat for aquatic animals and plants

Code	Priority	Specific Objective	Short Term Actions	Long Term Actions	Funds Already Committed	Funds Needed for Future Actions	Responsibility for Action	When	Status	Comments
WQ/C	High	Improve foreshore amenity and ecosystem functioning in the nearshore zone of Fennell Bay. Reduce macroalgae and sedimentation in the nearshore zone.	WQ/CA: In Fennell Bay/Edmunds Bay and tributaries, rehabilitate littoral and riparian vegetation (Mudd Creek and LT Creek). WQ/CB: In Fennell Bay/Edmunds Bay and catchment, expedite completion of a Stormwater Management Plan. WQ/CC: In Fennell Bay/Edmunds Bay, implement controls and management practices to improve the quality of stormwater, such as grassing road verges, enforcement of erosion and sedimentation controls, community education re domestic activities, introduce constructed wetlands on public land.	Review success of these strategies, improve predictive ability of the model, identify areas for improvement or variation, adopt measures for works in Cockle Bay, Warners Bay and Swansea Flats.	Part of LMCCAnnual Budget for road verges, erosion & sediment control	Funding of $194,000 applied for from Federal Govt for catchment works to improve water quality in this catchment. Implementation of Stormwater Management Plan/ Catchment Management Plan could require several $M after further investigation. $75,000 Bush & Roads	Lake Macquarie Co-Ordinator and LMCC in consultation with EPA, LMCMC and DLWC.	1999 - 2002	Strong community interest via Landcare and Streamwatch groups with assistance from Industry, DLWC & LMCC	Reduction of nutrient levels in nearshore sediments; reduction in rate of sedimentation in the nearshore zone; reduction in macroalgal growth in nearshore zone. See Monitoring Plan. % road verges sealed or grassed. % hinterland tracks with drainage controls. Nearshore WQ meets ANZECC guidelines. Reduced demand for dredging of stormwater drain outlets. % reduction in macroalgae in nearshore. Total % estuary and tributary banks with intact native vegetation.

WATER QUALITY ACTION PLAN

OBJECTIVE:
- ❑ To maintain water quality suitable for fishing, swimming, boating and visual amenity
- ❑ To sustain a healthy and diverse habitat for aquatic animals and plants

Code	Priority	Specific Objective	Short Term Actions	Long Term Actions	Funds Already Committed	Funds Needed for Future Actions	Responsibility for Action	When	Status	Comments
WQ/D	High	Develop a Stormwater Catchment Management Plan for the Lake.	Stormwater planning will focus initially on the priority catchments of Fennell Bay/Edmunds Bay (see action above), Cockle Bay (Winding Creek), Warners Bay and Swansea Flats.		Urban Stormwater Trust has provided LMCC with $130,000 addresses erosion & sediment, and litter control. Stormwater Trust, LMCC & WSC providing $120,000 for a Stormwater Management Plan.		LMCC WSC	Stormwater Catchment Management Plan to be completed Jul 1999.	Stormwater Management Plan is underway. Work has commenced on Stormwater Trust funded projects. Contract let for study to identify priorities for stormwater management.	Co-ordinated planning and management of stormwater in the Lake catchment will facilitate implementation of appropriate controls to achieve ANZECC guidelines.
WQ/E	High	Implement priority actions from the Stormwater Management Plan to reduce nutrient, litter, sediment and bacteria in the nearshore zone and in embayments/ tributaries.	WQ/EA: Works described above for Fennell Bay/Edmunds Bay. WQ/EB: Implement street sweeping. WQ/EC: Implement program of grassing unsealed road verges. WQ/ED: Council erosion and sediment control officer appointed. WQ/EE: Water Quality Facilities, Road Verges, Bush Revegetation.	See water sensitive design actions in Land Use Planning and Management Action Plan.	$168,000 pa (300% increase since 1995) allocated to street sweeping. $12,000 Water Sensitive Urban Design	$125,000 $285,000 $950,000 $30,000 $400,000 $389,000	LMCC DLWC (Supp.) LMCC WSC Urban Stormwater Trust LMCC	Trial programmes on grassed road verges carried out in 1996/97. May 1998 to Jun 2000	Ongoing.	Litter, nutrient levels, suspended sediments and bacteria reduced in the nearshore waters of selected bays, to meet ANZECC guidelines. Reduction in macroalgal growth in nearshore zone. Commitment of

			WQ/EF: Water Quality Facilities - Operation				WSC	Ongoing		funds after application and due process.

WATER QUALITY ACTION PLAN

OBJECTIVE:
- ❑ To maintain water quality suitable for fishing, swimming, boating and visual amenity
- ❑ To sustain a healthy and diverse habitat for aquatic animals and plants

Code	Priority	Specific Objective	Short Term Actions	Long Term Actions	Funds Already Committed	Funds Needed for Future Actions	Responsibility for Action	When	Status	Comments
WQ/F	High	Reduce sewage inputs to the Lake from septic tanks.	• Serve notices to connect all unsewered urban properties to reticulated sewer, where it is available. • Enhance Council septic tank inspection programme and follow up. • Prepare sewage management strategy for implementation from July 1999.	Improve controls on new developments in unsewered areas (restrict development in unsewered areas).	$10,000	$100,000 pa for registration and inspection (User Pays)	LMCC WSC	Management Strategy due to be completed by June 1999.	Management Plan being prepared.	% urban population and area unsewered. % septic tank systems failing. Compliance with ANZECC guidelines.
WQ/G	High	Reduce sewage inputs from boats to enhance water quality.	Installation of three or four additional sewage pump-out sites and monitor performance	Introduction of regulation similar to Myall and Sydney Harbour requiring holding tanks and use of pump-out facilities on all recreational craft (plus enforcement of regulation).		$650,000 Ongoing maintenance costs of $5,000 each per annum.	Waterways DLWC and LMCC.	Complete by Aug 2000		Volume of sewage received at pump-out stations. ANZECC guideline met in all popular boating embayments
WQ/H	High	Understand the	Study of	Depending on	$120,000	See Estuary	EPA in	Study to	Sampling	The report will

		impact of Se and metals on ecosystems to ensure that Lake ecosystems are not being adversely impacted, providing basis for decisions about Management Strategies.	ecosystem interaction of trace metals. A rigorous scientific study of Se and metals in sediments, water column and biological pathways to investigate the impact of Se and metals on the health of Lake fauna.	results of the study, remediation or removal of contaminated sediment and further works to reduce discharges may be recommended.		and Tributary Remediation Management Action Plan for cost estimates for removal or remediation of contaminated sediment in selected embayments.	consultation with Lake Macquarie Co-Ordinator and Fisheries, Industry and Community.	be completed by mid-2000.	commenced Oct 1998	clarify the ecological impacts of Se and metals in the Lake and assist informed decisions about whether remedial action is warranted.

WATER QUALITY ACTION PLAN

OBJECTIVE:
- ❑ To maintain water quality suitable for fishing, swimming, boating and visual amenity
- ❑ To sustain a healthy and diverse habitat for aquatic animals and plants

Code	Priority	Specific Objective	Short Term Actions	Long Term Actions	Funds Already Committed	Funds Needed for Future Actions	Responsibility for Action	When	Status	Comments
WQ/IA	High	Reduce impacts of bank erosion on sedimentation of waterways and nutrient levels.	Identify areas of severe foreshore and river bank erosion and select 6 priority sites for demonstration of bank remediation techniques to reduce sediment and nutrient load.	Develop and implement a programme of bank stabilisation works in association with other catchment controls.	$6,000 to complete DLWC mapping of bank instability. Powercoal is undertaking bushland regeneration works to reduce erosion from fire trails ($20,000)	Six sites at $25,000 = $150,000	DLWC in consultation with Landcare groups. Lake Macquarie Co-Ordinator with WSC, LMCC .	Survey due to be completed in early 1999. July 99	6 demonstration sites to be completed by July 2000	Enhanced riparian, littoral and nearshore benthic vegetation/habitat; Healthy seagrass in nearshore areas; Estuarine and riparian wetlands protected. Improved community understanding of appropriate bank management techniques (See Item CE/B)
WQ/IB	High	Reduce impacts of bank erosion on sedimentation of waterways and nutrient levels.	Engineering works associated with streambank erosion repairs			$150,000 $110,000 $30,000	DLWC (Supp.) LMCC WSC	Commence Mar 99 Complete Jul 2002		
WQ/J	High	Reduce sedimentation of waterways from bank erosion.	Reduce boat speeds in critical areas to reduce erosion.				Waterways		Speed restrictions already exist in many areas.	Reduced foreshore & streambank erosion.
WQ/N	High	Reduce Streambank & Foreshore	Rehabilitate foreshore, nearshore and		$10,000 LMCC	$350,000	Lake Macquarie Co-	Mar 1998 Oct 2000	Some works in North Creek &	

		Erosion	riverine zones North and South Creeks - Warners Bay				Ordinator		Investigations commenced	
WQ/IC	High	Cockle Bay/Creek Bank Stabilisation	Engineering Works			$150,000	Lake Macquarie Co-Ordinator			

WATER QUALITY ACTION PLAN

OBJECTIVE:
- ❑ To maintain water quality suitable for fishing, swimming, boating and visual amenity
- ❑ To sustain a healthy and diverse habitat for aquatic animals and plants

Code	Priority	Specific Objective	Short Term Actions	Long Term Actions	Funds Already Committed	Funds Needed for Future Actions	Responsibility for Action	When	Status	Comments
WQ/K	High	Upgrade sewerage system to reduce overflows and leakage to improve water quality in the Lake and tributaries in wet weather.	**Cockle Bay** • Upgrade Cardiff Wastewater transportation system (Carrier main complete $5.6M) • Upgrade Boolaroo WWPS • Booragul/Teralba WWPS (investigation underway) • Upgrade to Queens Avenue Cardiff **Warners Bay/ Croudace Bay** • Investigation underway • **Swansea Flats** (drains from ~half Swansea peninsula) • Grouting of Swansea 6 carrier main to reduce infiltration • Investigation underway for entire Swansea peninsula (Swansea 2 WWPS catchment)		$1.7 M $0.35 M $0.01 M $0.34 M $2 M $0.25 M $0.08 M $0.29 M $0.36 M		HWC	Complete Aug 1999 Complete Jul 1999 Complete May 1999 Complete July 2000 Complete July 2000 Complete July 2000 Complete Dec 1998 Complete Dec 1998	Commenced Commenced Commenced Commenced Commenced	Wet weather overflows from the sewage transport system reduced. Dry weather overflows eliminated. ANZECC guideline met in selected embayments.

			Belmont Bay • Belmont No. 1 WWPS upgrade • Belmont No. 3 WWPS upgrade							

WATER QUALITY ACTION PLAN

OBJECTIVE:
- ❑ To maintain water quality suitable for fishing, swimming, boating and visual amenity
- ❑ To sustain a healthy and diverse habitat for aquatic animals and plants

Code	Priority	Specific Objective	Short Term Actions	Long Term Actions	Funds Already Committed	Funds Needed for Future Actions	Responsibility for Action	When	Status	Comments
WQ/M	Medium	Reduce sewage inputs from sewage transport system.	(See item above)	Prepare EIA for Waste Water transportation system to target critical areas.	$2.5 M EIA, computer modelling of sewers/data collection.		HWC in consultation with Community and EPA.	EIA to be completed 2000.	Data being collected and models being developed.	ANZECC guidelines met in selected embayments
WQ/L	Medium	Reduce input of pollutants from selected point sources - both selected industry and small business regulated by Councils.	Continue Pollution Reduction Programmes with licensed industry (e.g. in relation to stormwater and process water from Pasminco).	Further reduce point source discharges using economic instruments, education strategic enforcement, planning controls and Pollution Reduction Programmes.	EPA funds 1.5 full-time staff to work on licensed premises in Lake Macquarie catchment. LMCC 2 Staff Employed Industrial based education programmes	Pollution control works funded by private industry.	EPA and local government in consultation with Industry.	Load-based licensing to be implemented. Council audits of unlicensed premises.	Existing PRP on Pasminco requires all discharge of contaminated stormwater and process water to cease by 2000. Hunter Water Waste Water transport system to be licensed in 1999 (with commencement of POEO).	Small business in Lake Macquarie committed to business and environmental benefits of cleaner production. Further 50% reduction in load of Se and metals to Lake Macquarie by 2000.
WQ/L	High	Reduce input of pollutants from selected point sources - both selected industry and small business regulated by Councils.	Councils to increase audit of unlicensed premises, and to promote cleaner production techniques by small business.			$40,000	LMCC	Council audits of unlicensed premises.		
WQ/O	High	Establish vegetation corridors to protect riparian/litto	Vegetation planting to reduce pollutants.			$25,000	LMCC	Jul 2001		

		ral zones								
WQ/P	High	Rehabilitate foreshore Swansea Flats	Vegetation plantings			$10,000	LMCC	July 2000		

WATER QUALITY ACTION PLAN

OBJECTIVE:
- ❑ To maintain water quality suitable for fishing, swimming, boating and visual amenity
- ❑ To sustain a healthy and diverse habitat for aquatic animals and plants

Code	Priority	Specific Objective	Short Term Actions	Long Term Actions	Funds Already Committed	Funds Needed for Future Actions	Responsibility for Action	When	Status	Comments
WQ/Q	High	Reduce impacts of bank erosion on sedimentation of waterways and nutrient levels in the Mannering Park to Gwandalan region	Rehabilitate creeklines and foreshores in priority areas (eg. Gwandalan, Chain Valley Bay)	Review success of these strategies, identify areas for improvement or variation, adopt further measures for use in this region		$190,000	WSC in conjunction with Lake Macquarie Co-ordinator	1999--2000		% estuary and tributary banks with intact native vegetation
WQ/R	High	Reduce macroalgae and sedimentation in the nearshore zone of the Mannering Park to Gwandalan region.	Implement controls and management practices to improve the quality of stormwater, such as grassing road verges, community education re domestic actiivities, sediment traps, and constructed wetlands on public land in the Mannering Park to Gwandalan region	Review success of these strategies, identify areas for improvement or variation, adopt further measures for use in this region		$410,000	WSC in conjunction with Lake Macquarie Co-ordinator	1999 - 2000		% reduction in macroalgae in nearshore zone; reduction of nutrient levels in nearshore sediments

8.2 Lake Health Monitoring Action Plan

Environmental problems/issues

The tributaries are an integral part of the Lake system, feeding sediment, nutrients and pollutants into the foreshores and deeper parts of the Lake. The tributaries, the Lake body and the Swansea Channel not only need to be healthy in their own right. They also provide indicators of pollution from the rest of the catchment.

Why is it worth doing?

Monitoring will allow the measurement of benefits resulting from the implementation of management Action Plans.

Streamwatch monitoring promotes community education as school children developing an understanding of the impacts of humans on their environment. Ferral monitoring is more technical. Through its catchment models can be tested and polluting activities within the catchment targeted.

LAKE HEALTH MONITORING ACTION PLAN

OBJECTIVES:
- ❑ To provide appropriate and comprehensive information to assist the management of the estuary and its tributaries
- ❑ To measure the effectiveness of various management options
- ❑ To provide information which will help to develop the community's understanding of the Lake and its catchment
- ❑ To provide information which will assist the development of a suitable predictive tool which models key biophysical processes of the Lake
- ❑ To provide appropriate and comprehensive information that will assist decision making in the management of the estuary, measure effectiveness in the management of the estuary, increase community understanding and facilitation co-ordination in the management of the estuary.

Code	Priority	Specific Objective	Short Term Actions	Long Term Actions	Funds Already Committed	Funds Needed for Future Actions	Responsibility for Action	When	Status	Comments
HM/A	High	To monitor and assess trends for the long term health and ecological integrity of the Lake and to monitor the suitability of the Lake for social uses, primarily those described in ANZECC guidelines.	Annual Lake body monitoring at 7 sites, at a frequency of one month, for 14 parameters.	Review sites, parameters and frequency after a suitable body of data is obtained.	$21,600 pa. (EPA licence condition for 2 sites for Pacific Power and Delta Electricity.)	$57,400 pa. (This may be reduced to $32,400 pa if an additional 2 sites are included on the EPA Pacific Power and Delta Electricity licences.)	Lake Macquarie Co-Ordinator with LMCC, WSC, EPA, HWC		Two sites commenced. Lake Monitoring Plan developed (see Appendix)	ANZECC guidelines.
HM/B	High	To ensure that EPA licensed premises comply with their discharge limits and to assess their contribution to inputs to the Lake.	Review need for monitoring at three sites which do not currently monitor stormwater discharges.	Ongoing management of the monitoring network.	$100,000 pa. (As part of EPA operational budget)	Nil.	EPA in association with licence holders.	Sites currently doing no monitoring to be assessed within 12 months.	Ongoing.	Information on level of compliance and inputs to the Lake available.
HM/C	High	To monitor near shore water quality to assess the health of the	Identify opportunities to co-ordinate current monitoring in the	Review sites, parameters and frequency to identify trends		$24,000 pa.	Lake Macquarie Co-Ordinator with LMCC,	Commenced	Some monitoring is currently undertaken	Compliance with ANZECC guidelines. Identification of trends in

		Lake and to protect community health.	Lake to avoid duplication of resources. Monitor 17 bathing sites				WSC, HWC		by LMCC & WSC.	water quality and ecological health.

LAKE HEALTH MONITORING ACTION PLAN

OBJECTIVES:
- ❑ To provide appropriate and comprehensive information to assist the management of the estuary and its tributaries
- ❑ To measure the effectiveness of various management options
- ❑ To provide information, which will help to develop the community's understanding of the Lake and its catchment
- ❑ To provide information which will assist the development of a suitable predictive tool which models key biophysical processes of the Lake
- ❑ To provide appropriate and comprehensive information that will assist decision making in the management of the estuary, measure effectiveness in the management of the estuary, increase community understanding and facilitation co-ordination in the management of the estuary.

Code	Priority	Specific Objective	Short Term Actions	Long Term Actions	Funds Already Committed	Funds Needed for Future Actions	Responsibility for Action	When	Status	Comments
HM/D	High	To monitor the quality and quantity of sediment entering the Lake.	• Consolidate information relevant to the sampling of sediments in the Lake. • Continue the measurement of volumes of sediment removed from the lake/ tributaries by dredging. • 7 sites selected to be monitored for N, P DO & heavy metal.	• Implement a monitoring programme to determine the extent of ooze build-up around the Lake. • Identify options for the use of aerial photography to monitor sediment accumulation. • Monitor the efficiency of sediment control programmes. • Monitor trace elements at selected sites.	• Volumes removed from dredging and stormwater treatment devices are recorded however reporting mechanisms need to be improved. • Power stations measure non-filtrable residues.	$38,200 pa	Lake Macquarie Co-Ordinator with DLWC LMCC	January 1999	Sediment inflow to the Lake and catchment can have a variety of impacts including effects on flushing, damage to seagrass and introduction of nutrients. A regular sampling programme does not currently exist to monitor these impacts.	Monitoring results will provide valuable scientific data for the planning and design of future remediation programmes and management actions.
HM/E	High	To monitor changes in wetland condition.	Establish a cooperative agreement on the monitoring of wetlands in Lake Macquarie Catchment	• Monitor wetland condition on an annual basis through the use of remote		$30,000 every 5 years.	LMCC WSC DLWC Industry groups LMCMC	July 1999	Monitoring of wetlands is problematic in that no simple set of	Assessment of changes in wetland condition will be completed with reference to the findings of the LM Wetland

				imaging/aerial photography. • Investigate the possibility of using new technologies such as digital video to monitor wetland health.					parameters suits all wetlands. There are 60+ wetlands recorded in Lake Macquarie. The LM Wetlands Management Study is currently in draft format.	Management Study and other relevant studies.

