Shoalhaven City Council

Swan Lake & Berrara Creek Natural Resources Management Strategy

Adopted 17 December 2002

FOREWORD

Why A Natural Resources Management Strategy?

Swan Lake, Berrara Creek and their catchments are important community assets for environmental, economic, recreational and social reasons. Increasing demands for residential and recreational opportunities need to be balanced with protection of the very values of the area that people find attractive. We need to ensure the long-term protection of our environment, and to minimise our impacts on natural resources. To this end, Shoalhaven City Council, New South Wales and Commonwealth Government agencies, and the community have prepared this Natural Resources Management Strategy for Swan Lake, Berrara Creek and their catchments. It acknowledges past environmental management, attempts to integrate current programs and proposes some new approaches. We are doing this to safeguard the ecology of the waterways and their catchments, to balance potentially competing uses and to provide a framework for future planning.

Project supported by:

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CONTENTS

ABBREVIATIONS

AHD	Australian Height Datum (approx. mean sea level)
ANZECC	Australia New Zealand Environment and Conservation Council
Bonn Convention	Convention on the Conservation of Migratory Species of Wild Animals
CAMBA	China Australia Migratory Bird Agreement
DLWC	Department of Land and Water Conservation
DMR	Department of Mineral Resources
EA	Environment Australia
EPA	Environment Protection Authority
JAMBA	Japan Australia Migratory Bird Agreement
LEP	Local Environmental Plan
L/s	Litres per second
NPWS	National Parks and Wildlife Service
NRMS	Natural Resources Management Strategy
ppt	parts per thousand
REP	Regional Environmental Plan
SCC	Shoalhaven City Council
SEPP	State Environmental Planning Policy

SUMMARY

This Swan Lake and Berrara Creek Natural Resources Management Strategy (NRMS) provides a comprehensive and integrated set of strategies to restore, protect and conserve the natural resources of the waterways and their catchments to ensure that their use is ecologically sustainable in the long term. The NRMS is the result of combining estuary management planning and catchment management planning into one process.

The proposed strategies and actions in the NRMS deal with six management areas: water quality, erosion and sedimentation, nature conservation, entrance management, recreation and visual quality. For each management area the NRMS contains values, objectives, issues, strategies and actions. The strategies for each management area are set out in the tables below. The actions proposed for carrying out each strategy are set out in the tables in sections 5 through 10 of this document. The strategies and actions are of four types: planning and development controls, protective and remedial works, education programs and monitoring/research.

The primary point of contact with the community during the preparation of this NRMS has been the Swan/Berrara Estuary Management Task Force. The task force has reviewed a number of drafts of the document and individual task force members have contributed greatly to its preparation.

Extensive community consultation was undertaken to guide the preparation of the NRMS. In addition to informal discussions held with many people that have an interest in the area, the broader community has had formal opportunity to contribute through a comprehensive survey of community values and issues in February 2001. A draft version of the NRMS was exhibited for public comment from March to May 2002. The Swan/Berrara Estuary Management Task Force considered the submissions and discussed changes to the draft. Shoalhaven City Council adopted the NRMS in Decmber 2002.

Strategies for Water Quality
WQ1 - Minimise sewage contamination of Swan Lake and Berrara Creek from existing sewage management systems
WQ2 - Improve system for reuse and disposal of effluent from reticulated sewerage scheme
WQ3 - Control other pollutants at source
WQ4 - Minimise pollutant transport in stormwater drains
WQ5 - Ensure boating is not contaminating lake water
WQ6 – Monitor water quality
WQ7 - Educate residents and visitors on stormwater issues and solutions

Strategies for Erosion and Sedimentation
ER1 - Accommodate natural processes of lake and creek bank erosion and accretion, but reduce human-induced erosion
ER2 - Reduce amount of sediment entering the creeks, lake and wetlands from the catchments by controlling erosion at its sources

Strategies for Nature Conservation
NC1 - Protect significant ecological communities and populations of rare or threatened species that are not in reserve system
NC2 - Retain the natural state of the Cudmirrah dunes
NC3 - Protect the natural values of foreshores and wetlands
NC4 - Educate visitors and residents on importance of protecting natural values
NC5 - Remove piles of garden waste from public areas
NC6 - Control weeds in bushland areas
NC7 - Protect lake and creek from introduction of *Caulerpa taxifolia*
NC8 - Maintain or establish buffer zones between developed areas and sensitive habitats, where possible
NC9 - Control populations of introduced animals in natural areas
NC10 - Reduce impact of roaming domestic animals on native animal populations
NC11 - Reduce impact of motor vehicle drivers on wildlife populations