LAKE HEALTH MONITORING ACTION PLAN

OBJECTIVES:

- ❑ To provide appropriate and comprehensive information to assist the management of the estuary and its tributaries
- ❑ To measure the effectiveness of various management options
- ❑ To provide information, which will help to develop the community's understanding of the Lake and its catchment
- ❑ To provide information which will assist the development of a suitable predictive tool which models key biophysical processes of the Lake
- ❑ To provide appropriate and comprehensive information that will assist decision making in the management of the estuary, measure effectiveness in the management of the estuary, increase community understanding and facilitation co-ordination in the management of the estuary.

Code	Priority	Specific Objective	Short Term Actions	Long Term Actions	Funds Already Committed	Funds Needed for Future Actions	Responsibility for Action	When	Status	Comments
HM/F	High	Monitor tributary water quality	Monitor 9 representative tributaries for water quality	Review sites parameters & frequency		$100,000 pa Year 1 $66,000 pa thereafter	Lake Macquarie Co-Ordinator with LMCC	Mar 1999 to 2004		ANZECC guidelines
HM/G	High	Monitor foreshore & Tributary vegetation & erosion	Red/Yellow/Green mapping	Review trends		$6,000 pa	DLWC	Mar 1999	Preliminary mapping commenced	% of Red/Yellow/Green
HM/H	High	Monitor seagrass & Algae	Monitor 7 sites (includes channel & Black Neds Bay)	Review		$30,500 pa	Lake Macquarie Co-Ordinator with Fisheries, LMCC, WSC and Power Stations	Mar. 1999		
HM/I	High	To review, evaluate and revise overall Lake monitoring to identify monitoring/data gaps, incorporate new technologies and respond to changes in environmental conditions.	To identify a mechanism for the evaluation of the identified monitoring programmes.	Implement a review and evaluation process on a two-yearly basis.			Lake Macquarie Co-Ordinator	Jan 2000	This action will provide the opportunity to evaluate monitoring results and methodologies to ensure their suitability for changing environmental conditions.	See Section 6 of Framework Document
HM/J	High	To provide a mechanism to report monitoring results to the wider community of Lake Macquarie.	To identify options for collating monitoring data at a central location.	Report monitoring results and environmental trends to the wider community on an annual basis.	Nil	See Section 6 re Office of Lake Macquarie Lake Macquarie Co-Ordinator	Lake Macquarie Co-Ordinator	Year 2000	Monitoring data is currently held by various authorities. No consistent format or reporting mechanism exists. Council's SoE report	Improved community understanding of environmental issues and conditions. See Section 6 of Framework Document % Red/Yellow/Green

									provides an important opportunity for reporting to the community.	

8.3 Land Use Planning and Management Action Plan

Environmental problems/issues

The catchment of Lake Macquarie is environmentally and economically significant to the State and experiences continued growth and change in natural resources development, mining, energy, forestry, tourism, rural activities and urban and rural settlement. All individual disturbances to the environment caused by natural events or human activity have the potential to cause cumulative impacts on water quality.

Increases in nutrient and sediment concentration have been observed in the Lake since the early 1950s. Algal levels have increased in association with increased nutrient levels, and clarity of the Lake's water has decreased.

Whilst all catchment activities contribute to the problem, previous studies have shown that urban areas in particular make a significant contribution to sedimentation and nutrient discharges to the Lake via stormwater. Lake Macquarie is, and will remain, the most populous local council area in the Lower Hunter. Population is expected to increase by 30,000 new residents by the year 2021, requiring an additional 15,800 dwellings.

Who it affects and how

The urban design at the northern end of the Lake makes it difficult to rehabilitate the landform in a manner that allows compatibility between littoral vegetation and nearshore marine flora and fauna. Recreational usage, with its concomitant beneficial effects of environmental awareness, competes for the narrow strip of land between the road systems and the shore. The roads themselves cause high levels of polluted run-off and there is little space in which to treat these levels of nutrients and heavy metals. Residential development, in many places, encroaches on the shoreline and in other areas severely degrades the shoreline by mowing, tree clearing and seagrass damage. The only effective means of securing mitigation of these effects is by expensive systems of regulation, education and engineering works.

The southern, south eastern and south western areas of the Lake catchment offer an opportunity to more effectively implement an urban design which is compatible with the long term sustainability of the Lake. A buffer zone along the Lake shore of sufficient depth that it can naturally treat the incidental non-controlled run-off from development and maintain the attractive natural beauty of the Lake will be of considerable long term economic, as well as ecological, benefit to the region. There are considerable benefits in maintaining nearshore vegetation in a way that is compatible with the estuarine habitat of productive species of the Lake.

Such urban design objectives should be addressed by Local and State governments to ensure that the mistakes of the north in the past are not visited on future generations by a more knowledgeable government community. The work of the Taskforce will have to be done all over again unless urban planning embraces a big picture of the catchment and identifies those natural systems which must remain in place to ensure a beneficial and healthy lifestyle for the community.

All Lake users are affected by changes to Lake water quality. Elevated nutrient and algae levels and bacterial contamination after rain impacts on recreational use. Sedimentation reduces the ventilation of shallow embayments and leads to the loss of aquatic habitat.

How can we fix the problem?

Through the proper management of the many human activities within the catchment, most of the significant attributes of the Lake should be able to be protected and enhanced. Well-targeted strategies for both the rural and urban sectors of the Catchment need to be adopted and implemented. The focus should be on:

- ❑ stormwater and wastewater management;
- ❑ erosion and sedimentation control;
- ❑ reviewing the pattern of urban and rural settlement within the catchment to achieve the best water quality outcomes for the Lake;
- ❑ protecting wetlands, littoral vegetation and riverine corridors;
- ❑ adoption of best management practice by all land use sectors within the catchment; and
- ❑ ensuring the appropriate assessment of all development proposals that have the potential to significantly harm the water quality of the Lake.

Why is it worth taking action?

Action should be taken to apply the State Government's Wetlands Policy to the significant wetlands in the region. The policy is proving to be an effective way of looking at the significance of wetlands in a regional context. It is essential that the Lake's catchment be thought of as a whole unit in land use planning and not as isolated parcels of land.

The Lake plays a vital role in the Lower Hunter. It needs to be managed in an integrated way to ensure its value as a community resource is retained.

LAND USE PLANNING AND MANAGEMENT ACTION PLAN

OBJECTIVES:

- ❑ To implement best practice in the management of stormwater and wastewater runoff
- ❑ To conserve and enhance wetlands, littoral and riparian vegetation
- ❑ To adopt land use and urban form which protects the lake
- ❑ To maintain water quality to protect the environment and recreational values
- ❑ To achieve ecologically sustainable development

Code	Priority	Specific Objective	Short Term Actions	Long Term Actions	Funds Already Committed	Funds Needed for Future Actions	Responsibility for Action	When	Status	Comments
LU/A	High	Alleviate the future impact of urbanisation on Lake Macquarie.	Review and implement urban settlement strategy and LEP.		$40,000 LMCC Lifestyle 2020 Review $1.32 M Central Coast Strategy Review. $15,000 WSC		DUAP LMCC WSC	Dec 1999	Commenced	Improved water quality. No net increase of sediments and nutrients from new development. Improved urban planning.
LU/B	High	Alleviate the future impact of urbanisation on Lake Macquarie.	Introduce Water Sensitive Urban Design Regional Development Control Plan. Prepare Stormwater Management Plans.		$12,000 $120,000		LMCC WSC LHCC REMS DUAP LMCC WSC	Aug 1999		Improved water quality. No net increase of sediments and nutrients from new development. Improved urban design. (See Item W Q/D)
LU/C	High	Alleviate the future impact of urbanisation on Lake Macquarie.	Enforce sediment/erosion control regulations.		$58,632 pa - LMCC - Erosion/ Sediment Control Officer.	Recurrent	LMCC WSC	Ongoing		No net increase of sediments from new development. Increase regulation of erosion and sediment control requirements.
LU/D	High	Alleviate the future impact of urbanisation on Lake Macquarie.	New urban development to be confined to sewered areas. Buffer areas to be provided and maintained along foreshores.				LMCC WSC	Ongoing		No net increase of nutrients from new development.
LU/E	High	Protect wetlands/littoral and riparian vegetation.	• Study of Wetlands • Review current practices and			$45,000	LMCC WSC	July. 1999		No net loss of wetlands/littoral vegetation. Enhanced

			practices and strategies for protection • Implementation of Protection plans							riparian/ littoral conditions.

LAND USE PLANNING AND MANAGEMENT ACTION PLAN

OBJECTIVES:

- ❑ To implement best practice in the management of stormwater and wastewater runoff
- ❑ To conserve and enhance wetlands, littoral and riparian vegetation
- ❑ To adopt land use and urban form which protects the lake
- ❑ To maintain water quality to protect the environment and recreational values
- ❑ To achieve ecologically sustainable development

Code	Priority	Specific Objective	Short Term Actions	Long Term Actions	Funds Already Committed	Funds Needed for Future Actions	Responsibility for Action	When	Status	Comments
LU/F	Medium	Appropriately locate rural residential development.	Prepare rural settlement strategy for the catchment and incorporate elements of Lifestyle 2020 and WSC plans.				LMCC WSC DUAP	Sept. 1999		No net increase of nutrients and other pollutants. Improved rural planning.
LU/G	Medium	Control and maintain on-site effluent disposal systems from rural development.	New rural residential lots to be capable of containing and disposing of effluent wastes on-site.			User Pays	LMCC WSC	Ongoing		No net increase of nutrients from new development.
LU/H	Low	Achieve sustainable agricultural practices.	Promote a whole of farm planning approach for rural properties in the catchment. Promote land care.				LMCC LMCMC (DLWC/ Dept of Agriculture WSC)	1999		Reduced erosion/sedimentation and nutrient input from the catchment.
LU/I	Low	Reduce the impact of forestry on water quality.	Ensure best practices are adopted and implemented.				State Forests	Ongoing		No net increase of sediment/nutrients from Forestry operations.
							State Rail			

LU/J	Low	Reduce the impact of infrastructure utilities on water quality.	Ensure best practices are adopted and implemented.				RTA HWC energyAustralia Transgrid	Ongoing		No net increase of sediment/nutrients from utility operations.

8.4 Community Education and Participation Action Plan

Environmental problems/issues

The wider community has a significant impact on the environment, both within the catchment and estuary. Everyday activities in the household or industrial workplace can adversely impact on the quality of the downstream environment. There is a need to foster community ownership of their contribution to environmental problems and to alter community behaviours and attitudes to local issues.

The link between 'impacts' and 'environmental quality' is not however clearly understood. Many residents who complain about decreased environmental amenities do not understand the relationship between their actions and the effects they dislike.

Both regulatory and educational approaches are required to address the problem of the Lake. Regulatory processes are not always effective or the most appropriate approach when modifying individual behaviour but are effective when penalising deliberate bad behaviour.

Who it affects and how

The community as a whole, and specifically Lake users, are suffering from the cumulative effects of environmentally damaging actions.

How can we fix the problem?

Education, awareness raising and community ownership are important in forming this 'link' between actions and impacts on the environment. Community education in the key areas of stormwater pollution, management of litter and pet faeces, seagrass ecology, vegetation management, fish stock conservation and foreshore management are essential.

Why is it worth taking action?

Education has been proven as a cost-effective way of influencing attitudinal change within the community although behavioural change may require a longer-term education program. Education is also considered to be an equitable approach to fixing the problems affecting the Lake because the benefits can be widely spread throughout the community.

An educated community can assist in behavioural modification of visitors and by suggestion as to where authorities should place their investments in regulation, education and infrastructure.

COMMUNITY EDUCATION AND PARTICIPATION ACTION PLAN

OBJECTIVES:

- ❑ To involve, inform and foster stewardship in caring for the Lake and catchment
- ❑ To facilitate community involvement and ownership of the environment through identification of environmental initiatives
- ❑ To influence community behaviour, awareness and attitudes to the environment and natural ecological processes
- ❑ To identify specific issues and influence community behaviour

Code	Priority	Specific Objective	Short Term Actions	Long Term Actions	Funds Already Committed	Funds Needed for Future Actions	Responsibility for Action	When	Status	Comments
CE/A	High	To raise community awareness.	Prepare annual community involvement and education programme and budgets.	Ongoing. Implementation of education programmes.	$7,000	--	WSC LMCC EPA	Mar 1999	Limited education programmes are implemented by Council on an annual basis.	Changes in community behaviour and attitudes to the environment. Involvement in community based initiatives.
CE/B	High	To measure change in community attitude and behaviour	Prepare and undertake community survey of attitudes and behaviour.	Repeat every 3 years.	Nil	$9,000 $1,000 $10,000	LMCC WSC DLWC (Supp.)	Jul 1999	Provide baseline information to measure future change in attitude and behaviour.	Changes in community behaviour and attitudes to the environment. Involvement in community based initiatives.
CE/CA	High	To involve the community in positive environmental action and develop a sense of ownership.	Education - foreshore and Seagrass issues - Fennell/Edmunds Bay			$20,000	Lake Macquarie Co-ordinator	Mar 1999		
CE/C	High	To involve the community in positive environmental action and develop a sense of ownership.	Education - foreshore and Seagrass issues - Warners Bay			$20,000	Lake Macquarie Co-ordinator	Mar 1999		
CE/D	High	To involve the community in positive environmental action and develop a sense of ownership.	Education - foreshore and Seagrass issues - Swansea Flats			$20,000	Lake Macquarie Co-ordinator	July 1999 June 2000		

COMMUNITY EDUCATION AND PARTICIPATION ACTION PLAN

OBJECTIVES:

- ❑ To involve, inform and foster stewardship in caring for the Lake and catchment
- ❑ To facilitate community involvement and ownership of the environment through identification of environmental initiatives
- ❑ To influence community behaviour, awareness and attitudes to the environment and natural ecological processes
- ❑ To identify specific issues and influence community behaviour

Code	Priority	Specific Objective	Short Term Actions	Long Term Actions	Funds Already Committed	Funds Needed for Future Actions	Responsibility for Action	When	Status	Comments
CE/E	High	To raise community awareness and change behaviour and attitudes to the environment.	Implement Education Programmes: • Reduction in Stormwater Pollution • Ecological Value of Seagrass • Ecological Value of Wetlands and Saltmarsh • Preventing erosion and rehabilitating foreshores • Erosion and Sediment Control	Ongoing. Implementation and extension of programme to new areas.		$150,000 $10,000 $5,000	DLWC (Supp.) LMCC WSC LMCC DLWC WSC	Jul 1999 to Jul 2004	Wetlands around the Lake are currently facing many impacts from urbanisation. Numerous foreshore areas around the Lake are experiencing erosion (incl. Marmong Pt, Croudace Bay, Marks Pt), resulting in loss of waterfront land and associated values as well as sedimentation in adjacent areas. Education of community & developers, & enforcement of erosion and sediment controls is required to reduce sediment runoff from building sites.	Measure change in community attitude and behaviour. Through community surveys. Improved protection of seagrass, wetlands and foreshore areas.
			• Implement General Industry Education Programme.		$30,000 (EPA)		LMCC EPA		EPA Pollution Reduction Programme in place for licensed discharges. Non-licensed premises need to be targeted.	Reduced discharge of contaminants from industrial premises.
			• Implement Education Programme for Community, Commercial and Recreational Fishers to increase understanding for sustainable harvest of wild fish populations		$42,000 (Fisheries)		Fisheries LMCC WSC NB: In Consultation with LMCMC		Concern over bycatch from commercial fishing led to a petition for a 'net-free Lake'. Currently, little concern over the amount of fish taken from the Lake (cumulative impact of fishing activities). Lack of awareness	Improved fish stock management. Improved community attitude to fish stock and habitat protection. Improvements

			fish populations and protection of fish habitat.						that fish come from a functioning ecosystem (no consideration of sustainability).	to commercial fishing methods.

COMMUNITY EDUCATION AND PARTICIPATION ACTION PLAN

OBJECTIVES:

- ❑ To involve, inform and foster stewardship in caring for the Lake and catchment
- ❑ To facilitate community involvement and ownership of the environment through identification of environmental initiatives
- ❑ To influence community behaviour, awareness and attitudes to the environment and natural ecological processes
- ❑ To identify specific issues and influence community behaviour

Code	Priority	Specific Objective	Short Term Actions	Long Term Actions	Funds Already Committed	Funds Needed for Future Actions	Responsibility for Action	When	Status	Comments
CE/F	High	Promote Research and Development.	• Maintain LMCC Environmental Research Fund. • Involve University and TAFE in specific course-related studies.	Ongoing. Identify research and development priorities.	$10,000 p.a.		LMCC EPA	Jan. 1999	Funding is provided on an annual basis by LMCC to small research projects.	Improved data availability for management of the environment and decision-making.
CE/G	High	Inform Community of Progress with Estuary and Catchment Management Framework actions.	• Prepare 6-monthly Newsletter. • Report Monitoring Results. • Prepare Media Releases. • Conduct Community Workshops.	Ongoing. Ongoing. Ongoing. As required.		$10,000	Lake Macquarie Co-ordinator	Jul 1999	Council produces an annual SoE report containing information on estuary and catchment management $5,000 p.a.	See IM/A
CE/H	High	Educate Contractors involved in Earthworks on importance of sediment controls.	Develop programs and implement	Maintain education		$5,000	Lake Macquarie Co-ordinator	July 1999	DLWC have training programme available	

COMMUNITY EDUCATION AND PARTICIPATION ACTION PLAN

OBJECTIVES:

- ❑ To involve, inform and foster stewardship in caring for the Lake and catchment
- ❑ To facilitate community involvement and ownership of the environment through identification of environmental initiatives
- ❑ To influence community behaviour, awareness and attitudes to the environment and natural ecological processes
- ❑ To identify specific issues and influence community behaviour

Code	Priority	Specific Objective	Short Term Actions	Long Term Actions	Funds Already Committed	Funds Needed for Future Actions	Responsibility for Action	When	Status	Comments
CE/H	Medium	Involve Community in Sustainable Environmental Initiatives.	• Co-ordinate community working bee days. • Facilitate formation of Landcare/Environment Groups. • Undertake Environfest - currently an annual event. • Participation in Clean-Up Australia.	Hold local Landcare seminars / workshops. Facilitate community involvement - Landcare display. Increased participation.	DLWC - Landcare programme LMCC Environfest budget ($32,000) Clean-up budget ($30,000)	Ongoing funding required	LMCC LMCMC DLWC Landcare LMCC & Sponsors LMCC & Sponsors	Ongoing	Record number of groups and achievements.	Increased community involvement. Increased participation in Clean-Up Australia day. Increased participation in Environfest.
CE/I	Medium	Involve and Educate Youth.	Facilitate Streamwatch in Primary and High Schools, and Education programmes.	Ongoing.	$33,000	Ongoing funding required	HCMT DLWC LMCC LMCMC	Ongoing	Currently, 14 schools in Lake Macquarie participating in Streamwatch.	Increased number of schools - Streamwatch.