Strategies for Entrance Management
EM1 - Develop and adopt entrance management policy
EM2 – Minimise intervention in natural entrance behaviour, with full reinstatement in the longer term
EM3 - Adopt interim entrance management policy
EM4 - Prevent illegal opening of lake entrance

Strategies for Recreation
R1 - Zone different parts of lake for appropriate uses (see figure 9-1)
R2 - Protect foreshores and public reserves from degradation due to recreational use
R3 - Provide access to public foreshore land next to Berrara Creek
R4 - Reduce impacts of motor vehicle drivers on recreational users of forest roads

Strategies for Visual Quality
VQ1 - Maintain or restore visual character of natural landscapes and landforms
VQ2 - Ensure built forms do not impact adversely on coastal scenery

1 INTRODUCTION

1.1 SWAN LAKE AND BERRARA CREEK

Swan Lake and Berrara Creek are located in the City of Shoalhaven on the New South Wales south coast (see Figure 1-1).

Swan Lake is a large brackish coastal lake that is intermittently connected to the sea.

Berrara Creek is located about two kilometres south of Swan Lake and is much smaller.

Most of the land surrounding the lake and creek is bushland, reserved as national park.

There are three small villages beside the waterways. Swanhaven is located on the northeastern shore of Swan Lake and Cudmirrah is located beside the lake inlet. The village of Berrara is near the mouth of Berrara Creek.

Swan Lake, Berrara Creek and their catchments are characterised by many environmental, social, commercial and recreational values that make them popular places for a wide variety of activities. However, the pressure of these uses has sometimes resulted in competition for and degradation of the area's natural resources.

1.2 AIM

This Natural Resources Management Strategy provides a comprehensive and integrated set of strategies **to restore, protect and conserve the natural resources of Swan Lake, Berrara Creek and their catchments so as to ensure that their use is ecologically sustainable in the long term**.

A number of government agencies, community groups and individuals have been involved in the management of the natural resources of the Swan/Berrara area prior to the preparation of this NRMS. This NRMS aims to integrate existing programs and proposes some new approaches.

The NRMS has been prepared under the following hierarchy of NSW Government policies.

1.2.1 NSW Coastal Policy

The NSW Coastal Policy 1997 is the Government's policy for the co-ordinated planning and management of the NSW coastal zone. It aims to guide the management and planning of the coastal zone by co-ordinating the various policies, programs and standards which apply at both State and local government level including the Estuary Management Policy under which this Natural Resource Management Strategy has been developed. The 1997 Coastal Policy has as its central focus the ecologically sustainable development (ESD) of the NSW coastline, and is based on the four ESD principles contained in various NSW Acts and Statutes. These are:

i). Conservation of biological diversity and ecological integrity - the need to conserve the variety of all life forms, especially the variety of species, and to ensure that the productivity, stability and resilience of ecosystems is maintained.

ii). Intergenerational equity - that the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.

iii). Improved valuation, pricing and incentive mechanisms - requires that environmental factors, such as the value of ecosystems, polluter pays principle etc be incorporated into the valuation of assets and services and considered in decision-making processes.

iv). The precautionary principle - that if there are threats of serious or irreversible environmental

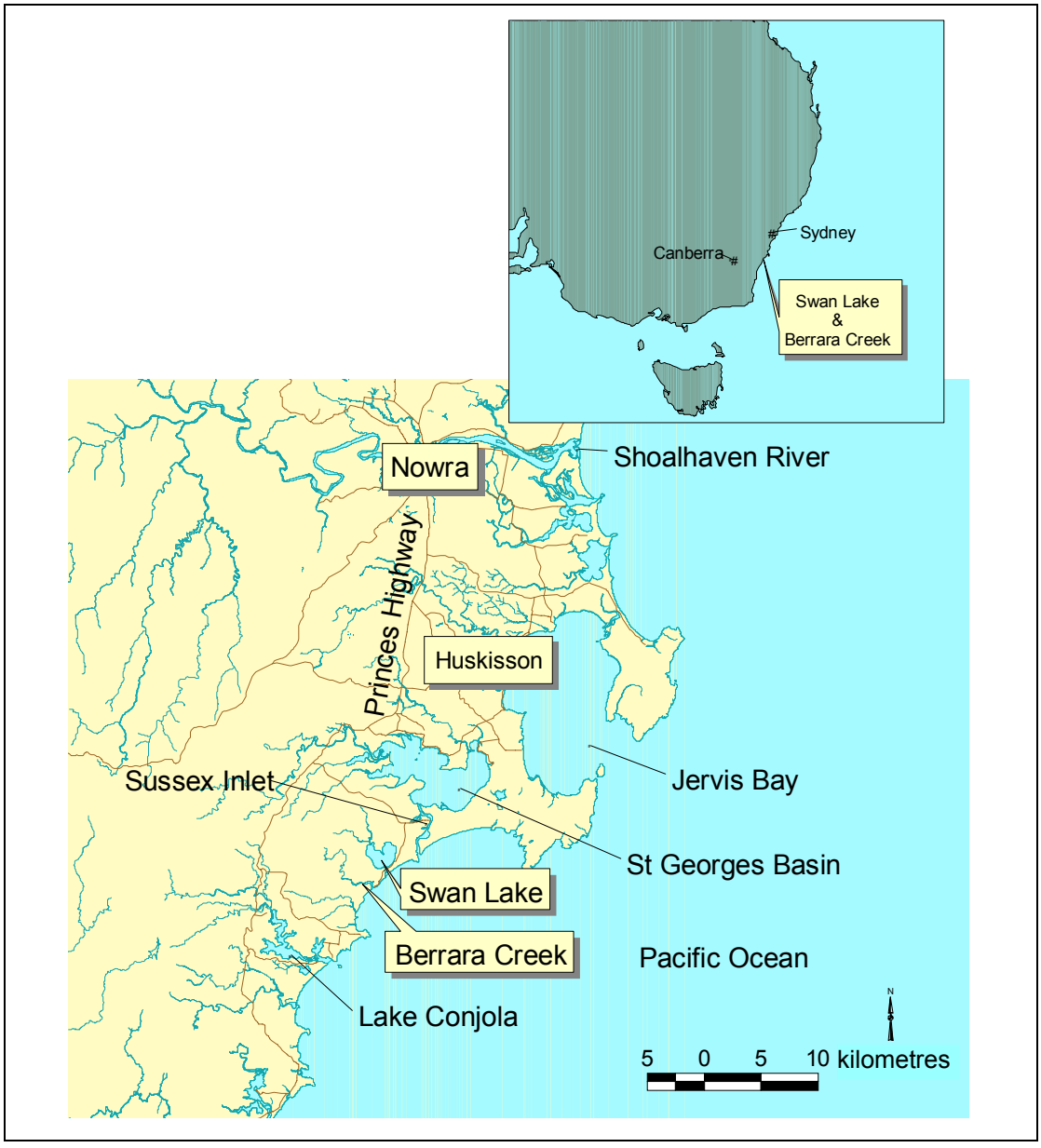

Figure 1-1. Location of Swan Lake and Berrara Creek.

damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.

1.2.2 Total Catchment Management

Total Catchment Management (TCM) is the overlying management approach that involves the coordinated use and management of land, water, vegetation, ecosystems and other resources within a drainage basin. In the Shoalhaven, the Southern Catchment Management Board manages TCM. In 2002, the Board released a draft blueprint for the management of natural resources in the region.

1.2.3 NSW Estuary Management Policy

The NSW Estuary Management Policy is one of several component policies under the umbrella NSW State Rivers and Estuaries Policy. The Estuary Management Policy has been developed by the State Government in recognition of the ecological, social and economic importance of the State's estuaries and in response to concern about the long-term consequences of their accelerating degradation. This policy forms part of a suite of catchment management policies and 'provides for the assessment of all estuarine uses, the resolution of conflicts and the production of a unified and sustainable management plan for each estuary, including remedial works and the redirection of activities, where appropriate' (NSW Government 1992).

The goal of the Government's Estuary Management Policy is to achieve integrated, balanced, responsible and ecologically sustainable use of the State's estuaries, which form a key component of coastal catchments.

The Coastline Management Manual and Estuary Management Manual are currently being reviewed and combined into a single updated manual, which will reflect the principles of the NSW Coastal Policy and incorporate broad-based natural resource management principles.

1.3 PLANNING PROCESS

A Management Team consisting of SCC and DLWC has overseen the preparation of the NRMS. A project officer prepared the NRMS, working with the community in doing so. The primary point of contact with the community has been the Swan/Berrara Estuary Management Task Force. The project officer was employed by Shoalhaven City Council on behalf of the Management Team.

This NRMS is the result of combining catchment management planning and estuary management planning into one process. This approach to natural resource management is based on the following:

- the quality of estuaries is largely determined by the management of their catchments;
- one of the goals of catchment management is to work with local communities in developing a concise statement of major issues and preferred management for each of the major land and water units (catchments) in the area;
- it is the policy of government to integrate the management of natural resources;
- the approach will increase community understanding about how activities in the catchment impact the estuary;
- it will increase community input to planning;
- the strategies will identify landcare needs in the catchment.