8.5 Biodiversity Conservation Management Action Plan

Environmental Problems/Issues

Biodiversity means the variety of life and refers not only to the number of species but also to the genetic variety within species and to the ecosystems which support life of Lake Macquarie and its Catchment.

The biodiversity of fisheries and aquatic habitat of Lake Macquarie are inextricably linked to that of the surrounding wetlands and catchment of the Lake.

While serious changes have been wrought since human settlement, especially during the last two centuries, the Lake Macquarie area still retains considerable populations of plants and animals and the diverse ecosystems that support them. Some are now endangered or considered vulnerable and at risk and deserve special attention. A more sensitive approach to habitat modification or destruction - clearing, wetland draining and infilling, alterations to watercourses - is needed.

Who it affects and how

The gradual loss of biodiversity will affect the community, through the catchment and Lake being unable to sustain the economic, social and environmental values we presently enjoy.

How can we fix the problem?

Conservation and maintenance of native forests, freshwater and estuarine wetlands, aquatic communities, remnant bushland areas; retention and restoration of viable wildlife corridors; protection of rare plants and animals; and the control of plant pests, feral animals and unconstrained domestic animals are key aspects of protecting Lake Macquarie's biodiversity and maintaining its relationships with regional and national biological systems.

The regional biodiversity is the subject of a comprehensive strategy "The Lower Hunter Central Coast Regional Biodiversity Conservation Strategy", which encompasses Lake Macquarie and its Catchment. Biodiversity management initiatives are most effective when referenced to other work being undertaken in the area. This management plan provides opportunities to share information and build strategic links with the above project.

Objectives include:

- ❑ Develop a biodiversity database for the whole catchment.
- ❑ Protect and maintain the greatest possible diversity in those areas considered to be of high conservation value.

- ❑ Identify threats to significant plant and animal communities and develop measures to counter or alleviate those threats.

- ❑ Develop a management plan for the conservation of biodiversity in Lake Macquarie and its catchment.

- ❑ Encourage community involvement in biodiversity management and promote its values.

Why is it worth taking action?

Lake Macquarie will retain its interesting plants and animals and the diverse ecosystems that support them, and this will improve the community's quality of life for the present and future generations.

BIODIVERSITY CONSERVATION MANAGEMENT PLAN

OBJECTIVES:

- ❑ To protect the natural ecological processes within the Lake and its Catchment
- ❑ To protect and enhance biodiversity
- ❑ To protect endangered species and their habitats
- ❑ To protect wetlands and their catchments

Code	Priority	Specific Objective	Short Term Actions	Long Term Actions	Funds Already Committed	Funds Needed for Future Actions	Responsibility for Action	When	Status	Comments
BC/A	High Med. Med.	Match land use to the ecological sensitivity of land and threatened species habitat	Review LEP Zones for environmental protection	• Implement improved controls on clearing in sensitive areas (see LU/A) • Implement new zones. • Investigate means by which new zones can be implemented (e.g. negotiating with landowners possibly through a revolving fund buying land, rezoning and reselling where rezoning would seriously affect existing development opportunities on the land)		To be determined	LMCC WSC	During 1999	LMCC 2020 Lifestyle Review underway	% of LMC in conservation reserves. Number of viable wildlife corridors. Numbers of species listed as threatened in LMC. See Item LU/A
BC/B	Med.	Improve the functioning and condition of littoral/riparian areas	Assess the condition of littoral/riparian areas around the Lake and in the catchment.	• Review planning controls. • Prioritise areas to be targeted. • Implement measures to improve & enhance native vegetation in riparian areas.			DLWC LMCC WSC	During 1999		See Item HM/G. Area (m^2) restored to natural state.
BC/C	High	Rehabilitate and enhance wetlands.	Finalise the Wetlands Management Study. Expand study	• Progressively rehabilitate wetlands as per the Wetlands Management Study.	$30,000		LMCC WSC	Dec 1999		See Items HM/E, LU/E, CE/E, FA/D

			to include additional wetlands.	• Implement planning controls/policy for wetlands.						

BIODIVERSITY CONSERVATION MANAGEMENT PLAN

OBJECTIVES:

- ❑ To protect the natural ecological processes within the Lake and its Catchment
- ❑ To protect and enhance biodiversity
- ❑ To protect endangered species and their habitats
- ❑ To protect wetlands and their catchments

Code	Priority	Specific Objective	Short Term Actions	Long Term Actions	Funds Already Committed	Funds Needed for Future Actions	Responsibility for Action	When	Status	Comments
BC/D	High	Maintain remnant vegetation and corridors	Prepare native vegetation	• Review planning controls and develop policy.		$10,000	LMCC WSC NPWS	During 1999		See Item LU/A
BC/E	Med	Monitor birdlife habitat on Lake Islands & those classified under International Treaties (CAMBA, JAMBA)					LMCMC NPWS			

8.6 Fisheries and Aquatic Habitat Management Action Plan

Environmental problems/issues

The cumulative impacts of development around the Lake have had a detrimental impact on the fish habitat and fish stocks in the Lake.

The protection of the aquatic habitat is a priority, as the health of the habitat is a reflection of the health of the Lake, and these habitats often act as natural water treatment areas. The aquatic habitats include freshwater wetlands, saltmarsh and mangroves, and seagrass beds. Some of the major impacts that directly impinge upon these habitats are dredging, sedimentation, sediment quality, inappropriate boat mooring structures and inappropriate development around the edges and upstream of the wetlands. If there is no suitable habitat, there will be no fish.

A component of the aquatic habitats in the lake that is often overlooked is the seagrass wrack (dead seagrass) that washes ashore around the Lake. Wrack is an important habitat for a range of species of small invertebrates. These invertebrates are an important component of the biodiversity around the Lake, as well as a source of food for the fish in the Lake. The decomposing wrack is also an important source of primary productivity, which forms the base of the food chain.

The effects of selenium and heavy metals on the fish in the Lake are seen by many as having a major health impact. A report released in June 1997 by NSW Health concluded that eating fish and crabs in Lake Macquarie poses no risk to human health unless consumed in extreme quantities over a substantial period of time.

Conflict between Commercial and Recreational Fishers

Lake Macquarie supports significant commercial and recreational fisheries and conflict in the allocation of fisheries resources between the competing sectors has escalated in recent years.

Prior to and during the 1980s, representations were made by individuals, however during the 1990s a number of recreational fishing interest groups, including the Concerned Anglers Group and the Southern Lake Macquarie Action Group, have become increasingly involved in lobbying against commercial fishing in the Lake. Recreational fishers' concerns include:

- ❑ A perceived decline in catches;
- ❑ Excessive commercial fishing effort;
- ❑ Detrimental effects of hauling on fish habitats;
- ❑ Excessive levels of bycatch taken in haul nets;
- ❑ Detrimental effects of commercial fishing on tourism; and

- ❑ Pollution levels in fish.

Fishermen and Gear

At least 280 species of fish are known to inhabit the waters of Lake Macquarie, although not all are caught in the commercial and recreational fishery.

The history of the Lake Macquarie fishery from 1890 to 1956 was outlined by Thomson (1959) as part of a CSIRO study.

Over the period 1971-1981, the Lake Macquarie fishery was consistently ranked second to the Clarence River in terms of estuarine fish production in NSW. During this time, the catch varied from 244 tonnes in 1971-1972 to 480 tonnes in 1975-76 and averaged 384 tonnes over the entire decade (Virgona, 1983; Pease & Grinberg, 1995).

Increased catches in other estuaries have now relegated Lake Macquarie to the fourth most productive in NSW.

Over recent years, the value of the catch estimated from fishers' catch returns has remained relatively constant at about $1 million dollars per annum.

Estimated Value of the Commercial Catch from Lake Macquarie

Year	1994-95	1995-96	1996-97
No. of Fishers	45	40	39
Value of Catch	$1,179,375	$1,018,167	$1,050,343

Commercial fishing for fin-fish in Lake Macquarie is carried out using gillnets and seine nets. Gill-netting is done in the northern and southern regions of the Lake. In contrast, the use of seine nets is restricted to the southern regions of the Lake, as is commercial prawning. Commercial prawn fishers normally use seine nets specifically constructed for the purpose.

Recreational fishing occurs throughout the Lake and is either shore-based or carried out using a range of boats generally powered by outboard motors. Recreational prawning is also carried out from the shore or boats using scoop nets or from the shore using drag nets.

Figure 5 of Appendix 1 shows NSW Fisheries Closures for Lake Macquarie.

Status of the Fisheries

The most recent scientific study of the fisheries of Lake Macquarie (Virgona 1983) drew the following conclusions:

- The catch per unit effort for the commercial fishery was comparable with or greater than that documented during the 1950s (CSIRO study) indicating that Lake Macquarie was as productive as it had been;
- The annual total commercial fish catch and catches of the main commercial species increased over the preceding 25 years;
- There had been little variation in the commercial catch composition over the preceding 25 years, with sea mullet, tailor, yellowfin bream and luderick dominating the catches;
- The annual prawn catch had increased over the preceding 25 years;
- Recreational (angling) effort was estimated to be high in relation to other estuaries in NSW and this was attributed to the large size of the Lake and its proximity to the nearby cities of Newcastle and Sydney;
- The composition of the angling catch was similar to other estuaries and was dominated by 8 species;
- Using tagged fish, the annual exploitation rate of yellowfin bream was estimated to be 7.1%;
- Angling effort was lower in winter and spring compared to summer and autumn, and overall was greatest in the northern part of the Lake where greater angling effort occurred from boats;
- Catch per unit effort (CPUE) for anglers did not appear to differ in regions of the lagoon where seining occurs compared to areas without commercial fishing;
- Very high proportions of the catch retained by anglers were under legal size;
- There was little physical overlap between the commercial and recreational fishers in Lake Macquarie because of regulations, closures and the different times of day that they fish;
- The main overlapping species were luderick, tailor, dusky flathead, yellowfin bream, trumpeter, whiting and leatherjackets, and there was no evidence suggesting that the stocks of these species had been depleted; and
- The Vales Point and Wangi power station cooling water intake and outlet areas were focal points for anglers, and there was no depletion of fish and prawn stocks attributable to the development of power stations around Lake Macquarie.

Nevertheless, long term anecdotal evidence supports the perception that there are less fish available for recreational anglers.

Artificial Reefs

The installation of artificial reefs is supported by both commercial and recreational fishers as a means to extend fish habitat and enhance productivity. While the efficacy of artificial reefs for this purpose in estuarine environments such as the Lake remains unproven, the proposal to test their effectiveness through sound research is supported.

Enhancement

As the Lake is an open system and many of the important fish and crustacean species migrate to the sea to spawn, enhancement of fishing through stocking programs remains problematic. Recent work by NSW Fisheries stocking mulloway into an enclosed coastal lake has shown the potential. Although the techniques for artificial production of a number of important species are available, it remains to be shown that recruitment failure is the primary factor affecting fish abundance in the Lake. In the short term, it is unlikely that stock enhancement through the supply of farmed juveniles is a feasible or useful contributor to the improvement of fishing in the Lake.

Aquaculture

Aquaculture in the Lake would be detrimental and there would be significant impacts on water quality with excessive nutrient pollution leading to eutrophication. There is a lack of suitable areas, together with the physical navigation hazards presented by structures in this busy estuary. The possibility of contamination of wild stocks by imported diseases must also be considered.

While land-based aquaculture may have some potential, especially with freshwater species, nutrient pollution of the Lake by large scale ventures would have to be carefully managed.

Consultation

Commercial fishers were consulted by NSW Fisheries in a series of meetings and on the water discussions to identify and canvass options for resolving issues of conflict.

The key issues raised in meetings with Commercial Haul Net Fishers on 20 July 1998 and Commercial Mesh Net Fishers on 7 August 1998 and other Lake Fishers are summarised in Appendix 5.

The majority of fishers felt that any buy-outs should be on a voluntary basis using a tender scheme. They felt this to be a fair way for fishers to get what they feel their fishing business is worth. Like the other group of fishers, these fishers had concerns over their eligibility to re-enter the fishing industry.

The major difference of opinion between the two groups of fishers consulted was whether buy-outs should be voluntary or compulsory. All fishers thought that a fair price would be to include all gear, earning capacity and age. They also sought the option to re-enter the industry without being treated as a 'new entrant' under the current licensing policy restrictions if they choose to buy back into the industry at another location at a later date.

Compensation for Restriction of Fishers' Access Rights

Historically, commercial fisheries in NSW have been managed under an open access scheme. However, on 1 March 1997, the estuary general fishery (including all commercial fishing in Lake Macquarie) became a restricted fishery. Under this arrangement only those fishers who met fishery specific entry criteria based on catch history (previous participation) were granted future access rights (endorsements) in the fishery. A number of commercial fishers currently fishing in the Lake were refused specific gear category endorsements, including haul netting, but have been permitted to continue fishing while their appeals against the allocation of endorsements are heard.

To date, there has been no judicial consideration on the property rights (if any) relating to the issue of endorsements under the *Fisheries Management Act 1994*, or of the nature of commercial fishing licences in this state. However, there have been cases in NSW where fishers have received payment for restriction or curtailment of access rights in specific circumstances. For example, the Botany Bay prawn trawl fleet received payment for the loss of trawling grounds when Sydney Airport was extended.

A number of cases heard in other states have examined the nature of commercial fishing licences as property rights, including:

- Pennington -v- McGovern where the South Australian Supreme Court held that a licence under the South Australian Act was a proprietary interest; and

- Austell Pty Ltd -v- Commissioner of State Taxation (WA) where the WA Supreme Court found a crayfishing licence and the rights conferred by the transfer of a vessel were proprietary in nature.

Recent precedents in Queensland (Pumicestone Passage closure) and in Victoria (Port Phillip Bay scallop fishery closure) have reinforced the obligation on governments to recognise the rights of commercial fishers and to provide adequate settlements if fishing businesses are closed down.

The Minister for Fisheries has indicated that, while reserving the right to modify fishing methods and areas of operation where appropriate, commercial fishing licences will not be arbitrarily cancelled without the provision of fair and just payment. Any further closure or restrictions on commercial fishing in the Lake will only be undertaken in full consultation with the fishers involved.

Commercial Fishers' Position

Commercial fishermen believe that the resources of the Lake should be conserved and shared as required under the *Fisheries Management Act 1994*, with the objectives:

(a) to conserve fish stocks and key fish habitats, and

(b) to conserve threatened species, populations and ecological communities of fish and marine vegetation, and

(c) to promote ecologically sustainable development, including the conservation of biological diversity, and

consistently with these objectives:

(d) to promote viable commercial fishing and aquaculture industries, and

(e) to promote quality recreational fishing opportunities, and

(f) to appropriately share fisheries resources between the users of those resources.

Commercial fishers believe that recreational effort has increased substantially in recent years.

The number of commercial fishers has been reduced substantially over that period and as part of the Estuary General Restricted Fishery, the Lake is in the final stages of implementation of a strict management regime where ongoing use of particular gear types has been rigorously allocated on the basis of past participation.

Commercial fishers believe that much of the conflict is generated by a well organized recreational lobby and a compliant local media. They also believe that the conflict will eventually die down with better education of the public.

There are substantial areas of agreement between commercial and recreational fishers including:

- ❑ Concern over past and present habitat degradation and water quality;
- ❑ The need to conserve and enhance habitat to promote fish stocks; and
- ❑ The need for artificial reefs in certain areas of the Lake.

Commercial fishers support the concept of a buy-back to reduce commercial fishing effort and conflict on the Lake providing that the scheme was voluntary.

Recreational Fishers' Position

Recreational fishers strongly support the conservation of fish stocks and the protection and restoration of fish habitats. They recognise that environmental degradation of the Lake has impacted fish stocks and support remedial action. They also believe that recreational catch rates have fallen dramatically in the last decade, and that commercial fishing in the Lake is not sustainable. The primary platforms of the major recreational fishing groups are:

- opposition to all forms of haul netting
- phasing out of all commercial fishing as soon as possible
- installation of artificial reefs
- increase areas closed to all forms of fishing
- conservative bag and size limits
- increased compliance activity of all fishers
- introduction of voluntary fisheries education officers
- education to promote environmental responsibility

Public support for various options including a Lake specific fishing license to fund the buy-out of commercial fishers were canvassed by recreational fishing groups with equivocal results.

Recommendations

Recommendations of the Taskforce arising from the considerations of the Fisheries Subgroup are:

1. Commence negotiations of a buy-out process of haul netters in Lake Macquarie in the 1999 financial year with an aim of total exclusion as soon as possible and this process to be initiated by the Lake Macquarie Estuary Co-ordinator.

2. At the completion of the buy-out of the haul netters, the same process commences for other commercial fishers in Lake Macquarie.

3. Recreational Fishers Association, Advancing Lake Macquarie and Lake Macquarie Tourist Industry be requested to consider how local contributions could be raised for the commercial fishers buy-out scheme.

4. The State Government be requested to provide matching funds on locally raised funds until the buy-out of all commercial fishers in Lake Macquarie Estuary is complete.

5. NSW Fisheries be requested to ensure that non-Lake Macquarie commercial fishers cease fishing in Lake Macquarie.

6. NSW Fisheries be requested to commence a review of habitat management in the Lake with a view to increasing fish stocks and commence monitoring of Lake seagrasses.
7. NSW Fisheries be requested to increase its compliance activities to stop fishing in restricted areas.

8. NSW Fisheries and the Department of Land & Water Conservation be requested to assist in the introduction of properly constructed artificial reefs in fishing and non-fishing areas of Lake Macquarie.

9. NSW Fisheries be requested to monitor the artificial reefs on an on-going basis to assess their effectiveness in regrowth of fish population.

10. NSW Fisheries be requested to increase compliance enforcement with recreational fishers for undersized fish and bag limits.

Who it affects and how

The loss or degradation of the aquatic habitats will have a direct effect on the quality and quantity of the fish stocks in the Lake and possibly on the water quality of the Lake.

The three sections of the community that will be affected by any impacts on the habitat are:

- The commercial and recreational fishers - the removal or degradation of habitat will place pressure on the size and diversity of existing fish stocks. As this pressure increases, predominantly as the recreational pressure increases, there will be increasing conflict between stakeholders.

- The tourist industry will be impacted if recreational values (from real or perceived reductions in fish catches, boating amenity, smell or ooze from degrading marine vegetation) are reduced and the quality of the water is affected.

- The community loses the benefits of the recreational, commercial and physical amenity of the Lake.

The selenium and heavy metal issue may impact the fishers as the perception that the fish are unhealthy will impact fishing in the Lake with its flow-on effects to commercial and tourism industries.

How can we fix it?

Fixing or preventing the situation from becoming worse will require determination of the extent of the problem and the development and implementation of strategies to address the issues. Some issues may only be problems of perceptions and will be addressed by an education or information program, while other issues may involve extensive studies and the development and implementation of management strategies.

Replanting of seagrass may be feasible in areas of the Lake.

Implementation of the Fisheries Sub-Group recommendation to the Taskforce will assist in resolving conflict and improving the health of the fisheries habitat.

Why is it worth doing?