Shoalhaven City Council has

management responsibility for a relatively large number of estuaries. Although considerable resources are put towards estuary management in the Shoalhaven, there had been concern in the community that, because of the high costs and length of time associated with the preparation and implementation of Estuary Management Plans for some of the City's waterways, it would be a very long time before funds could made available for Swan Lake and Berrara Creek (and a number of other waterways). Nevertheless, there were immediate and ongoing management needs for these waterways, which could be better dealt with by a strategic rather than *ad hoc* approach.

Consequently, the then Lower Shoalhaven Catchment Management Committee coordinated the getting of limited funding (see section 1.5) to employ a project officer to assist in the preparation of this NRMS. In preparing this NRMS, because of the limited funds available, it was not possible to complete all the steps for estuary management planning as set out the NSW Government's Estuary Management Manual. In particular, the relatively expensive "Processes Study" was not done. Instead, the NRMS responds to immediate and foreseeable management needs, based on existing information. The NRMS includes actions for collection of new information where necessary and allows for improvement to future management based on that new information.

1.4 PLANNING FRAMEWORK

There were a range of policies, plans and strategies that were considered during the preparation of this NRMS. These included:

- NSW State Rivers and Estuaries Policy
- NSW Wetlands Management Policy
- NSW Coastal Policy 1997
- NSW Government's Water Quality and River Flow Interim Environmental Objectives
- Crown Land Foreshore Tenures Policy (non commercial occupations) (1991)
- Crown Lands Caravan Parks Policy.

At the same time as this NRMS was being prepared, the Healthy Rivers Commission was conducting an independent inquiry into management of coastal lakes in New South Wales (Healthy Rivers Commission, 2001). The content of discussion papers produced by the commission was considered when the strategies and actions in this NRMS were being developed.

The Healthy Rivers Commission issued its final report on coastal lakes in April 2002, but the formal NSW Government response was still being formulated when this Swan Lake and Berrara Creek NRMS was finalised. The final Healthy Rivers Commission report retains the "Significant Protection" category for future management of Swan Lake, and indicates that coastal lakes in the Shoalhaven are priority areas for development of sustainability assessment and management plans. Shoalhaven City Council supports pilot assessments being undertaken for its coastal lakes, including Swan Lake.

Whilst this NRMS was in preparation the NSW Government announced a 'Coastal Protection Package' that included, amongst other things, a Comprehensive Coastal Assessment (CCA) to be undertaken over three years. A Planning NSW fact sheet states that: "The environmental, social and economic values of the State's 1300 km coastline will be assessed. The CCA will provide common data on, and an analysis of, the values of land within the coastal zone for use in planning and management decisions. This will involve standardising and

integrating existing data sets and the identification and filling of significant data/information gaps. The CCA will give State and Local Government, industry and the community high quality information to make decisions about coastal development and conservation. It will also provide information to guide investment decisions by coastal industries." It is not clear at this stage whether the CCA will provide any new information that would benefit the content of this Swan Lake and Berrara Creek Natural Resources Management Strategy. If it does, there will be opportunity to incorporate it during future reviews of this NRMS.

The NSW National Parks and Wildlife Service is preparing a draft plan of management for the Conjola National Park which covers a large area of the catchments. The planning process for the national park is subject to the provisions of the National Parks and Wildlife Act 1974 and will involve input from the community. To provide for some consistency of planning for the area, the National Parks and Wildlife Service has participated in the preparation of this Natural Resources Management Strategy.

Some of the strategies in this NRMS, for example proposals for education programs, may benefit from coordination on a regional basis. As this NRMS is implemented, there will be consideration of estuary management plans and other natural resources management strategies that have been adopted by Shoalhaven City Council (St Georges Basin, Lake Conjola, Currarong, Lake Wollumboola, Lake Tabourie and Ulladulla Harbour) and those currently in preparation (Narrawallee Inlet, Burrill Lake and Shoalhaven River).

Some of the strategies in this NRMS may require amendments to existing Council planning and development controls (eg the LEP and Council policies). Others affect the granting of development consents, permits and/or licences for works to repair existing degradation (eg bank stabilisation works) and to prevent future damage (eg sediment traps, artificial wetlands). Where possible, any plans to be amended or created have been identified in the actions for each strategy.

Shoalhaven City Council has adopted a development control plan for foreshores. Development Control Plan No 62 (Foreshore Development Guidelines) provides detailed guidelines to ensure that development within foreshore areas is undertaken in a manner, which preserves the amenity of the foreshore, and is sympathetic to the physical constraints encountered within such areas. The DCP provides controls on, amongst other things, the height and bulk of foreshore development.