The health of the habitat is a reflection of the health of the Lake as the habitats often act as filters and buffers between the land and the water. Degradation of the Lake will have a marked reduction in the attraction of the area to tourists and the local community, with loss to the local economy through fishing and associated activities.

Development and implementation of educational and management strategies to address the contentious issues will help to manage the problems, allay the fears held by the public, and reduce conflict between stakeholders.

FISHERIES AND AQUATIC HABITAT MANAGEMENT ACTION PLAN

OBJECTIVES:

- ❑ To maintain a healthy and diverse fish population within the Lake
- ❑ To protect and enhance aquatic habitat in order to maintain biodiversity of the ecosystem, species and genetic levels
- ❑ To manage the fishery resource allocation and resolve conflict between commercial and recreational fishers.

Code	Priority	Specific Objective	Short Term Actions	Long Term Actions	Funds Already Committed	Funds Needed for Future Actions	Responsibility for Action	When	Status	Comments
FA/A	High	Phase out haul netting and reduce the extent of netting in Lake Macquarie.	• Undertake Community Education Programme on haul netting activity in the Lake and the effects of its withdrawal.	Implement staged programme to reduce the number of netting licences in the Lake.		Up to $3 million - Annual cost dependent on financing.	Fisheries	1999	30 licences exist in the Lake. Independent review of effects will be required.	Commercial fishing effort in the Lake will be reduced. Conflict between commercial and recreational fishers defused.
FA/B	Med.	Maintain aquatic habitat health and diversity in Lake and tributaries.	• Develop a user based strategy, including a zoning system, for conservation of habitat to designate levels of access and use (e.g. moorings, dredging). • Extend Seagrass Monitoring Programme in conjunction with Pacific Power. • Identify blockages to fish passage (cockle Creek). • Reinforce policing of illegal catches.	Develop a Lake user management plan. (Link to DLWC Dredging EIS) Remediation & removal of blockages.	$15,000 - Seagrass Monitoring by Pacific Power, Delta Electricity.	$200,000 $30,500 p.a. $500,000	Fisheries DLWC LMCC WSC Fisheries DLWC LMCC WSC Fisheries DLWC	Mar 1999	Management decisions are made on a case by case basis. Seagrass Monitoring occurs in the southern part of the Lake. A number of weirs and culverts exist in the tributaries.	Develop a management strategy to reduce damage to aquatic habitat and reduce conflict between Lake users. Enhance management of seagrass habitat issues. (See HM/H) Maintain fish biodiversity in tributaries.
FA/B	High	Maintain aquatic habitat health and diversity in Lake and	• Prepare Seagrass Management Plan.			$50,000	Fisheries		*Posidonia sp*. May be classified as a threatened	

		tributaries							species in the future.	

FISHERIES AND AQUATIC HABITAT MANAGEMENT ACTION PLAN

OBJECTIVES:

- ❑ To maintain a healthy and diverse fish population within the Lake
- ❑ To protect and enhance aquatic habitat in order to maintain biodiversity of the ecosystem, species and genetic levels
- ❑ To manage the fishery resource allocation and resolve conflict between commercial and recreational fishers.

Code	Priority	Specific Objective	Short Term Actions	Long Term Actions	Funds Already Committed	Funds Needed for Future Actions	Responsibility for Action	When	Status	Comments
FA/C	High	Reduce seagrass damage from boat moorings.	Develop Mooring Strategy for Lake Macquarie.	Replace all moorings with seagrass friendly moorings.			Fisheries Waterways	Jan 1999		Mooring Strategy prepared. See ET/J
FA/D	Med.	Rehabilitation of wetland areas.	Develop priorities for wetland rehabilitation.	Rehabilitation of degraded wetland areas.	$75,000 Salts Bay stabilisation.	$55,000	Fisheries DLWC LMCC	Jan 1999	LMCC Wetland Study completed 1998.	Wetland Rehabilitation Strategy prepared. See LU/E
FA/E	Med.	Remove haul netting because it damages seagrasses.	• Alternative technology or modified gear. • Management Practices. • Education.			$50,000	Fisheries Commercial fishers	Jan 1999		Implement gear changes.
FA/F	Low	Reduce dead seagrass on foreshores.	Develop Management Strategy for seagrass wrack.			$20,000	Fisheries LMCC	Jan 1999		Council implements strategy.
FA/G	Low	Improve Recreational Angler catch rates.	Assess artificial reef feasibility.			$20,000	Fisheries DLWC LMCC Concerned Anglers	Jan 1999		Status of artificial reefs settled.

8.7 Estuary and Tributary Remediation and Management Action Plan

Environmental problems/issues

The status of the bed and banks of the estuary and tributaries is a function of the interaction of many processes including land management practices (catchment activities), water circulation and the sediment/water relationships. A number of issues have been identified as requiring immediate action. They are:

- ❑ poor navigation;
- ❑ poor water circulation;
- ❑ stratification;
- ❑ poor public amenity;
- ❑ nuisance algal growth;
- ❑ fish kills;
- ❑ excess nutrients and heavy metals;
- ❑ excess erosion and sedimentation; and
- ❑ seagrass damaging moorings/berthing.

Who it affects and how

Poor estuarine and tributary condition impacts upon all of the community.

- ❑ Tourism, aesthetics (e.g. odour from rotting macro algae, visual impact of erosion and sedimentation)
- ❑ Birds and aquatic fauna (e.g. habitat, reproduction, migration)
    - Heavy metals in the sediments can be bio-accumulated
    - Silt deltas cover seagrass and restrict migration

    all rely on the bed of the Lake and tributaries to be relatively stable and healthy.

How can we fix the problem?

Artificial or natural wetlands can remove some nutrients and silts from the stormwater and the construction of gross pollutant traps (GPTs) can capture most of the gravels from stormwater drains. However, this is a short-term measure and end point strategy. Improved catchment management practices will be necessary and education and awareness programs can facilitate this.

Dredging of silt deltas will allow improved navigation, water circulation and a reduction in water stratification and may be appropriate to remediate silted bays and creeks.

Why is it worth doing?

The Lake and tributaries are natural sinks for nutrients and sediments. However, the oversupply of these together with pollutants is degrading the health of the Lake. Estuarine health is a measure of the sustainable use by humans of the Lake and catchment. The human impacts must be managed to ensure good water quality and habitat.

ESTUARY AND TRIBUTARY REMEDIATION AND MANAGEMENT ACTION PLAN

OBJECTIVES:

- ❑ To improve water quality
- ❑ To reduce incidence of fish kills in tributaries
- ❑ To reduce sediment transport from within the catchment
- ❑ To maintain appropriate navigational access and implement
- ❑ To reduce excess algal growth appropriate mooring and berthing for recreational and
- ❑ To reduce the availability of nutrients and heavy metals commercial boating to the water column and ecosystem
- ❑ To improve public amenity
- ❑ To restore water circulation and reduce water stratification

Code	Priority	Specific Objective	Short Term Actions	Long Term Actions	Funds Already Committed	Funds Needed for Future Actions	Responsibility for Action	When	Status	Performance Indicators
ET/AA	High	Progressively remediate Fennell and Edmunds Bays.	Undertake maintenance dredging of silt fans of Fennell and Edmunds Bays.	As required	$270,000 - DLWC / LMCC for Lake maintenance dredging.	$50,000	LMCC	Within 12 months	Periodic algal blooms and fish kills occur. Federal Government submission made ($130,000)	Improved water quality (see Monitoring Plan) and amenity. Reduced incidence of algal blooms and fish kills.
ET/AB	High	Progressively remediate Warners Bay	Undertake the maintenance dredging of silt fans of Warners Bay	As required		$45,000 pa	LMCC	2000 /ongoing		Improved water quality
ET/AC	High	Progressively remediate Cockle Bay	Undertake maintenance dredging of silt fans of recent uncontaminated sediment of Cockle Bay	As required		$20,000	LMCC	1999		Improved water quality
ET/AD	High	Progressively remediate Swansea Flats	Undertake maintenance dredging of silt fans at Swansea Flats	As required		$10,000	LMCC	Jul 1999		Improved water quality
ET/AE	High	Undertake dredging of silt fans elsewhere in Lake		As Required		$290,000 - 2 years $240,000 - Year 3	LMCC	1999-2001		Improved water quality
ET/B	High	Obtain	Undertake the		--	$128,000	Lake	Mar 1999	Focus on	Improved water

		Development Consent for, and be in a position to call tenders to carry out, the proposed remedial works in both Bays.	Investigation, Design Documentation and EIS for the remediation and possible removal of sediment from Fennell and Edmunds Bays.			Investigation $136,000 Design and Documentation	Macquarie Co-Ordinator	to Oct 2000	Fennell and Edmunds Bays to provide example for other Lake Macquarie embayments.	quality (see Monitoring Plan) and amenity.

ESTUARY AND TRIBUTARY REMEDIATION AND MANAGEMENT ACTION PLAN

OBJECTIVES:

- ❑ To improve water quality
- ❑ To reduce incidence of fish kills in tributaries
- ❑ To reduce sediment transport from within the catchment
- ❑ To maintain appropriate navigational access and implement appropriate mooring and berthing for recreational and commercial boating
- ❑ To reduce excess algal growth
- ❑ To reduce the availability of nutrients and heavy metals to the water column and ecosystem
- ❑ To improve public amenity
- ❑ To restore water circulation and reduce water stratification

Code	Priority	Specific Objective	Short Term Actions	Long Term Actions	Funds Already Committed	Funds Needed for Future Actions	Responsibility for Action	When	Status	Performance Indicators
ET/C	High	To undertake appropriate activities to improve the water quality and the public amenity of the Bays.		Remediation of Fennell and Edmunds Bays.	--	High cost - up to $2.5m *		Nov 2000 to Nov 2002	Await outcome of above.	Improved water quality (see Monitoring Plan) and amenity.
ET/D	High	Integrate Consent process for dredging and remedial works in Lake Macquarie.	Develop a Strategic Environmental Impact Assessment and Approval Process for Lake remediation works.	Periodic review and update.	--	See ET/B	LMCC DUAP WSC	Within 12 months	Currently, separate EISs are prepared, which can increase time taken and costs.	Reduced delay and cost in effecting recommended remedial dredging works.
ET/E	High	Obtain Development Consent for, and be in a position to call tenders to carry out, the proposed remedial works in Cockle Bay	Undertake Investigation, Design and EIS Documentation for the removal of sediment from Cockle Bay and Cockle Creek.		--	$190,000	Lake Macquarie Co-Ordinator	Jul 2001 Jun 2002	Project linked to current EPA Study on Sediments in Cockle Creek.	Improved water quality (see Monitoring Plan) and amenity.

		and Cockle Creek.								
ET/F	High	To undertake appropriate works to improve the water quality and the public amenity of Cockle Bay and Cockle Creek.	Undertake remediation of Cockle Bay and Cockle Creek.			$2.5m*	Lake Macquarie Co-Ordinator	Aug 2002 Dec 2004	Await outcome of investigation.	Improved water quality (see Monitoring Plan) and amenity.
ET/G	Medium	To assess all known problem areas within the Lake and tributaries for the removal of sediment. Obtain Development Consent for, and be in a position to call tenders to carry out, the proposed remedial works at the three top priority sites.	Conduct an Investigation and Prioritisation of the removal of sediment from Lake and tributary areas with problems. Undertake the Design and Documentation for the removal of sediment from the three highest priority Lake and tributary areas.			$400,000	Lake Macquarie Co-Ordinator with LMCC and WSC	Jan 2000		

* Indicative costs only and subject to Investigation, Design and Documentation Phase.

ESTUARY AND TRIBUTARY REMEDIATION AND MANAGEMENT ACTION PLAN

OBJECTIVES:

- ❑ To improve water quality
- ❑ To reduce incidence of fish kills in tributaries
- ❑ To reduce sediment transport from within the catchment
- ❑ To maintain appropriate navigational access and implement
- ❑ To reduce excess algal growth appropriate mooring and berthing for recreational and
- ❑ To reduce the availability of nutrients and heavy metals commercial boating to the water column and ecosystem
- ❑ To improve public amenity
- ❑ To restore water circulation and reduce water stratification

Code	Priority	Specific Objective	Short Term Actions	Long Term Actions	Funds Already Committed	Funds Needed for Future Actions	Responsibility for Action	When	Status	Performance Indicators
ET/H	Medium	To undertake appropriate	Undertake remediation works	Progressive remediation		High cost - up to $1.2m *		Commence Year 2000	Await outcome of	Improved water quality (see

		works to improve the water quality and public amenity of degraded tributary sites.	for identified problem tributary sites.	over 4 years.				- over 4 years.	investigation.	Monitoring Plan) and amenity.
ET/I	Medium	To undertake appropriate works to improve the water quality and public amenity of other identified degraded Lake areas.	--	Undertake the remediation of remaining degraded Lake areas.	--	High cost - up to $20m *	Lake Macquarie Co-Ordinator	Progressively over 5 years commencing 2004	Await outcome of investigation.	Improved water quality (see Monitoring Plan) and amenity.
ET/J	High	To implement appropriate mooring and berthing for recreational and commercial vessels to reduce the impact on seagrasses.	Develop management plan for seagrass friendly moorings.	--	--		Waterways Fisheries DLWC LMCC WSC Boating rep.	Jan 1999	Swing moorings cut a circular swathe in the seagrass around the mooring.	Regeneration of seagrasses. See FA/C
ET/K	Medium	To provide appropriate temporary berthing facilities for recreational and commercial vessels.	Develop management plan for existing and new public wharves.				Waterways Fisheries DLWC LMCC WSC Boating rep.		Some existing wharves are not catering for all vessels.	Better use of infrastructure.

* Indicative costs only and subject to Investigation, Design and Documentation Phase.

ESTUARY AND TRIBUTARY REMEDIATION AND MANAGEMENT ACTION PLAN

OBJECTIVES:

- ❑ To improve water quality
- ❑ To reduce incidence of fish kills in tributaries
- ❑ To reduce sediment transport from within the catchment
- ❑ To maintain appropriate navigational access and implement
- ❑ To reduce excess algal growth appropriate mooring and berthing for recreational and
- ❑ To reduce the availability of nutrients and heavy metals commercial boating

to the water column and ecosystem
❑ To improve public amenity
❑ To restore water circulation and reduce water stratification

Code	Priority	Specific Objective	Short Term Actions	Long Term Actions	Funds Already Committed	Funds Needed for Future Actions	Responsibility for Action	When	Status	Performance Indicators
ET/L	High	Remediate foreshore of Coon Island	Investigate, Design Documentation of EIS, Construction and remediation works for Coon Island.			$250,000	Lake Macquarie Co-Ordinator	July 2000 to Jun 2002		
ET/M	High	Remediate foreshore of Swansea Flats	Investigate, Design Documentation of E.I.S. Construction and remediation works for Swansea Bay			$480,000	Lake Macquarie Co-Ordinator	Jul 1999 Jun 2002		

8.8 Entrance Channel Navigation Management Action Plan

Environmental problems/issues

Poor navigability due to sedimentation of the Channel at a number of sites including:

- ❑ the dropover;
- ❑ the entrance to Black Neds Bay;
- ❑ the entrance to Swan Bay;
- ❑ the main ocean entrance; and
- ❑ Pelican.

Who is affected and how

Recreational and commercial vessels have restricted navigable access in the Channel. Numerous sand shoals restrict access along the Channel. The degree of restriction for each vessel varies with the draft of the vessel and the tidal range at the restriction.

The owners and operators of the vessels and commercial outlets serving the boating and tourist industries are affected by the restricted navigation.

The navigation restrictions limit the number of vessels visiting the Lake and the associated reduced tourism impacts on a range of commercial outlets. They also affect the current and potential use of commercial charter vessels which also affects the economics of tourism.

The navigation restrictions limit the number of local vessels being able to leave the Lake. This limits the ability of the owners of the vessels to fully utilise their vessels for touring. This may convince the owners to relocate their vessel to another port that has good access, taking potential business from the local commercial outlets.

The present restrictions to the navigable capacity of the Channel may contribute to vessel accidents with potential for vessel damage and personal injury.

How can we fix the problem?

Maintenance dredging of the sand shoals affecting the navigation. This is a short term solution to the problem and would be required to be undertaken at regular intervals.

Major dredging and the construction of training works and/or reclamation to develop a balanced flow in the Channel could be undertaken. These works would maintain a stable channel with no shoaling problems.

Why is it worth taking action?

A well-established long-term use of the Lake is for boating of various types, recreational fishing and an increasing charter tourism industry.

The continued effective and safe use of the Lake and, in particular, the Channel for these purposes is dependent on the maintenance of navigable waters.

Undertaking maintenance dredging over three years will permit monitoring of the rate of siltation and infill, together with the increased usage of the Channel following improved navigability. Knowing the increased usage of the Channel will assist in undertaking a full economic evaluation of any proposed works to ensure a long term solution.

ENTRANCE CHANNEL NAVIGATION MANAGEMENT ACTION PLAN

OBJECTIVES:
- ❑ To improve and maintain the navigable access to Lake Macquarie
- ❑ To monitor boating usage of the Channel
- ❑ To monitor Channel sedimentation

Code	Priority	Specific Objective	Short Term Actions	Long Term Actions	Funds Already Committed	Funds Needed for Future Actions	Responsibility for Action	When	Status	Performance Indicators
CN/A	High	Obtain approval for and be in a position to call tenders to carry out the proposed dredging.	Undertake the Investigation, Design & Documentation for dredging the main channel and the ''dropover''		$15,000 $15,000		LMCC DLWC	Aug 1998 to Oct. 1998	Works are currently being undertaken. Due for completion early September 1998.	Concerns over poor navigation in the Channel. The project will improve the navigation in the Channel and allow passage of large vessels from the ocean to the Lake
CN/B	High	To undertake works to ensure a minimum depth of 2.5m along the channel for navigational reasons.	Undertake a maintenance dredging of the main channel and the ''dropover''.		$162,000 $162,000		LMCC DLWC	Oct 1998 to Jan 1999	Waiting for the completion of all preliminary works. Significant completion expected by Christmas 1998. Funding to be determined.	The project will allow navigation along the Channel for vessels with a draft of 2.5m.
CN/C	High	Undertake regular hydrographic surveys of the Channel to predict navigation problems so remedial actions can be implemented prior to the problem restricting navigation. (Will help ensure the commitment to maintain a 2.5m deep navigation	Undertake ongoing monitoring of the navigation channel, via hydrographic surveys.			$60,000 over 3 years	Lake Macquarie Co-ordinator LMCC DLWC Waterways	Mar. 1999 to Mar 2002	Regular (6 monthly) surveys to be undertaken following the proposed maintenance dredging of the Channel. Funding to be determined.	The project will enable the monitoring of the Channel to ensure navigational problems are limited and access for larger vessels ensured and navigational confidence in the Channel increased and maintained.

		channel.)								

ENTRANCE CHANNEL NAVIGATION MANAGEMENT ACTION PLAN

OBJECTIVES:
- ❑ To improve and maintain the navigable access to Lake Macquarie
- ❑ To monitor boating usage of the Channel
- ❑ To monitor Channel sedimentation

Code	Priority	Specific Objective	Short Term Actions	Long Term Actions	Funds Already Committed	Funds Needed for Future Actions	Responsibility for Action	When	Status	Performance Indicators
CN/D	High	To determine any changes in the use of the Channel including the draft of vessels.	Undertake ongoing monitoring of vessels using the Channel.			$15,000	LMCC Waterways	Mar 1998 to Feb 2002	Monitoring of vessels using the Channel to commence as soon as possible. Ongoing project for at least 3 years.	Need to determine the economic benefit of ensuring continued safe navigation through the Channel. Data indicating the usage of the Channel. Data to be used to determine the size of vessels using the Channel and any changes in the usage of the Channel.
CN/E	High	To undertake the work to ensure a navigation channel is maintained into Black Neds Bay	Undertake dredging of the entrance to Black Neds Bay		$10,000 $10,000		LMCC DLWC	Nov 1997 to Dec 1997	The project has been undertaken and completed in 1997/98 with funds from LMCC & DLWC.	The project has allowed vessels to enter and exit Black Neds Bay without restriction.
CN/F	High	Undertake regular surveys of the sand shoals at the entrance to Black Neds Bay to monitor the navigation channel.	Monitor the sand shoals at the entrance to Black Neds Bay			$42,000	Lake Macquarie Co-ordinator LMCC DLWC Waterways	Mar 1999 to Feb 2002	The surveys could be incorporated with the monitoring of the main navigation channel. Monitor until long term options for the entrance	The project will allow monitoring of the entrance to minimise potential navigational problems at the site. It will also allow the determination of sedimentation rates for long term remedial works to be

									are considered.	considered.

ENTRANCE CHANNEL NAVIGATION MANAGEMENT ACTION PLAN

OBJECTIVES:
- ❑ To improve and maintain the navigable access to Lake Macquarie
- ❑ To monitor boating usage of the Channel
- ❑ To monitor Channel sedimentation

Code	Priority	Specific Objective	Short Term Actions	Long Term Actions	Funds Already Committed	Funds Needed for Future Actions	Responsibility for Action	When	Status	Performance Indicators
CN/G	Medium	To assess the processes of sediment movement in the Channel		Determine the long term process of sand movement in the Channel		$100,000	Lake Macquarie Co-ordinator LMCC DLWC	Nov 2001 to Jul 2002	Any proposed works in the Channel that effect sediment movement need to consider the impact of those works on the whole channel. Funding to be determined.	The project will allow a complete understanding of the sediment movement within the Channel. This will assist in the assessment of any works being undertaken in the Channel
CN/H	Low	Obtain development consent to undertake the works to prevent sand shoals forming at the entrance to Black Neds Bay.		Undertake the Investigation, Design, Documentation & Construction of a preventative measure to control shoaling of the entrance to Black Neds Bay.		$250,000	Lake Macquarie Co-ordinator LMCC DLWC	Jul 2002 to Jul 2003	The project is dependent on the results of monitoring in the area. Funding to be determined.	The project will allow vessels to enter and exit Black Neds Bay without restriction with minimal maintenance dredging.
CN/I	Med	To evaluate preliminary concept designs for long term Channel stability and to select the preferred option.		Undertake a feasibility study on the long term management options for developing a stable Channel.		$150,000	Lake Macquarie Co-ordinator LMCC DLWC	Jul 2002 to Nov 2002	The project depends on the monitoring results of the Channel and vessel usage. Funding to be determined.	The project will select the preferred long term management option for the Channel.
CN/J	Medium	Obtain Development		Undertake the Investigation,		$250,000	Lake Macquarie		The project depends on	The project will enable the

		Consent for and be in a position to call tenders to carry out the proposed Channel stabilisation works		Design & Documentation for long term channel stabilisation works.			Co-ordinator LMCC DLWC		the outcome of feasibility study. Funding to be determined.	Channel stabilisation works to be approved and undertaken.

ENTRANCE CHANNEL NAVIGATION MANAGEMENT ACTION PLAN

OBJECTIVES:
- ❑ To improve and maintain the navigable access to Lake Macquarie
- ❑ To monitor boating usage of the Channel
- ❑ To monitor Channel sedimentation

Code	Priority	Specific Objective	Short Term Actions	Long Term Actions	Funds Already Committed	Funds Needed for Future Actions	Responsibility for Action	When	Status	Performance Indicators
CN/K	Medium	To undertake the long term Channel stabilisation works.		Undertake long term Channel stabilisation works		$5.0M	Lake Macquarie Co-ordinator LMCC DLWC		The project depends on the outcome of the ID&D study. Funding to be determined. See CN/J.	The project will stabilise the Channel to ensure navigation and foreshore stability.
CN/L	Low	Obtain Development consent for and be in a position to call tenders to carry out the proposed dredging or training works of the ocean entrance		Undertake the Investigation, Design & Documentation for dredging or training works of the ocean entrance		$50,000	Lake Macquarie Co-Ordinator LMCC DLWC		Works dependent on the monitoring of the area. If there is reduced navigation and safety for vessels entering the Channel the project should proceed. Funding to be determined.	Concerns over unsafe navigation at the entrance to the Channel. Project will improve the navigation in the Channel entrance and allow safer passage of larger vessels from the ocean into the Channel.
CN/M	Low	To undertake works to ensure a safe navigation channel from the ocean into the Channel		Undertake maintenance dredging or training works at the ocean entrance to the Channel		$500,000	Lake Macquarie Co-ordinator LMCC DLWC		The project depends on the outcome of the ID&D study. Funding to be determined.	The project will allow safe navigation from the ocean into the Channel.

CN/N	High	Monitor effects of channel works on seagrass beds Marks Pt - Coon Island				$7,000 p.a.	Lake Macquarie Co-ordinator with Waterways & Fisheries	Oct 1998 to Feb 2002		

8.9 Entrance Channel Foreshore Erosion Management Action Plan

Environmental Problems/Issues

The erosion of the foreshore of Swansea Channel at a number of sites including:

- ❑ Salts Bay;
- ❑ Pelican Flat;
- ❑ Coon Island;
- ❑ Aeropelican; and
- ❑ Swansea (north of the Bridge).

Who is affected and how?

The erosion of the foreshore areas at the above locations threatens:

- ❑ community recreational areas;
- ❑ community access along the foreshore;
- ❑ environmentally sensitive areas; and
- ❑ community and private assets.

The erosion is occurring due to natural processes, human usage and as a result of works undertaken in the Channel. The main causes of the erosion are:

- ❑ high water velocities and the meandering channel migration causing erosion on the outside of the bends; and
- ❑ wave attack from ocean waves, wind waves and boat wash.

Works previously undertaken, such as the entrance training works and dredging, have altered the general hydraulic and morphological processes within the Channel. The Channel's tidal equilibrium has been disturbed by the impact of the works on the tidal prism, increased wave penetration and additional sediments introduced into the system.

The processes causing erosion at various sites are site specific and can be a combination of a number of processes.

How can we fix the problem?

A number of options are available to control the foreshore erosion, including groynes, revetment walls, reclamation and nourishment.

The selection of a preferred protective work at a site would be dependent on:

- ❑ the processes causing the erosion;
- ❑ the value of the foreshore being protected;
- ❑ the capital cost of the work;
- ❑ amenity required of the foreshore (visual, recreational, environmental);
- ❑ impact of the works on the Channel processes; and
- ❑ ongoing maintenance costs.

Why is it worth taking action?

The foreshore of the Channel has a number of different uses and the value to the community and land owners varies from site to site. Investigations into the value of the works and the benefit of the works at each site is required in the investigation stage of the project. The community has expressed concern at the significant erosion problems at Salts Bay and Aeropelican.

ENTRANCE CHANNEL FORESHORE EROSION MANAGEMENT ACTION PLAN

OBJECTIVES:

- ❑ To protect the recreational amenity of the foreshore
- ❑ To protect environmentally sensitive foreshore areas
- ❑ To reduce sedimentation within the Channel
- ❑ To protect access along the foreshore
- ❑ To protect public and private assets

Code	Priority	Specific Objective	Short Term Actions	Long Term Actions	Funds Already Committed	Funds Needed for Future Actions	Responsibility for Action	When	Status	Performance Indicators
CF/A	High	Undertake the Investigation, Design & Documentation for the Salts Bay stabilisation works.	Obtain Development consent for and be in a position to call tenders to carry out the proposed stabilisation works.		$32,500 $32,500		LMCC DLWC	Oct 1998 to Apr 1999	Consultant proposals to undertake the project are currently being assessed. Appointment of consultant expected September 1998 and project to be completed by April 1999	Community concerns over the continued erosion of Salts Bay. The project will minimise further erosion of Salts Bay. This will stop a supply of sand into the Channel and help reduce the risk of a breakthrough into Black Neds Bay.
CF/B	High	Prepare an emergency action plan to close off any breakthrough into Black Neds Bay that may occur.	Have a plan in place to allow emergency works to take place to close off any breakthrough into Black Neds Bay.		$5,000 $5,000		LMCC DLWC	Oct 1998 to Apr 1999	The preparation of the plan to be incorporated into the ID&D project for the stabilisation of Salts Bay. Project consultant expected to commence September 1998 and project to be completed by April 1999	Community concerns over the severe erosion of Salts Bay. The project will ensure that in the event of a breakthrough into Black Neds Bay, efficient and appropriate actions will take place to reduce any adverse impacts.
CF/C	High	Undertake the stabilisation works of Salts Bay.	To undertake works to reduce the risk of a breakthrough into			$500,000	LMCC DLWC	Jun 1999 to Mar 2000	Waiting for the completion of the	The project will stabilise Salts Bay. This will minimise the

			Black Neds Bay and minimise the supply of sediment into the Channel.						preliminary works and to obtain development consent. Funding to be determined.	supply of sand into the Channel and reduce the risk of a breakthrough into Black Neds Bay.

ENTRANCE CHANNEL FORESHORE EROSION MANAGEMENT ACTION PLAN

OBJECTIVES:

- ❑ To protect the recreational amenity of the foreshore
- ❑ To protect environmentally sensitive foreshore areas
- ❑ To reduce sedimentation within the Channel
- ❑ To protect access along the foreshore
- ❑ To protect public and private assets

Code	Priority	Specific Objective	Short Term Actions	Long Term Actions	Funds Already Committed	Funds Needed for Future Actions	Responsibility for Action	When	Status	Performance Indicators
CF/D	High	Undertake the investigation, design and documentation of beach revetment works at Aeropelican	Obtain Development Consent for and be in a position to call tenders to carry out the proposed remedial works at Aeropelican.		$20,000		LMCC DLWC	Jun 1998 to Oct 1998	Works are currently being undertaken by Council. Development Application has been lodged. Determination expected September 1998	Community concerns over the severe erosion restricting access along the foreshore adjacent to Aeropelican. The project will stabilise the foreshore and maintain public access.
CF/E	High	Undertake temporary stabilisation works for the Aeropelican foreshore.	To undertake temporary stabilisation works to control erosion of the foreshore from wave attack.		$5,000		LMCC	Oct 1998 to Nov 1998	Waiting for development consent. Funds available from LMCC	The project will control erosion of the foreshore until funds for permanent remediation works can be allocated.
CF/F	High	Undertake remediation works of the Aeropelican foreshore.		To undertake works to control foreshore erosion and reclaim public access along the Aeropelican foreshore.		$120,000	Lake Macquarie Co-ordinator LMCC DLWC	Mar 1999 to Mar 2000	Development consent after issue of order. Funding to be determined. Work should take up to 2 months to complete	The project will stabilise the Aeropelican foreshore and reclaim the public access between Aeropelican and the Channel

ENTRANCE CHANNEL FORESHORE EROSION MANAGEMENT ACTION PLAN

OBJECTIVES:

- ❑ To protect the recreational amenity of the foreshore
- ❑ To protect environmentally sensitive foreshore areas
- ❑ To reduce sedimentation within the Channel
- ❑ To protect access along the foreshore
- ❑ To protect public and private assets

Code	Priority	Specific Objective	Short Term Actions	Long Term Actions	Funds Already Committed	Funds Needed for Future Actions	Responsibility for Action	When	Status	Performance Indicators
CF/G	Medium	Undertake the Investigation, Design Documentation for foreshore protection works at Pelican Flat		Obtain Development Consent for and be in a position to call tenders to carry out the proposed remedial works at Pelican Flat.		$60,000	Lake Macquarie Co-ordinator LMCC DLWC	Oct 2000 to Sep 2001	Public concepts sketches made for Estuary Management Plan. Additional options and review needed prior to final design. Funding to be determined.	Community concerns over the erosion reducing the amenity of foreshore at Pelican Flat. The project will stabilise the foreshore and ensure public amenity.
CF/H	Medium	Undertake foreshore protection works at Pelican Flat		To undertake works to stabilise foreshore erosion at Pelican Flat		$350,000	Lake Macquarie Co-ordinator LMCC DLWC	Oct 2001 to Oct 2002	Waiting for development consent. Funding to be determined.	The project will stabilise the Pelican Flat foreshore and maintain public amenity of the reserve.
CF/I	High	Monitor the erosion of the foreshore at Coon Island	Undertake regular surveys of the Coon Island foreshore to monitor the rate of erosion. & Little Pelican			$15,000 p.a.	Lake Macquarie Co-Ordinator LMCC DLWC	Mar 1999 to Feb 2002	The project to commence when resources become available. Could be undertaken with Channel Surveys	The project will allow the assessment of the erosion rates of the foreshore at Coon Island. This will help in the assessment of permanent stabilisation options.

ENTRANCE CHANNEL FORESHORE EROSION MANAGEMENT ACTION PLAN

OBJECTIVES:

- ❑ To protect the recreational amenity of the foreshore
- ❑ To protect environmentally sensitive foreshore areas
- ❑ To reduce sedimentation within the Channel
- ❑ To protect access along the foreshore
- ❑ To protect public and private assets

Code	Priority	Specific Objective	Short Term Actions	Long Term Actions	Funds Already Committed	Funds Needed for Future Actions	Responsibility for Action	When	Status	Performance Indicators
CF/J	Medium	Undertake the Investigation, Design, Documentation and Construction of foreshore protection works at Coon Island.		To prevent erosion of the foreshore at Coon Island. To obtain development consent and construct foreshore protection works at Coon Island		$150,000	Lake Macquarie Co-Ordinator LMCC DLWC	Feb 2002 to Sep 2002	The project will be instigated when monitoring indicates the rate and extent of erosion warrants foreshore protection works. Funding to be determined.	The project will stabilise the eroding foreshore at Coon Island.
CF/K	Medium	Undertake the Investigation and Design of training walls for the western foreshore of the Channel.		To design a training wall for the whole western foreshore that can be built in sections. A co-ordinated design will improve the visual amenity of the area.		$50,000	Lake Macquarie Co-Ordinator LMCC DLWC	Nov 2000 to Mar 2001	Work required prior to any rehabilitation of the existing foreshore protection works. Funding to be determined.	The project will allow for a standard or co-ordinated construction method for any sections of foreshore that is degraded and requires to be rehabilitated.
CF/L	Low	Undertake foreshore protection works on the western foreshore of the Channel		To stabilise degraded sections of the foreshore on an as needs basis.		$1.0M	Lake Macquarie Co-Ordinator LMCC DLWC	Nov 2001 onwards	Waiting for completion of design. Works dependent on when existing sections of foreshore require rehabilitation. Funding to be determined.	The projects will rehabilitate the foreshore protection works to an acceptable standard.

8.10 Integrated Management Action Plan

Environmental problems/issues

The achievement of the broad and detailed objectives of environmental management for the Lake and its Catchment will require significant effort and resources of the Government, Lake Macquarie City Council and Wyong Shire Council, Government agencies, industry and the community.

The identified Management Actions and Priority Action Plans will require a high degree of co-ordination and the continuing good will of all organisations and community involved.

Who it affects and how

The successful co-ordination of management's efforts to address environmental issues of the Lake and its Catchment will affect all those involved in the management process and result in improved efficiency, reduced duplication and lower costs.

Objectives will be achieved within time and budget and greater transparency of the management process will be evident. Users of the lake and those dependent on it, directly or indirectly, and those resident around the Lake will benefit from the improved amenity. Ecological sustainability development will be achieved.

How can we fix the problem?

- ❑ Adopt an agreed management structure focusing on the needs of the Lake and work with an environmental management framework based on ISO 14001 for Environmental Management Systems.

- ❑ This will provide an ability to plan and co-ordinate the management efforts of Councils, government agencies, industry and the community to maximise efficiency and achieve cost effective solutions.

- ❑ Focus the available resources on catchments and embayments in an integrated way will result in improvements not only through remediation but also prevention of additional degradation further upstream in the Catchment.

- ❑ An agreed funding arrangement for environmental works will provide security for programs and share responsibility across stakeholders.

Why is it worth doing?

To improve the health of the Lake and its Catchment and achieve sustainability of the natural resources of the Lake and its Catchment.

INTEGRATED MANAGEMENT

OBJECTIVES:

- ❑ To achieve integrated management and regulation
- ❑ To achieve co-operative resourcing of sub-catchment programmes with those above
- ❑ To identify opportunities to streamline statutory approval processes
- ❑ To identify funding opportunities and sources and promote cost effective investment in the Lake Macquarie Estuary and Catchment Management

Code	Priority	Specific Objective	Short Term Actions	Long Term Actions	Funds Already Committed	Funds Needed for Future Actions	Responsibility for Action	When	Status	Performance Indicators
IM/A	High	Implement an Environmental Management Framework	Adopt Lake Macquarie Estuary & Catchment Framework based on ISO 14001	Review			Lake Macquarie Project Management Committee (See Section 6)	July 1999		
IM/BA	High	Implement Management Structure	Adopt and implement the Office of Lake Macquarie Estuary Co-ordinator.	Review		$150,000 p.a. for 3 years	Taskforce DLWC (Supp)	July 1999		
JM/BB	High	Implement Management Structure	Lake Macquarie Co-ordinator Administrative support	Review		$58,000 pa	LMCC	July 1999		
IM/C	High	Secure funding for Estuary and Catchment Rehabilitation	Adopt agreed funding arrangement for 3 Yr Priority Plan	Review			Taskforce	July 1999		
IM/D	High	Streamline and integrate approval process	Develop strategic Assessment & Approval Process for environmental restoration works	Review & Refine			DUAP LMCC WSC Lake Macquarie Co-ordinator and other agencies.	During 1999		Reduced Time Reduced Cost See ET/D

9. INTEGRATED THREE YEAR PRIORITY ACTION PLANS

All of the high priority actions were extracted from the specific action plans included in Section 8 and are presented hereunder and are broken into the following sub-headings. Accurate costings were applied to these tasks.

- ❑ Fennell Bay / Edmunds Bay and catchment
- ❑ Cockle Bay and catchment
- ❑ Warners Bay and catchment
- ❑ Swansea Flats catchment
- ❑ Mannering Park to Gwandalan Region catchments
- ❑ Entrance channel navigation
- ❑ Entrance channel foreshore erosion
- ❑ Lake general / Health monitoring
- ❑ Lake general

The three-year period for undertaking these tasks was determined because it will take that length of time to complete the work involved. Many of the tasks require detailed investigation before the physical task commences.