Actions carried out as a result of this NRMS will have to comply with such legislation as:

- *Local Government Act 1993* (SCC)
- *Environmental Planning and Assessment Act 1979* (planningNSW)
- *State Environmental Planning Policy No. 14 - Coastal Wetlands* (planningNSW)
- *State Environmental Planning Policy No. 35 - Maintenance Dredging of Tidal Waterways* (planningNSW)
- *Local Environmental Plan 1985,* (SCC)
- *Crown Lands Act 1989* (DLWC)
- *Rivers and Foreshores Improvement Act 1948* (DLWC)
- *Soil Conservation Act 1938* (DLWC)
- *Coastal Protection Act 1979* (DLWC)
- *Maritime Services Act 1935* (Waterways Authority)
- *Fisheries Management Act 1994* (NSW Fisheries)

- *Protection of the Environment Operations Act 1997* (EPA)
- *Native Vegetation Conservation Act 1997 (DLWC)*
- *National Parks and Wildlife Act 1974 (NPWS)*
- *Threatened Species Conservation Act 1995* (NPWS)
- *Water Management Act 2000 (DLWC)*
- *Commonwealth Environment Protection and Biodiversity Conservation Act 1999(EA)*.

The information in the NRMS will also be used by Council to develop its annual State of the Environment report and its Strategic Business Plan which forms part of its internal Management Plan required by the Local Government Act.

1.5 ASSISTANCE

Shoalhaven City Council and the Commonwealth Government (Natural Heritage Trust, National Landcare Program and Coasts and Clean Seas Initiative) provided financial assistance for the preparation of this NRMS.

In addition, technical assistance has been provided by:

- Department of Land and Water Conservation
- Southern Catchment Management Board
- Environment Protection Authority
- Waterways Authority
- NSW Fisheries
- National Parks and Wildlife Service
- planningNSW
- Environment Australia
- National Oceans Office
- University of Wollongong.

1.6 CONSULTATION

The Swan/Berrara Estuary Management Task Force was established in 1996 as an advisory committee to Shoalhaven City Council. It provides a forum for resolving conflicting demands on Swan Lake and Berrara Creek and formulates long term management strategies to ensure their use is ecologically sustainable.

Committee members are drawn from the local community, together with Council and State Government representatives. The Task Force was established to perform the role of an Estuary Management Committee in accordance with the Estuary Management Policy, but its role broadened to include management of natural resources in the catchment as well. Task force members have contributed greatly to the preparation of this NRMS.

In addition to informal discussions held with many other people that have an interest in Swan Lake and Berrara Creek, the broader community has had a number of formal opportunities to contribute to the preparation of this NRMS.

A questionnaire was distributed to gauge the Swan/Berrara community's opinions on a set of draft values and issues. Approximately one thousand three hundred papers were distributed in February 2001 by the following means:

- letterbox drop at Cudmirrah, Swanhaven, Berrara and surrounding rural areas
- mail to all ratepayers with a postal address outside the catchments
- delivery to five caravan parks in the catchments
- mail to others that have expressed an interest in natural resource management of the area, including private citizens, non-government organisations, Federal and State agencies, local politicians, all councillors and many council staff.

Two hundred and forty three responses were received by the end of

March 2001. Results are summarised in Section 3 of this NRMS.

A draft NRMS was exhibited for public comment from March to May 2002. More than 330 written submissions were received.

Following this exhibition of the draft NRMS, submissions were assessed, changes to the draft NRMS discussed by the task force and a final NRMS was adopted by Council in December 2002.

2 THE WATERWAYS AND THEIR CATCHMENTS

2.1 LOCATION AND CHARACTER

Swan Lake and Berrara Creek are located just south of St Georges Basin and Jervis Bay in the City of Shoalhaven on the New South Wales south coast. By road they are approximately two hundred and ten kilometres south of Sydney and fifty kilometres south of Nowra.

The waterways and their catchments are shown in Figure 2-1. Figure 2-2 shows geographical features around the waterways.

The estuarine parts of these waterways are places where marine and terrestrial processes interact to produce particularly sensitive and complex coastal environments.

These estuaries, along with others in New South Wales, have a common origin. They formed around four to six thousand years ago when sea level rose to its present position, drowning coastal river valleys.

This sea level rise also triggered shoreward transport of huge volumes of sand that accumulated as beaches, many of which blocked off bays and river mouths.

In the long term, the estuaries also have a common destiny. They are very large sediment traps - to be filled with sediment delivered from the surrounding catchments and from the sea.

The time it takes to reach a mature stage depends primarily on catchment characteristics (water and sediment discharge), together with the initial dimensions and configuration of the estuarine basin.

The present day patterns of water and sediment dynamics that we see at Swan Lake and Berrara Creek can be explained in terms of the relative importance of catchment inputs, tidal forces and wave climate.