INTEGRATED THREE YEAR PRIORITY ACTION PLAN

FENNELL BAY / EDMUNDS BAY AND CATCHMENT

CATCHMENT ACTIVITIES

Code	Action	Timetable	Action	Funding	Possible Funding Source	
WQ/CB WQ/D	Stormwater Catchment Management Plan - Fennell Bay / Edmunds Bay.	Commenced - April 1998. Draft Report - December 1998. Complete - April 1999.	LMCC	$10,000 $4,000	LMCC Urban Stormwater Trust	Funded. See Item WQ/D - Lake Stormwater Catchment Management Plan.
WQ/CA	Rehabilitate foreshore and nearshore.	Commenced - 1998 - Landcare Groups. Ongoing.	Lake Macquarie Co-Ordinator with Landcare	$20,000 $50,000 pa	DLWC NSW Rivercare	Funded. Subject to application. (River Care)
WQ/CC WQ/EA	Water Quality Facilities - traps, road verges, bush regeneration.	Commence - February 1999. Complete - July 2000.	Lake Macquarie Co-Ordinator with LMCC	$75,000 Bush and Road Verges Traps $50,000 $75,000	Forestry) EnergyAustralia) Transgrid) LMCC) Powercoal) LMCC DLWC (Supp.)	LMCC allocates $50,000 pa for road verges. See Item WQ/E - Stormwater Management.
WQ/CC	Enforce regulation.	Sediment & Environmental Officer appointed (LMCC) - ongoing.	LMCC	$20,000	LMCC	Funded.
CE/CA	Education for general public - foreshore and seagrass issues.	Commence - March 1999. Complete - January 2000.	LMCC	$10,000 $10,000	LMCC DLWC (Supp.)	
HM/F	Monitor Creeks.	Commence - March 1999. Ongoing.	Lake Macquarie Co-Ordinator	$5,000 p.a. $6,000 p.a. $6,000 p.a.	TAFE (in kind) DLWC (Supp.) LMCC	See HM/F - Lake Health Monitoring
CE/I	Streamwatch Education Programme.	Commenced - ongoing.	HCMT	$6,000 p.a.	HCMT Powercoal HWC DET DLWC	Funded.

INTEGRATED THREE YEAR PRIORITY ACTION PLAN

FENNELL BAY / EDMUNDS BAY AND CATCHMENT

CATCHMENT ACTIVITIES

Code	Action	Timetable	Action	Funding	Possible Funding Source	
WQ/F	Investigate and connect septic tanks to sewerage system.	Notices/inspections (LMCC) - Commence - January 1999.	LMCC	$50,000	User pays	Funded.
		Investigation of Toronto West - Commence - January 1999.	LMCC Health Dept	$5,000 $5,000	LMCC DLWC (Supp.)	
		Servicing Strategy for Toronto West - Commence after investigation - Complete 1999.	HWC	$10,000	HWC	Funded.

INTEGRATED THREE YEAR PRIORITY ACTION PLAN

FENNELL BAY / EDMUNDS BAY AND CATCHMENT

BAY ACTIVITIES

Code	Action	Timetable	Action	Funding	Possible Funding Source	
ET/AA	Delta dredging (maintenance).	Commence - July 1999 Complete - June 2000	LMCC	$25,000 $25,000	DLWC (Supp.) LMCC	Federal Government Submission made ($130,000).
ET/B	Bay remedial works - Investigation.	Commence - March 1999. Complete - September 1999.	Lake Macquarie Co-Ordinator with LMCC	$64,000 $64,000	LMCC DLWC (Supp.)	Federal Government Submission made.
ET/B	Design and documentation plus EIS.	Commence - October 1999. Complete - October 2000.	Lake Macquarie Co-Ordinator with LMCC	$68,000 $68,000	LMCC DLWC (Supp.)	
ET/C	Bay remediation - ranging from seagrass replanting and foreshore revegetation to dredging.	Commence - November 2000. Complete - November 2002.	Lake Macquarie Co-Ordinator	$2,500,000	DLWC (Supp.)	

INTEGRATED THREE YEAR PRIORITY ACTION PLAN
COCKLE BAY AND CATCHMENT

Code	Action	Timetable	Action	Funding	Possible Funding Source	
WQ/D	Stormwater Catchment Management Plan - Cockle Bay.	Commenced - April 1998. Complete - April 1999.	LMCC	$10,000 $4,000	LMCC Urban Stormwater Trust	Funded. See Item WQ/D - Lake Stormwater Management Plan.
WQ/EE	Water Quality Facilities: • Treatment structures • Road verges • Bush regeneration	Commence - Jul 1999. Complete - December 2001.	LMCC Landcare	$230,000 $150,000 $25,000 $25,000 $50,000 $50,000	LMCC DLWC (Supp.) LMCC DLWC (Supp.) DLWC (Supp.) LMCC Forestry, coal companies, energy supply companies, RTA (in kind)	See Item WQ/E - Implement Stormwater Management Plan.
WQ/ED	Enforce regulation.	Sediment and Environmental Officers (LMCC) already appointed.	LMCC	$20,000	LMCC	Funded.
CE/E	Education: • Reduction in stormwater pollution • Erosion and sediment control • Restoration of urban waterways • Small business • Foreshore rehabilitation		Lake Macquarie Co-Ordinator with LMCC WSC EPA LMCMC			Refer to Lake General Priority Plan
HM/F	Monitor creeks.	Commence - March 1999. Ongoing	Lake Macquarie Co-Ordinator	$10,000 p.a. $10,000 p.a.	DLWC (Supp.) LMCC	See HM/F - Lake Health Monitoring.
CE/I CE/H	Community involvement: • Streamwatch education programme • Facilitate formation of Landcare groups and initiate Rivercare projects .	Streamwatch current. January 1999 and ongoing.	HCMT Landcare	$10,000 $15,000	HCMT NHT HWC Dept of Education - DET DLWC (in kind)	Funded
ET/AC	Delta dredging of recent uncontaminated sediment.	Investigations for navigation dredging in mouth of Cockle Creek to commence March 1999 to June 1999.	LMCC	$10,000 $10,000	LMCC DLWC (Supp.)	

INTEGRATED THREE YEAR PRIORITY ACTION PLAN

COCKLE BAY AND CATCHMENT

Code	Action	Timetable	Action	Funding	Possible Funding Source	
ET/E	Design and documentation plus EIS for remediation.	Commence - July 1999 Complete - June 2000	Lake Macquarie Co-Ordinator with LMCC	$$130,000 $60,000	DLWC (Supp.) LMCC	Follows EPA 2-Year Study. Possible contribution from Pasminco.
ET/F	Remediation, ranging from seagrass replanting to dredging.	Commence - Jul 2001. Complete - December 2004.	Lake Macquarie Co-Ordinator	$2,500,000	DLWC (Supp.)	
WQ/IC	Stabilise areas of severe bank erosion (riparian) - Investigation, design and restoration works.	Commence investigation and design - March 1999. Complete - October 1999. Commence works - December 1999. Complete - December 2001.	Lake Macquarie Co-Ordinator	$75,000 $75,000	DLWC (Supp.) LMCC	
WQ/K	Upgrade sewage carrier main system to reduce overflows and leakage and to improve quality in tributaries. • Upgrade Boolaroo WWPS. • Investigate Booragul/Teralba WWPS. • Upgrade to Queens Avenue, Cardiff. • Upgrade Cardiff WWPS and rising main (carrier main complete $5.6M)	Commenced Complete Jul 1999 Commenced Complete Nov 1999 Commenced Complete May 1999 Commenced Complete Aug 1999	HWC	$350,000 $10,000 $310,000 $1,700,000		Funded. Funded. Funded. Funded.
WQ/L HM/B	Reduce input of pollutants from point sources - both EPA licensed and small business regulated by Councils. • Continue Pollution Reduction Programmes with Pasminco (stormwater and process water). • EPA to licence HWC sewage transport system with introduction of POEO. • Council to increase audit of unlicensed premises and to promote cleaner production techniques by small business.		EPA LMCC	$100,000 pa $40,000	Covered in EPA routine budget (1.5 staff for regulation of licensed premises in Lake Macquarie). LMCC	Funded

INTEGRATED THREE YEAR PRIORITY ACTION PLAN

COCKLE BAY AND CATCHMENT

Code	Action	Timetable	Action	Funding	Possible Funding Source	
BC/C HM/E LU/E CE/E	Rehabilitate degraded saltmarsh and wetland areas (Cockle Creek and Five Islands).	Commence investigation - October 1998 to October 2001.	RTA Fisheries Landcare	$250,000	RTA	Funded.
LU/B	Trial water sensitive urban design DCP (North Lakes urban release area).	Commence - March 1999.	LMCC DUAP	--	Developer financed.	

INTEGRATED THREE YEAR PRIORITY ACTION PLAN
WARNERS BAY AND CATCHMENT

CATCHMENT ACTIVITIES

Code	Action	Timetable	Action	Funding	Possible Funding Source	
WQ/D	Stormwater Catchment Management Plan - Warners Bay.	Commenced - April 1998. Complete - April 1999.	LMCC	$10,000 $4,000	LMCC Urban Stormwater Trust	Funded. See Item WQ/D - Lake Stormwater Catchment Management Plan.
WQ/N	Rehabilitate foreshore, nearshore and riverine zones of North and South Creeks. • Investigation, design and rehabilitation works.	Commenced investigation - March 1998. Complete works - October 2000.	LMCC Landcare Lake Macquarie Co-Ordinator	$10,000 $125,000 $225,000	LMCC DLWC (Supp.) LMCC	Funded.
WQ/E	Water Quality Facilities • Road verges • Treatment structures • Bush regeneration	Commence - February 1999. Complete - July 2001.	Lake Macquarie Co-Ordinator with LMCC	 $50,000 $50,000 $5,000 $30,000	 DLWC (Supp.) LMCC DLWC (Supp.) LMCC	LMCC allocates $50,000 pa - Road verges. See Item WQ/E - Stormwater Management.
WQ/ED	Enforce regulation.	Sediment & Environmental Officer appointed (LMCC) - ongoing.	LMCC	$20,000	LMCC	Funded.
CE/C	Education for general public - foreshore and seagrass.	Commence - March 1999. Complete - January 2000.	LMCC	$10,000 $10,000	LMCC DLWC (Supp.)	
HM/F	Monitor Creeks.	Commence - March 1999. Ongoing	Lake Macquarie Co-Ordinator with LMCC	$5,000 p.a. $6,000 p.a. $6,000 p.a.	TAFE (in kind) DLWC (Supp.) LMCC	See HM/F - Lake Health Monitoring
CE/I	Streamwatch Education Programme.	Commenced - ongoing.	HCMT	$6,000 pa	HCMT DET DLWC	Funded.
WQ/K	Upgrade Warners Bay / Croudace Bay sewage system to reduce overflows and leakage.	Investigations commenced. Complete - July 2001.	HWC	$2,000,000	HWC	Funded.

INTEGRATED THREE YEAR PRIORITY ACTION PLAN

WARNERS BAY AND CATCHMENT

BAY ACTIVITIES

Code	Action	Timetable	Action	Funding	Possible Funding Source	
ET/AB	Delta dredging (maintenance).	Commenced. North Creek completed. Drainage outlets as required.	LMCC	$20,000 pa $25,000 pa	DLWC (Supp.) LMCC	

INTEGRATED THREE YEAR PRIORITY ACTION PLAN

SWANSEA FLATS

CATCHMENT ACTIVITIES

Code	Action	Timetable	Action	Funding	Possible Funding Source	
WQ/D	Stormwater Catchment Management Plan - Swansea Flats.	Commence - November 1998. Complete - January 1999.	LMCC	$10,000 $4,000	LMCC Urban Stormwater Management Trust	Funded. See Item WQ/D - Lake Stormwater Catchment Management Plan.
WQ/P	Rehabilitate foreshore.	Commence - Jul 1999. Complete - 2000.	Lake Macquarie Co-Ordinator with LMCC and Landcare	$5,000 $5,000	LMCC DLWC (Supp.)	
WQ/E	Water Quality Facilities	Commence - Jul 2000 Complete - Jun 2001.	LMCC	$25,000 $25,000	LMCC DLWC (Supp.)	
WQ/ED	Enforce regulation.	Sediment and Environmental Officer appointed (LMCC) - ongoing.	LMCC	$20,000	LMCC	Funded.
CE/D	Education - general public - foreshore, seagrass.	Commence - Jul 1999. Complete - January 2000.	LMCC	$10,000 $10,000	DLWC (Supp.) LMCC	
CE/I	Streamwatch education programme	Commenced and ongoing.	HCMT	$1,000 pa	HCMT LMCMC HWC DET DLWC	Funded.
WQ/K	Investigate sewage reticulation for Swansea #2 WWPS.	Commence - October 1998. Complete - October 1999.	HWC	$80,000	HWC	Funded.
WQ/K	Effect major repairs (grouting) to reticulation lines in Swansea #6 WWPS.	Commence - December 1998. Complete - April 1999.	HWC	$250,000	HWC	Funded.
CE/E	Staff training to implement improved foreshore land management practices.	Commence - November 1998.	LMCC	Minor cost	LMCC	Funded.
ET/L	Undertake the investigation, design, E.I.S. documentation and construction of foreshore protection works at Coon Island.	Commence investigation - March 2000. Complete - December 2001 Commence construction - January 2001. Complete construction - December 2002.	Lake Macquarie Co-Ordinator with LMCC	$50,000 $50,000 (design) $75,000 $75,000	LMCC DLWC (Supp.) LMCC DLWC (Supp.)	

INTEGRATED THREE YEAR PRIORITY ACTION PLAN

SWANSEA FLATS

BAY ACTIVITIES

Code	Action	Timetable	Action	Funding	Possible Funding Source	
ET/M	Bay remediation works - investigation of hydraulics and nearshore circulation in Fish Co-op / Lake Road.	Commence - Jul 1999. Complete - March 2000.	Lake Macquarie Co-Ordinator with LMCC	$40,000 $50,000	LMCC DLWC (Supp.)	
ET/M	Design, documentation and EIS.	Commence - March 2000. Complete - March 2001.	Lake Macquarie Co-Ordinator with LMCC	$50,000 $40,000	LMCC DLWC (Supp.)	
ET/M	Remediation by part removal to natural sea bed of man made islands.	Commence - July 2001. Complete - July 2002.	Lake Macquarie Co-Ordinator with LMCC	$150,000 $150,000	LMCC DLWC (Supp.)	
CN/N	Monitoring effects of Channel works on seagrass beds from Marks Point to Coon Island.	Ongoing.	. Waterways	$7,000 pa	Waterways	See CN/N - Entrance Channel Navigation
FA/B	Prepare Seagrass Management Plan.	Commence January 1999.	Fisheries	$50,000	DLWC (Supp.)	

INTEGRATED THREE YEAR PRIORITY ACTION PLAN

MANNERING PARK TO GWANDALAN REGION CATCHMENTS

Code	Action	Timetable	Action	Funding	Possible Funding Source
WQ/Q	Rehabilitate creeklines and foreshores in priority areas in the Mannering Park to Gwandalan region.	Commence July 1999	WSC	$190,000	WSC DLWC
WQ/R	Water quality facilities in the Mannering Park to Gwandalan region. ▪ road verges ▪ treatment structures ▪ education	Commence April 1999 Complete September 2001	WSC	$410,000	WSC DLWC

INTEGRATED THREE YEAR PRIORITY ACTION PLAN

ENTRANCE CHANNEL NAVIGATION

Code	Action	Timetable	Action	Funding	Possible Funding Source	
CN/A	Undertake the investigation, design and documentation for dredging the main Channel and the 'Drop Over'.	Commenced August 1998. Completion October 1998.	LMCC	$15,000 $15,000	LMCC DLWC	Funded. Funded.
CM/B	Undertake maintenance dredging of the Main Channel and Drop Over - Minimum depth 2.5 metres.	Commence October 1998. Complete January 1999.	LMCC	$162,000 $162,000	LMCC DLWC	Funded
CN/C	Undertake ongoing monitoring of the navigational channel - hydrographic surveys.	Commence - March 1999. Complete - March 2002.	Lake Macquarie Co-Ordinator with Waterways	$20,000 pa	Waterways	
CN/D	Undertake monitoring of vessels using the Channel.	Commence - March 1999. Complete - February 2002.	Lake Macquarie Co-Ordinator with Waterways	$15,000	Waterways	Funded.
CN/F	Monitor the sand shoals at the entrance to Black Neds Bay.	Commence - March 1999. Complete - February 2002.	Lake Macquarie Co-Ordinator with Waterways	$14,000 pa	Waterways	
CN/N	Monitor effects of Channel works on seagrass beds - Marks Point to Coon Island.	Commence - October 1998. Complete - February 2002.	Lake Macquarie Co-Ordinator with Waterways and Fisheries	$7,000 pa	Waterways	
CN/E	Undertake dredging of the entrance to Black Neds Bay.	Completed during 1997/98 financial year.	LMCC	$10,000 $10,000	LMCC DLWC	Completed.

INTEGRATED THREE YEAR PRIORITY ACTION PLAN

ENTRANCE CHANNEL FORESHORE EROSION

Code	Action	Timetable	Action	Funding	Possible Funding Source	
CF/A	Undertake investigation, design and documentation for Salts Bay stabilisation works.	Commence investigation October 1998. Complete April 1999.	LMCC	$32,500 $32,500	LMCC DLWC	Funded.
CF/B	Prepare an emergency action plan to close off any breakthrough into Black Neds Bay.	Commence investigation October 1998. Complete April 1999.	LMCC	$5,000 $5,000	LMCC DLWC	Funded.
CF/C	Undertake the stabilisation works of Salts Bay.	Follow from above and completed March 2000.	LMCC	$250,000 $250,000	DLWC (Supp.) LMCC	
CF/D	Undertake the investigation, design and documentation of beach revetment works at Aeropelican.	Commence June 1998. Complete October 1998.	LMCC	$10,000 $10,000	LMCC DLWC	Funded
CF/E	Undertake temporary stabilisation works for the Aeropelican foreshore.	Complete October 1998.	LMCC	$5,000	LMCC	Funded.
CF/F	Undertake remediation works for the Aeropelican foreshore.	Commence - March 1999. Complete - March 2000.	LMCC	$60,000 $60,000	DLWC (Supp.) LMCC (Aeropelican)	
CF/I	Monitor the erosion of the foreshore at Coon Island and Little Pelican	Commence - March 1999. Complete - February 2002.	Lake Macquarie Co-Ordinator with LMCC	$10,000 pa $5,000 pa	DLWC (Supp.) LMCC	

INTEGRATED THREE YEAR PRIORITY ACTION PLAN

LAKE GENERAL

LAKE MACQUARIE HEALTH MONITORING

This is a single Monitoring Programme for the Lake under the co-ordination of the Lake Macquarie Co-Ordinator (see Lake Health Monitoring Action Plan).

Code	Action	Timetable	Action	Funding	Possible Funding Source	
HM/H	Monitor seagrass and algae (includes channel).	Commence - March 1999. Complete and review - 2004.	Lake Macquarie Co-ordinator	$2,000 pa $8,000 pa $20,500 pa	WSC LMCC Pacific Power / Delta Elec	
HM/D	Monitor sediment build-up and quality. (7 sites: N, P, and DO)	Commence - February 1999. Complete - February 2004.	Lake Macquarie Co-Ordinator with LMCC	$14,100 pa $19,100 pa $5,000 pa	LMCC DLWC (Supp.) WSC	
HM/C	Monitor water quality - nearshore. (Bathing areas - 17 sites)	Commenced - September 1998.	Lake Macquarie Co-Ordinator with LMCC WSC	$17,000 pa $3,000 pa $4,000 pa	LMCC WSC HWC	
HM/A	Monitor Deep Water Lake health. (7 sites)	Commenced - September 1998.	Lake Macquarie Co-Ordinator with LMCC WSC	$10,400 pa $12,000 pa $25,000 pa $10,000 pa	LMCC WSC Power Stations HWC	Funded
HM/F	Monitor 9 representative creeks for pollution	Commence - March 1999.	Lake Macquarie Co-Ordinator with LMCC and WSC	$28,000 First Yr $3,000 $25,000 $11,000 pa Thereafter $3,000 pa $8,000 pa	DLWC (Supp.) WSC LMCC DLWC (Supp.) WSC LMCC	
HM/G	Undertake Red / Yellow / Green vegetation and erosion monitoring.	Commenced - August 1998. Complete - November 1998. And then on annual basis.	DLWC	$6,000 pa	DLWC	Funded
HM/E	Monitor changes in wetland conditions	Commence Jul 1999 Complete December 2000	Lake Macquarie Co-Ordinator with LMCC, WSC	$15,000 $11,500 $3,500	DLWC (Supp.) LMCC WSC	$25,000 study completed during 1998

INTEGRATED THREE YEAR PRIORITY ACTION PLAN

LAKE GENERAL

Code	Action	Timetable	Action	Funding	Possible Funding Source	
IM/BA	Appoint Lake Macquarie Co-Ordinator and Supporting Management Structure, and adopt Integrated Estuary and Catchment Management Framework. (Refer to CE/G)	Commence - Jul 1999.	DLWC	$150,000 pa	DLWC (Supp.)	
IM/BB	Lake Macquarie Co-Ordinator Office Accommodation and Clerical Support	Commence Jul 1999	LMCC	$58,000 pa	LMCC	
WQ/A	Develop Integrated Model for Catchment and Estuary.	Commenced - August 1998. Complete - June 1999.	DLWC and HWC Lake Macquarie Co-Ordinator with LMCC and WSC	Catchment - $10,000 $10,000 Integration - $40,000 $10,000 $50,000 $30,000	 DLWC HWC LMCC WSC DLWC (Supp.) EPA (in kind)	 Funded Funded
LU/A	Develop Urban Settlement Strategy.	Commenced - 1998. Complete - December 1999.	LMCC WSC DUAP	$40,000 $15,000	LMCC WSC	Funded from existing resources.
LU/B	Water Sensitive Urban Design.	Commence - January 1999 (LMCC). Complete - August 1999 (WSC).	LMCC WSC DUAP	$12,000	LHCC Regional Environmental Management Strategy	Funded.
WQ/D	Develop Stormwater Management Plan.	Commenced - April 1998. Complete - Jul 1999.	LMCC WSC	$10,000 $80,000 $30,000	WSC LMCC Urban Stormwater Trust	Funded. (Applied for)
WQ/E	Implement Stormwater Management Plan - Capital Expenditure	Commenced Jul 1999 Complete - June 2002	LMCC WSC	$30,000 $615,000 $400,000	WSC LMCC Urban Stormwater Trust	 To be applied for by LMCC
WQ/EF	Stormwater Facilities Operation	Ongoing.	LMCC WSC	$289,000 $100,000	LMCC WSC	
WQ/IA	Foreshore erosion prioritisation.	Commence - November 1998. Complete - Feb 1999	DLWC	$6,000	DLWC	Funded.

INTEGRATED THREE YEAR PRIORITY ACTION PLAN

LAKE GENERAL

Code	Action	Timetable	Action	Funding	Possible Funding Source	
WQ/IA	Identify areas of severe foreshore and river bank erosion and select 6 priority sites for demonstration of bank remediation techniques to reduce sediment and nutrient load.	Commence - Jul 1999 Complete - Feb 2000	Landcare	$150,000	NSW Rivercare	Subject to application by Landcare/Rivercare Groups
WQ/IB	Engineering works associated with Streambank erosion remediation.	Commence - March 1999. Complete - February 2000.	Lake Macquarie Co-Ordinator with LMCC WSC	$150,000 $110,000 $30,000	DLWC (Supp.) LMCC WSC	
WQ/H	Study of Ecosystem Interaction of Trace Metals	EPA study - Commence - March 1999. Complete - June 2000.	EPA in consultation with Lake Macquarie Co-Ordinator, Fisheries, Industry & Community	$120,000	EPA	Funded
CE/I	Streamwatch programme		HCMT	$10,000 pa	HCMT LMCC DLWC HWC	Funded
WQ/B	Wetland construction in Croudace Bay	Commence - August 1998 Complete - December 1998	LMCC		LMCC Federal Govt.	Funded
WQ/O	Vegetation rehabilitation in corridors to protect riparian and littoral zones	Commence Jul 2001 Complete Jun 2002	LMCC	$25,000	LMCC	

INTEGRATED THREE YEAR PRIORITY ACTION PLAN

LAKE GENERAL

Code	Action	Timetable	Action	Funding	Possible Funding Source	
FA/A	Commence negotiations for the phasing out of Haul Netting	Commence Jul 1999	Lake Macquarie Co-Ordinator	To be determined	To be determined	
WQ/F	Enforce sewage connection and enhance septic inspection programme.	Commenced - September 1998. Complete - April 1999.	LMCC	$10,000	LMCC	Funded from existing resources.
WQ/F	Inspect and issue directions regarding septic tanks.	Commence - July 1999. Complete - July 2000.	LMCC WSC	$100,000 pa	User pays.	
LU/D	Councils to adopt a policy that no subdivision of urban land unless connected to reticulated water and sewer.	January 1999.	LMCC WSC	$0		
LU/E	Protect wetlands, littoral and riparian vegetation • Study of wetlands • Review current practices and strategies for protection • Implement protection plans	Commence Jul 1999 Complete Jun 2000.	LMCC WSC DUAP Fisheries DLWC NPWS	$45,000	DLWC (Supp.)	.
WQ/G	Construction of three or four boat sewage pump-outs.	Design - March 1999. Construction - January 2000. Both completed - August 2000.	DLWC LMCC WSC Waterways	$50,000 (design) $200,000 $400,000 $5,000 pa	DLWC Waterways DLWC LMCC (ongoing maintenance)	
WQ/G	Amend and enforce Clean Waters Act and Waterways and Foreshore Regulation to enforce holding tanks and use of pump-out facilities.	March 1999 - April 2001.	Waterways EPA	$0	User pays	
CE/B	Survey community attitudes.	Commence - March 1999 Complete - June 1999	LMCC WCS	$10,000 $9,000 $1,000	DLWC (Supp.) LMCC WSC	
CE/A	Community Education Plan.	Commence - March 1999. Complete - June 1999.	LMCC WSC EPA	$10,000	Existing resources	

INTEGRATED THREE YEAR PRIORITY ACTION PLAN

LAKE GENERAL

Code	Action	Timetable	Action	Funding	Possible Funding Source	
CE/E	General Education Programme implementation.	Commence - July 1999. Complete - July 2004.	LMCC WSC HCMT Streamwatch	$15,000 p.a. $10,000 p.a. $5,000 p.a.	DLWC (Supp.) LMCC WSC	
WQ/K	Upgrade waste water transportation system Belmont #1 WWPS Belmont #3 WWPS	Commenced Complete Dec. 1998 Commenced Complete Dec 1998	HWC	$290,000 $360,000		Funded
ET/AE	Delta dredging	Ongoing	LMCC	Years 1999 - 2000 $140,000 p.a. $150,000 p.a. Year 2001: $140,000 $100,000	 LMCC DLWC (Supp.) LMCC DLWC (Supp.)	Wyong Shire may access part of the DLWC (Supp.) funds

APPENDIX 1

LIST OF FIGURES

APPENDIX 2

PREMIER'S LAKE MACQUARIE TASKFORCE

TERMS OF REFERENCE

The Lake Macquarie Taskforce was established in April 1998 by the Premier of NSW to address issues affecting the health of Lake Macquarie. Its terms of reference require it to:

- ❑ Review the Lake Macquarie Estuary Management Plan and recommend a priority action plan and appropriate institutional arrangements for implementation;

- ❑ Review and recommend strategies that would alleviate the impact of current planning, development and urbanisation on Lake Macquarie;

- ❑ Review available evidence and seek expert advice to assess the likely causes of the problems requiring remediation under the priority action plan as a basis for determining and recommending appropriate price sharing arrangements. Consideration was to be given to identifying alternative sources of funding including the private sector and the Natural Heritage Trust; and

- ❑ Review the Lake Macquarie fisheries and recommend action in relation to conflict between recreational and commercial effort, and give consideration to marine reservation and the potential for stock enhancement and aquaculture.

APPENDIX 3

MEMBERS OF THE TASKFORCE AND SUB-GROUPS

Members of the Lake Macquarie Taskforce:

Mr Ian Kiernan	Chairperson
Mr Bob Wilson	Vice Chairperson, Wilson Corporate & Environmental Services
Cr John Kilpatrick	Mayor, Lake Macquarie City Council
Cr Greg Piper	Lake Macquarie Estuary Management Committee
Cr Fay Brennan / Cr Cliff Russell	Mayor, Wyong Shire Council
Mr Greg Walkerden	Wyong Shire Council
Mr Jeff Jansson	Lake Macquarie City Council
Mr Robert Hughes	Swansea High School
Mr Peter Nelson	Lake Macquarie Catchment Management Committee
Mr Lionel Jones	Concerned Anglers Association
Mr Don Cameron	Commercial Fishing Industry
Mr George Dodds	Environment Protection Authority
Mr Ben Chard	NSW Premier's Department
Mr John Diplock	NSW Fisheries
Mr Tony Burgin	Dept of Land & Water Conservation
Mr Peter Smith	Delta Electricity
Mr Peter Graham	Pacific Power
Mr Bob Clifton	Powercoal Pty Ltd
Mr Brett Moore	Waterways Authority
Mr John Ridgway	The Cabinet Office
Dr Bruce Thom	Coastal Committee of New South Wales
Mr Allan Ray	Hunter Regional Tourism Organisation
Mr Doug Sneddon	Dept of Urban Affairs & Planning
Ms Lindsey Williams / Mr Dimitri Burstein	NSW Treasury
Mr David Evans	Hunter Water Corporation
Mr Lucien van den Boogaard	Pasminco

Members of the Funding and Structure Sub-Group:

Dr Bruce Thom	Coastal Committee of New South Wales
Mr Bob Wilson	Wilson Corporate & Environmental Services
Cr John Kilpatrick	Mayor, Lake Macquarie City Council
Mr Jeff Jansson	Lake Macquarie City Council
Mr Peter Nelson	Lake Macquarie Catchment Management Committee
Mr John Ridgeway	The Cabinet Office
Ms Lindsey Williams / Mr Dimitri Burstein	NSW Treasury

Mr Ben Chard	Premier's Department
Mr Doug Sneddon	Department of Urban Affairs and Planning

Members of the Hydraulic Sub-Group:

Mr Ric Slatter	Dept of Land & Water Conservation
Mr David Hale	Lake Macquarie City Council Engineering Officer
Mr Allan Ray	Hunter Regional Tourism Organisation
Cr Greg Piper	Lake Macquarie Estuary Management Committee
Mr Brett Moore	Waterways Authority
Mr Ben Chard	Premier's Department

Members of the Biophysical Sub-Group:

Ms Pam Dean-Jones/Mr Mitch Bennett	Environment Protection Authority
Mr Jeff Jansson	Lake Macquarie City Council
Mr Bob Wilson	Wilson Corporate & Environmental Services
Mr Ross Cooke	Department of Land & Water Conservation
Mr Paul Flanagan	Pacific Power
Mr Glenn Sharrock	Delta Electricity
Mr Bob Clifton	Powercoal Pty Ltd
Mr Kevin Young/Mr Michael Osborne	Hunter Water Corporation
Cr Greg Piper	Lake Macquarie Estuary Management Committee
Mr Don Cameron	Commercial Fishing Industry
Mr Lionel Jones	Concerned Anglers Association
Mr Ben Chard	Premier's Department
Mr Lucien van den Boogaard	Pasminco
Mr Scott Carter	NSW Fisheries
Mr Robert Hughes	Swansea High School
Mr Doug Sneddon	Department of Urban Affairs and Planning

Members of the Fisheries Sub-Group:

Mr Don Cameron	Commercial Fishing Industry
Mr Lionel Jones	Concerned Anglers Association
Cr Greg Piper	Lake Macquarie Estuary Management Committee
Mr Allan Ray	Hunter Regional Tourism Organisation
Mr Ben Chard	Premier's Department
Mr John Diplock	NSW Fisheries

APPENDIX 4

LAKE MACQUARIE TASKFORCE

PROPOSED

LAKE MACQUARIE ESTUARY CO-ORDINATOR

Position Title: LAKE MACQUARIE ESTUARY CO-ORDINATOR

Organisation: Department of Land and Water Conservation - Lake Macquarie Estuary Co-ordinator

Supervisor: Regional Director, Department of Land and Water Conservation

1. PRIMARY OBJECTIVE

Manage the development, implementation and administration of the "Lake Macquarie Integrated Estuary and Catchment Management Framework" and co-ordinate the Lake-based activities of agencies and councils to achieve the best outcomes for Lake Macquarie; report to Government and the Community so as to maintain a healthy ecosystem, sustainable economic activity and community recreational resource.

In implementing the "Lake Macquarie Integrated Estuary and Catchment Management Framework", the Estuary Co-ordinator will be aware of and ensure that outcomes for the Lake are consistent with government natural resources policy objectives.

2. REPORTING RELATIONSHIPS

The Estuary Co-ordinator reports through a Project Management Committee to the Minister for Land and Water Conservation. The Estuary Co-ordinator will also provide regular advice to Lake Macquarie City Council and Wyong Shire Council.

The Estuary Co-ordinator convenes and provides advice to a Project Management Committee established to implement and review progress of the "Lake Macquarie Integrated Estuary and Catchment Management Framework".

Membership (10) comprises:

- ❑ Department of Land and Water Conservation;
- ❑ Department of Urban Affairs and Planning;
- ❑ Environment Protection Authority;
- ❑ Waterways Authority of NSW;

- ❑ NSW Fisheries;
- ❑ Lake Macquarie City Council;
- ❑ Wyong Shire Council;
- ❑ National Parks & Wildlife Service; and
- ❑ 2 Community representatives - one each from the Lake Macquarie Estuary and Coastal Management Committee and the Lake Macquarie Catchment Management Committee.

The Chairman (one of the Community representatives) and members of the Committee will be appointed by the Minister for Land and Water Conservation. Their role will be to authorise work plans, budgets and expenditure for Lake improvements and oversee the work of the Estuary Co-ordinator. Through the Estuary Co-ordinator, they will have accountability for implementing, monitoring, reviewing and reporting progress to government and other stakeholders regarding the "Lake Macquarie Integrated Estuary and Catchment Management Framework".

3. ROLE OF ORGANISATION

The Estuary Co-ordinator is to be a newly created, externally funded, position within the Department of Land and Water Conservation. The geographical area of the Estuary Co-ordinator's responsibility extends over the waterways of Lake Macquarie and its whole catchment area in relation to the actions to be undertaken within the "Lake Macquarie Integrated Estuary and Catchment Management Framework".

During year 3, the position of Estuary Co-ordinator and the effectiveness of the "Lake Macquarie Integrated Estuary and Catchment Management Framework" will be independently reviewed to assess achievements of the position and the program and the value of them continuing. The report of this review, accompanied by input from both Lake Macquarie City Council and Wyong Shire Council, will be submitted to the Minister for Land and Water Conservation for decision on the future of the Estuary Co-ordinator and the Lake improvement program.

4. ROLE OF POSITION

The role covers a variety of functions including planning, administration, public relations and negotiation. The Estuary Co-ordinator will:

(i) prepare for approval by the Lake Macquarie Project Management Committee an annual implementation program for the "Lake Macquarie Integrated Estuary and Catchment Management Framework" and review progress for reporting requirements;

(ii) develop a longer term action strategy for the Lake beyond the initial three-year action plan;

(iii) regularly review Lake and Catchment monitoring data and the effectiveness of actions; identify gaps and develop new strategies to address shortcomings and emerging issues;

(iv) establish an inventory of all information/data systems relevant to the Lake, to be made available on request to the community, councils and agencies.

(v) act as a point of contact for the community with regard to environmental management matters concerning the Lake and implementation of the "Lake Macquarie Integrated Estuary and Catchment Management Framework".

(vi) examine the development of a Lake Model to strengthen environmental monitoring and databases to aid Lake management and decision-making;

(vii) through the Project Management Committee, facilitate the co-ordination of the activities of agencies with interests relative to the Lake to ensure programs achieve the best outcomes for the Lake;

(viii) investigate and obtain other supplementary capital and recurrent funding sources to implement Lake improvement programs;

(ix) provide high quality and timely advice to the Minister for Land and Water Conservation, Lake Macquarie City Council and Wyong Shire Council;

(x) manage the operational budget;

(xi) undertake program reporting, as specified, to key stakeholders and the community;

(xii) develop and maintain strong linkages with the Lake Macquarie Catchment Management and Estuary and Coastal Management Committees, Major Industry and other relevant community groups; and

(xiii) ensure that all outcomes associated with management of Lake Macquarie are consistent with government policy in natural resource management.

5. ACCOUNTABILITY / REPORTING

As discussed in Section 2, a Lake Macquarie Project Management Committee will be established to oversee satisfactory implementation of the "Lake Macquarie Integrated Estuary and Catchment Management Framework" and set the agreed work program for the Estuary Co-ordinator. The Project Management Committee will meet a minimum of four times per year.

In the interest of improving liaison and stakeholder participation, the Estuary Co-ordinator will report quarterly to the Lake Macquarie Estuary and Coastal Management Committee, incorporating additional membership from business and the NSW Coastal Council. The Committee will receive progress reports on program implementation and have the opportunity to raise and discuss issues relating to the Lake.

Various subcommittees/project groups will be established, as required.

The Estuary Co-ordinator will meet the following reporting requirements to key stakeholders:

- ❑ An annual progress report and program evaluation for submission to Lake Macquarie City Council, Wyong Shire Council and the Minister for Land and Water Conservation. This report will be circulated to all stakeholders and be publicly available. It will provide relevant information to assist the "State of the Environment" reporting process of Councils.

- ❑ Half-yearly reports to Lake Macquarie City Council and Wyong Shire Council.

- ❑ Quarterly reports to the Lake Macquarie Estuary and Coastal Management Committee.

- ❑ Prepare a six-monthly newsletter to inform the general community on Lake-related issues.

6. POSITION DIMENSIONS

Professional Competencies:

The Estuary Co-ordinator will require relevant professional and project management skills.

Recruitment:

Will be undertaken through the Regional Director of the Department of Land and Water Conservation on an initial three-year contract subject to satisfactory annual performance review.

Location:

The position will be located at the offices of Lake Macquarie City Council, Boolaroo.