The interaction of these forces also determines prevailing entrance conditions - a crucial factor in explaining the characteristics of a particular estuary.

Swan Lake and Berrara Creek are naturally dynamic places, ie they change from time to time. These changes operate at various time scales, some over hours, days, weeks or years and others over decades, centuries or millennia. Some changes are cyclical and reasonably regular, such as the tidal rise and fall in Berrara Creek. Others may be cyclical but irregular, such as the rise and fall of water level in Swan Lake in response to rainfall, evaporation and the entrance opening or closing. Still other changes may be more permanent such as the shallowing of the lake from deposition of sediment.

The time frames over which these changes operate may be much longer than the time that we have been associated with the lake. This sometimes leads to claims by people that the lake had 'never been so high for so long' or 'never closed for so long' or 'never opened so frequently' or 'never had so many birds on it' or 'never had so few fish in it' etc. What is meant here is that those people have not seen the lake in such a condition. Even people with relatively long associations with the area (forty years or more) are unlikely to have seen the full range of conditions that Swan Lake has experienced in its approximately 4,000 year existence. To expect that Swan Lake will always behave tomorrow the way it behaved yesterday is unrealistic.

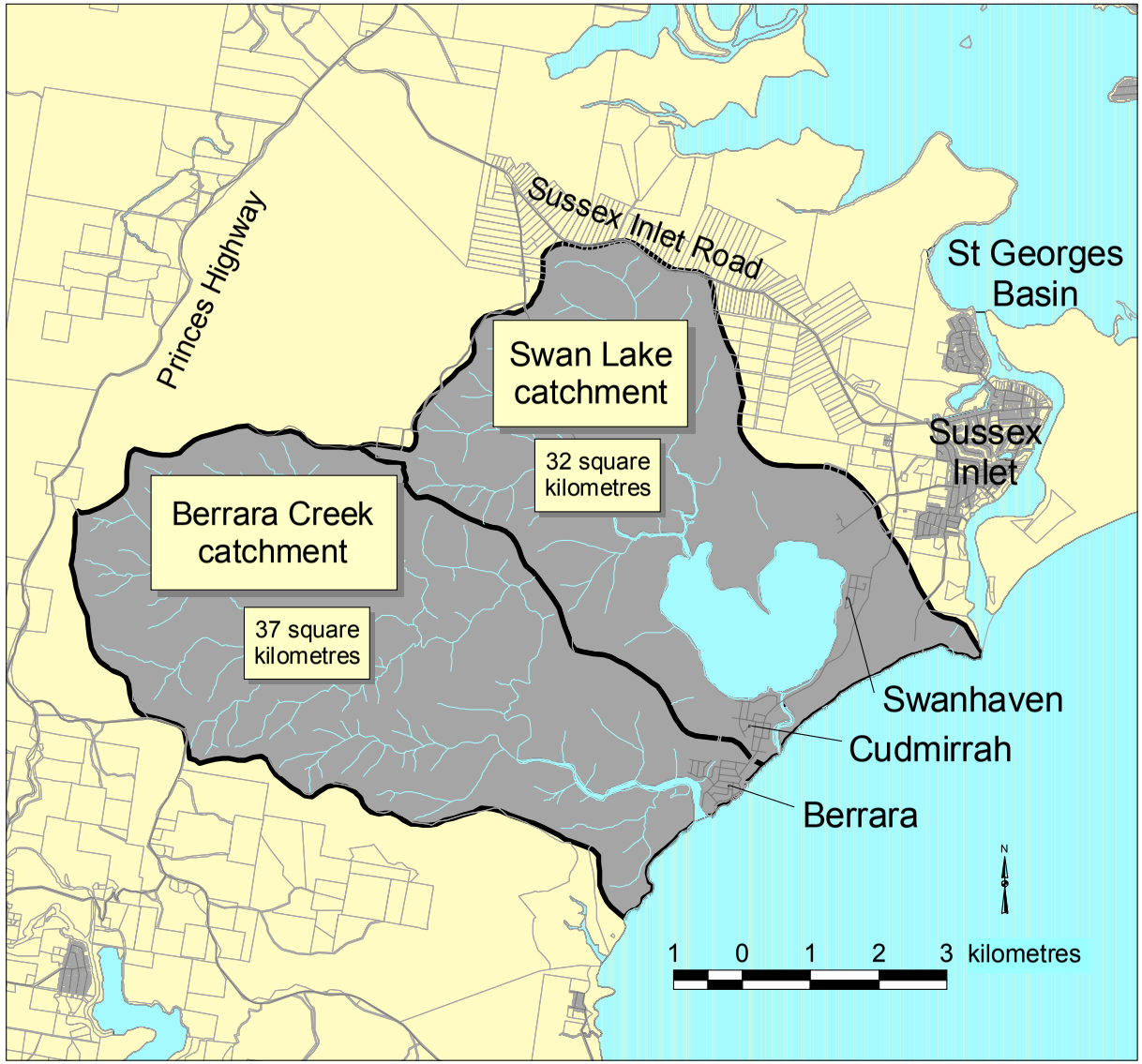

Figure 2-1. Swan Lake and Berrara Creek water catchments

Figure 2-2 Geographical features around Swan Lake and Berrara Creek
Source: © LAND AND PROPERTY INFORMATION PANORAMA AVENUE BATHURST 2795 www.lpi.nsw.gov.au

2.2 SWAN LAKE

Swan Lake is a large brackish coastal lake that is intermittently connected to the sea. It has a surface area of about 4.5 to 5 square kilometres and consists of a broad, shallow basin and a narrow, sinuous inlet about a kilometre long that occasionally opens to the sea. In the deepest part of the lake (see figure 2-3), the bed is about 3.8 metres below AHD (see page iv). The actual water depth at that point varies as the lake rises and falls and would be over 6 metres when the lake rises to its maximum height before opening to the sea (about 2.5 metres above AHD).

In the Healthy Rivers Commission (2001) inquiry into coastal lakes, Swan Lake was identified as having high sensitivity and high conservation value. The Commission proposed that the lake be classified in the 'Significant Protection' category for future management.

The catchment of the lake is about 32 square kilometres of mostly forested land. Two streams, Mondayong Creek and Teatree Creek drain into the north west of the lake basin. These creeks are brackish for about one kilometre upstream of where they join the lake. Otherwise, only minor drainage lines exist around the lake.

A bedrock outcrop (reef) to the south confines the entrance. To the north, dunes behind Cudmirrah Beach form a sand barrier, which extends southward as a spit to the lake inlet. A low point is present in the dune at a point where a meander in the inlet comes close to the back of the dune. This is known locally as 'The Gap' and there has been much debate about whether or not the lake has, in the past, connected to the sea at this point, or whether it should be artificially opened there in the future. It may be that some claims that timber-carrying barges passed through The Gap early this century result from confusion with another waterway with the same name near Sussex Inlet, a few kilometres to the north.

Swan Lake is a naturally variable place. Swan Lake is typical of many south coast lagoons in that it is usually closed to the sea by a sand bar and the condition of the lake's entrance plays an important part in the state of the estuarine ecosystem. The biological, chemical and physical character of the lake may stay relatively stable for months or years and then change dramatically within a short period if the entrance opens. The lake then functions as a tidal waterway for some time.

The condition of the lake's entrance is controlled by tides, waves, currents, sediment movement, creek flows, floods and human intervention. The interaction and ever changing nature of these factors may cause the entrance to migrate along the coastline, to close up, re-open, etc. At best, an ever-restless dynamic equilibrium exists that may be punctuated by irregular and sudden changes of behaviour (NSW Government, 1992).

To protect the high natural values of the lake, including maintenance of natural fluctuations in their ecological conditions and biodiversity, water quality and habitat, it is necessary to achieve as close to a natural opening regime as possible, ie, the lakes' water levels and connections to the sea should be allowed to vary naturally.

The ecology of the lake is profoundly affected by the behaviour of the connection to the sea. When the lake drains there are great changes not only to the water level and volume, but also to the chemical and physical qualities of the water. Pollard (1994a) measured salinity and temperature in Swan Lake from 1984 to 1988.

Salinity of around 10 ppt (sea water is about 36 ppt) at the beginning of the sampling period was gradually reduced, due to freshwater inflow, to around 6 ppt a year later. When the lake opened to the sea, salinity gradually rose to about 16 ppt. Temperature varied from about 10°C in winter to about 25°C in summer.

Some kinds of fish and shellfish that live in the lakes breed in the oceanic or coastal waters and enter the lakes as larvae or juveniles. Therefore, the behaviour of the lake's entrances, in conjunction with many other factors, can affect the numbers of fish of different ages that are present in the lake at any point in time. However, because of the complexities of the processes involved and our lack of understanding of these processes, it is extremely difficult, if not impossible to artificially manipulate the entrance opening with any certainty of enhancing fish or prawn production in the lakes. Artificial opening of the lakes may have negative impacts on fisheries production.

Occasionally, if water levels remain high for extended periods of time, then some die-back of terrestrial vegetation around the edges of the lake will occur. Likewise, if water levels remain very low for extended periods, then some wetlands that rely on intermittent inundation for their health may contract. This is part of the natural dynamics of the lake's ecosystems.