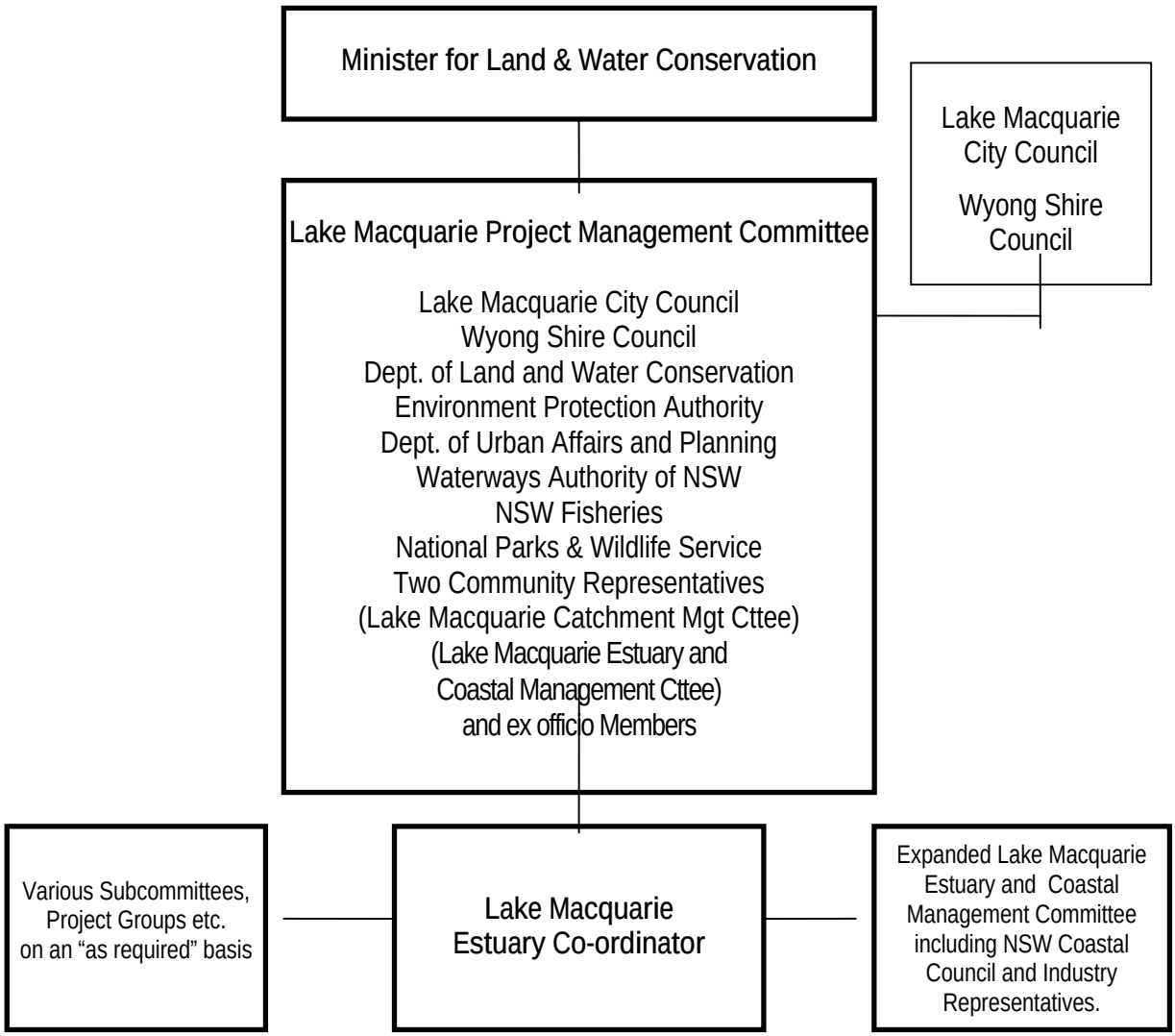
Operations Budget:

	$	
Estuary Co-ordinator	75,000	
+ 25% oncosts (approx)	18,750	
Consultancy and other program implementation costs	56,250	
Subtotal	**$150,000**	**(from Government)**
Lake Macquarie City Council	58,000	
TOTAL	**$208,000**	

7. ORGANISATION CHART

A diagram indicating the organisational and reporting relationships of the Lake Macquarie Estuary Co-ordinator is shown below.

LAKE MACQUARIE
ESTUARY AND CATCHMENT MANAGEMENT STRUCTURE



APPENDIX 6

LAKE HEALTH MONITORING PLAN

The broad objectives of the monitoring plan are:

- to provide a suitable data set to facilitate the management of the estuary and its tributaries;
- to evaluate the impacts of developments occurring in the catchment and measure the effectiveness of various management options;
- to set in place a procedure for investigation specific environmental incidents;
- to develop the community's understanding of the Lake and its catchment by providing sound scientific knowledge; and
- to facilitate the co-ordination of resources and avoid duplication in data collection.

Monitoring recommendations have been identified for eight (8) environmental parameters listed below:

1. recreational water quality (nearshore physico-chemical indicators);
2. nearshore sedimentation and sediment quality;
3. point-source discharges;
4. tributaries;
5. wetlands;
6. lake body water quality;
7. fish and other aquatic fauna; and
8. seagrass and macroalgae (nearshore biological indicators)

Monitoring proposals have been formulated on a catchment basis so that impacts may be attributed to their respective sources, allowing for an eventual focus on preventive management. While it is considered that monitoring activities should focus on the northern end of the Lake where impacts of development are most significant, it is acknowledged that monitoring of certain areas in the south, currently under development will also be essential. Monitoring of a control site (eg. Crangan Bay) will also be required to provide a representation of 'natural' conditions for comparative purposes. In addition to implementing the identified monitoring programs, analysis, interpretation and appropriate reporting of this data are further tasks that will also need to be undertaken.

The proposed monitoring programs (eg. sediment transfers in the catchment and accumulation in the Lake) have not addressed certain environmental parameters, and these will need to be addressed at a later stage.

Recreational Water Quality Monitoring (approx. $24,000 per annum)

Lake Macquarie Council, Wyong Council and the Hunter Water Corporation undertake monitoring to assess the suitability of water quality for recreational purposes. Monitoring by the Councils is currently undertaken at regular intervals within the Lake, tributaries and coastal areas and are focussed on determining the level of faecal coliform organisms present- The Hunter Water Corporation program is an interim program linked with the collation of information for an Erivironmental Impact Statement. The program has involved in-catchment monitoring during wet weather and wet and dry weather sampling of nearshore areas.

The parameters identified for the monitoring of recreational water quality are:

faecal contamination	pH	temperature
nuisance organisms	surface films	toxic chemicals
	visual clarity/colour	

It is proposed that monitoring be carried out on a weekly basis during the swimming season (October through to April) and quarterly at other times. 17 sites around the Lake (with random sampling along a 600m transect) have been identified with a concentration of sites around areas used for recreation involving primary contact.

Nearshore Sediment (approx. $33,000 per annum)

There is currently no formalised program to monitor sediment quantities for the lake and its catchment although for some areas, quantitative (ie. extent of sedimentation) and qualitative (ie. measurement of sediment constituents such as nutrients and metals) data exists. Indirect measurement of sediment deposition occurs by a number of means including record keeping for requests and complaints, estimates of total volumes of sediment removed by Council's dredging program and measurements of the volumes of sediment removed from Council's pollution control devices (eg. GPT's).

Pasminco and the power generation sector have in the past, monitored sediment quality which in the case of the latter, was undertaken to determine selenium levels. Sampling has generally been restricted to areas immediately adjacent to the power stations.

The monitoring plan recommends that the volumes of sediment removed from the Lake and tributaries continue to be measured but that the accuracy of the method used to collect and report the data be reviewed. Monitoring of six (6) sites impacted by urbanisation is also proposed to determine the extent of ooze build-up around the lake. Sediments in these locations will also be tested to determine nutrient, salinity and dissolved oxygen levels. Other recommendations for monitoring sediment include: the use of aerial photos and field surveys, assessing the accumulation of sediment in pipe and stream outlets, monitoring sediment transfers and runoff from development sites and/or monitoring for trace elements.

Point Source Discharges (approx. $100,000 per annum)

There are currently 24 premises licensed by the EPA to discharge potential water pollutants into the catchment of Lake Macquarie under strictly controlled conditions. Of these, 21 are required to monitor the concentration or volume of potential pollutants discharged. The remaining three premises comprise two quarries and a coal mine that are currently permitted to discharge stormwater overflows with limited concentrations of relevant potential pollutants without monitoring their discharge. The power stations and Pasminco are also required to carry out ambient environmental water quality monitoring because of their potential to have a significant impact on the Lake.

It has been suggested that the current point source monitoring network appears to be achieving its objectives, The EPA proposes to review the need for monitoring of stormwater discharges from premises where no monitoring is currently carded out.

Tributaries (initial funding $1000,000 - approx. $66,000 per annum after)

The Department of Land and Water Conservation (DLWC), Hunter Water Corporation (HWC) and a number of Streamwatch groups are involved in monitoring water quality and streambed condition in Tributaries throughout the catchment.

Tributaries and the streams and catchments that feed them provide the majority of fresh water and pollutants that enter the estuary and for this reason, it is imperative that the systems be assessed and monitored. To assist in developing an appropriate monitoring program and sampling parameters it will be necessary to identify potential pollutant sources and types entering the tributaries. On the basis of this assessment and the results of associated preliminary sampling, a long term monitoring program would be developed.

It is proposed that water quality be monitored for 6 events per annum at nine (9) sites. Sampling parameters would include conductivity, nitrogen, phosphorus, pH, dissolved oxygen, temperature, total dissolved solids, suspended solids, faecal coliforms, toxicants, heavy metals and pesticides. Macroinvertebrate sampling would also be undertaken in spring and autumn.

The Streamwatch program operates in a number of Tributaries including Winding Creek, Brush Creek, Cockle Creek and Stony Creek. Support for this project will continue. DLWC have indicated the continuation of their commitment to assessing the biophysical characteristics of Tributaries and preparing rivercare plans.

Wetlands (approx. $30,000 every 5 years)

No wetland-monitoring program currently exists in Lake Macquarie however, detailed studies have been completed for 58 wetlands in the catchment. Although wetlands are important natural ecosystems, providing valuable habitat for fauna including many frogs, birds and fish, it has been estimated that over the past 200 years, 60% of the state's wetland resource has been lost. The observed loss and degradation of Lake Macquarie wetlands makes it imperative that a comprehensive monitoring program be developed.

Wetland monitoring is problematic in that no simple set of parameter suits all wetlands. Initial monitoring will involve the use of aerial photography techniques. Any significant problems will be identified through this process and a suitable monitoring program identified. Parameters, which could be considered, include hydrology, water quality, fauna and flora. The monitoring program would potential be designed to classify and quantify resources, collect baseline data, measure impact effect, assess water quality, investigate pollution issues and forecast assimilation capacity.

Lake body water quality (approx. $79,000 per annum)

The Hunter Water Corporation and power generators, Pacific Power and Delta Electricity, have been monitoring the body of the lake since the early 1980's and 1970's respectively. Monitoring by Laxton for Hunter Water was undertaken six-monthly at 16 sites for parameters including secchi depth, chlorophyll-a, suspended solids, nitrogen, phosphorus, salinity and pH. (Some of the sites identified link with licensed monitoring sites and providing the EPA concurs to changing the location of two existing power station monitoring sites, the amount of funding which is required for this program could be reduced to $32,400). The power generators currently monitor 9 sites on a monthly basis for parameters including water quality, zooplankton, nitrates, dissolved oxygen and salinity.

The proposed monitoring program has been designed in accordance with ANZECC (1992) guidelines for the protection of marine aquatic ecosystems and recreational waters. A stratified sampling approach, at 7 sampling sites, has been chosen to allow for continuity between sites sampled under the current network and to better reflect the overall water quality of the body of the lake.

Two options for sampling frequency have been proposed namely, a frequency of one month and a frequency of two months, which is considered to be most infrequent sampling period appropriate.

Fish and other aquatic fauna

Lake Macquarie has had several extensive studies of fish and fisheries over the past 10 years in addition to current studies which include a NSW Fisheries Stock assessment project and a study by the NSW EPA to assess the effects of selenium and other heavy metals on communities of the lake.

There is much competition for fisheries resources in Lake Macquarie both between recreational and commercial fishers and the potential impacts of pollution on the lake. For monitoring proposals to be identified, a clear objective for a particular issue must be identified to ensure that monitoring is not undertaken for the sake of monitoring.

Currently, commercial fish catches are continually monitored as part of NSW Fisheries commitment to ongoing fish stock management programs with annual catch statistics for the Lake published in an annual report by NSW Fisheries. The formulation of

appropriate monitoring programs in response to specific fisheries management issues, may be required in the future.

Seagrass and macroalgae (Approx. $30,500 per annum)

Pacific Power and Delta Electricity have monitored the seagrass composition and distribution of the four species present in Lake Macquarie, annually since 1980. The areas monitored are those where the thermal plume may extend to $+1^{o}C$, being from Fishing Point Station around the south of the Lake to just north of Morisset. Transects are made every 50 - 100m with observations made every 10m along each transect.

Pacific Power and Delta Electricity have also recently completed a two-yearly survey of macroalgae in the lake to define the current status and provide a background to assess future change. Sampling was undertaken monthly at ten (10) site between 1995,1 997.

It is proposed that the existing seagrass monitoring program be extended to include seagrasses in the north of the lake in five (5) bays selected based on nearshore catchment inputs and potential effects on seagrass. The areas suggested include Warners Bay, Fennell Bay, Belmont Bay and Swansea Flats. Macroalgae monitoring is proposed on a quarterly basis in six (6) bays. Ten replicates would be required at each site.

APPENDIX 7

ACRONYMS

ANZECC	Australia and New Zealand Environment and Conservation Council
CAMBA	Chinese Australian Migratory Birds Agreement
COAG	Council of Australian Governments
DLWC	Department of Land and Water Conservation
DLWC (Supp)	Supplementary Funding to Department of Land and Water Conservation
DUAP	Department of Urban Affairs & Planning
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
EPA	Environment Protection Authority
ESD	Ecologically Sustainable Development
HCMT	Hunter Catchment Management Trust
HWC	Hunter Water Corporation
ID&D	Investigate, Design and Document
JAMBA	Japanese Australian Migratory Birds Agreement
LHCCREMS	Lower Hunter Central Coast Regional Environmental Management Strategy
LMCC	Lake Macquarie City Council
LMCMC	Lake Macquarie Catchment Management Committee
NPWS	National Parks & Wildlife Service
RTA	Roads & Traffic Authority
SoE Report	State of the Environment Report
TCM	Total Catchment Management
WSC	Wyong Shire Council

APPENDIX 8

TASKFORCE COMMUNITY PUBLIC MEETING SUMMARY

AND PUBLIC MEETING FEEDBACK SUMMARY

Speaker	Comment
	BELMONT:
a)	The environmental levy of $1.3m was a small amount and it would be better to concentrate of smaller areas than the whole Lake
b)	Expressed concern that all that seems to happen is study after study and no outcomes
c)	Fishing has deteriorated and was concerned about seagrasses taking over
d)	No co-ordination or co-operation occurs between Government departments and Councils and this needs to be improved if we want results
e)	Felt the State Government should be responsible to the high water mark
f)	Concerned that the environmental levy be spent on the Lake and not on administration, and that contributions were being made by industry around the Lake. Also expressed the desire that the boating community pay for channel clearance
g)	Major contributors to Lake pollution is the power stations and they should pay for remediation
h)	The Lake Co-ordinator needs to have a clear responsibility because the residents are becoming cynical about the process
i)	National Parks and Wildlife Service have large tracks of land around the Lake and erosion is a problem. They are not part of the Taskforce
j)	Stated he was not in favour of an environmental levy. The Power Stations should contribute more and Hunter Water Corporation should stop sewage flowing into the Lake
k)	There needs to be more flow into the Channel, which needs to be dredged all the way

l) Pollution is land based and small business should be given incentives to introduce better systems. The Lake also needs better septic tanks management but also she was happy to pay an environmental levy.

m) Anglers and boaters who throw rubbish and bottles into the Lake cause a lot of the pollution. Better management by Council and education is necessary

n) Most of the pollution comes from stormwater run-off and from urban areas. An education program is necessary

o) The major concern was the lack of fish in the Lake and the buy-out of commercial fishers should be accelerated

p) Developers and visitors from Sydney should be accountable and not the ratepayers

q) Meetings with the community should have been held earlier

r) An environmental levy will not raise enough money to fix the problems and industry should be made to pay

s) A lot of problems are caused by recreational fishers who are not complying with size limits and bag limits

t) Dredging is planned but this will not solve the channel issue

CHAIN VALLEY BAY:

a) Suggested fish farming to increase stocks of fish in the Lake

b) Commented in some detail about the brochure with the major points being: an environmental levy should be a flat amount and should not fund the co-ordinator
- the bird population is increasing and causing problems for fish
- there is not enough enforcement of fishing regulations on the Lake
- developers, industry and the Hunter Water Corporation should pay

c) Wyong Shire Council does little for the residential community on the Lake, no kerb and guttering etc.

d) Most of the work is being done in the northern part of the Lake and the bottom area needs to be protected as well

e) Questioned the selenium levels in the fish

f) Also highlighted that most of the work was being done in the northern part of the Lake.

g) Also question the selenium levels in fish and enquired what Delta Electricity was doing about this problem

h) Commented about the lack of expenditure in Chain Valley Bay by Wyong Shire Council

i) The problem is the catchment and if the Lake problems are to be fixed, the whole catchment needed to be addressed

j) Raised the option of artificial reefs and legality of spearfishing in the Lake

SUMMARY OF CORRESPONDENCE RECEIVED (main points)

a) The mines, power stations, industry and Hunter Water Corporation should be approached to contribute 33% of cost of remediation of the Lake

b) There has been a lack of input from the community in preparation of the plan. The Action Plan needs to have emphasis on land management and more than 4 catchments need work. Continuous dredging of Swansea Channel is a waste of resources

c) Concern about industry and the commercial fishermen, which both lead to depleted fish stocks in the Lake

d) Residents should breed fish to restock Lake as a business enterprise

e) Planning authorities have allowed overpopulation of the area. We need to stop future developments near catchments and restore damaged areas

f) Supports the Lake Co-ordinator. Four catchments are not enough and Dora Creek and Jewells Swamp should have been included

g) All available funds should be used for remediation and ongoing protection of the Lake. Funds should not be used to buy out commercial fishers or to dredge the channel. A program of $13m over 3-years is insufficient and the Premier should be asked for more. The Council should introduce a 5% levy or higher

h) The Channel should be widened to allow more flushing. Fisheries need to work towards increasing fish stocks and removing commercial fishers. Ecology needs to be improved to improve fish stocks

i) National Parks are not supporting proposals to reduce erosion on foreshores and they are not managing their area

j) Commercial fishers should be given sunset clause and no compensation

k) Fish stocks have greatly reduced over the last 20 years because of the condition of the Lake and the destruction of small fish due to haul netting by commercial fishers

l) Opposed to an environmental levy

m) Crown land on the northern side of Swansea needs repairing as it is severely degraded

n) Opposed to an environmental levy

o) A Taskforce was not necessary, as the Lake has been researched on many occasions. Mooring chains are creating problems for seagrasses

APPENDIX 9