When the lake entrance is closed, the water level may fall due to evaporation, remain stable (either high or low) during periods of balanced evaporation and rainfall, or rise in response to runoff from heavy rainfall in the catchment.

Under natural circumstances, if the lake level rises above the height of the sand berm on Cudmirrah Beach, then a break out occurs and the water level drops suddenly (ie, over a few hours) as the lake water drains to the sea. There is then some tidal exchange until the sand builds up at the entrance and the lake is closed again. Pollard (1994a) described the tidal exchange between the lake and the sea as relatively slow and gradual, due to the long and narrow entrance channel combined with the fact that this channel enters the sea across an exposed rock shelf.
The level to which the lake water drops after opening is determined by both the sea level and the level of the rock shelf.

The length of time that the lake remains tidal varies from one opening/closing event to the next. Dates of opening and closing events are summarised for the last 18 years in Table 2-1. The nature of the lake is that it is closed for much longer periods than it is open.

2.3 BERRARA CREEK

Much less is known about the characteristics of Berrara Creek. It is located about two kilometres south of Swan Lake and is much smaller. The lower three kilometres (approximately) of the creek is normally a tidal estuary, although the mouth of the creek occasionally closes to the sea (Table 2-2). However, even when the creek is closed, sea water may wash over the sand spit and into the creek at high tide (this happens less frequently at Swan Lake). The estuary has a surface area of about 0.2 square kilometres and a catchment of about 37 square kilometres.

Table 2-1. Records of Swan Lake entrance opening and closure (*records supplied by Keith Bunsell, William Simpson and Arthur South).

Date of opening	Date of closure	Number of days open	How opened?	Source of information*
7-Nov-83	7-Mar-84	121		Bunsell
17-Nov-83		~150	flood	South
23-Apr-84	30-Apr-84	7		Bunsell
28-Jul-84	18-Aug-84	21		Bunsell
4-Aug-84		11	flood	South
15-Oct-85	12-Mar-86	148		Bunsell
15-Oct-85		~150	flood	South
20-Oct-87	2-Dec-87	43	council	Bunsell
20-Oct-87		36	council	South
1-Apr-89	1-Jun-89	61	hand	Bunsell
1-Apr-89				South
3-Jun-89	15-Jul-89	42		Bunsell
12-Feb-90	15-May-90	92		Simpson
13-Feb-90	15-May-90	91	hand	Bunsell
14-Feb-90		90	flood	South
31-Jul-90	28-Aug-90	28		Simpson
1-Aug-90	27-Aug-90	26		Bunsell
1-Aug-90		75	flood	South
15-Sep-90	4-Oct-90	19		Simpson
15-Sep-90	11-Oct-90	26		Bunsell
10-Jun-91		28		South
10-Jun-91	12-Jul-91	32		Simpson
11-Jun-91	12-Jul-91	31		Bunsell
9-Feb-92		41	flood	South
10-Feb-92	21-Mar-92	40		Bunsell
10-Feb-92	21-Mar-92	40		Simpson
16-May-93	3-Jun-93	18	council	Bunsell
16-May-93		19	council	South
16-May-93			council	Council
18-May-93	3-Jun-93	16	council	Simpson
13-Nov-95		90	flood	South
14-Nov-95	14-Feb-96	92	hand	Bunsell
14-Nov-95	14-Feb-96	92		Simpson
6-Jul-97		14		South
6-Jul-97	3-Aug-97	28		Simpson
7-Jul-97	4-Aug-97	28	hand	Bunsell
19-Aug-98		68	flood	South
19-Aug-98	22-Oct-98	64	public	Simpson
19-Aug-98			flood	Council
3-Oct-99	unsuccessful attempted opening		public	South
15-Apr-02	29-May-02	44	public	Council

Table 2-2. Records of Berrara Creek entrance opening and closure (records supplied by William Simpson).

Approx. date of opening	Approx. date of closure	Approx. number of days open
	21-Mar-96	
13-Apr-96	15-May-96	32
19-Jun-96	25-Jun-96	6
1-Sep-96	28-Dec-96	118
3-Feb-97	5-Feb-97	2
13-Feb-97	25-Feb-97	12
1-Mar-97	1-Jun-97	92
28-Jun-97	15-Mar-98	260
19-May-98	15-Apr-00	697
6-May-00	16-Aug-00	102
22-Nov-00	10-Jan-01	49
30-Jan-01	28-Feb-01	29
12-Sep-01	20-Oct-01	38

Figure 2-3. Water Depth

Figure 2-4. Groundwater map for area east of Swan Lake (PPK, 1999)

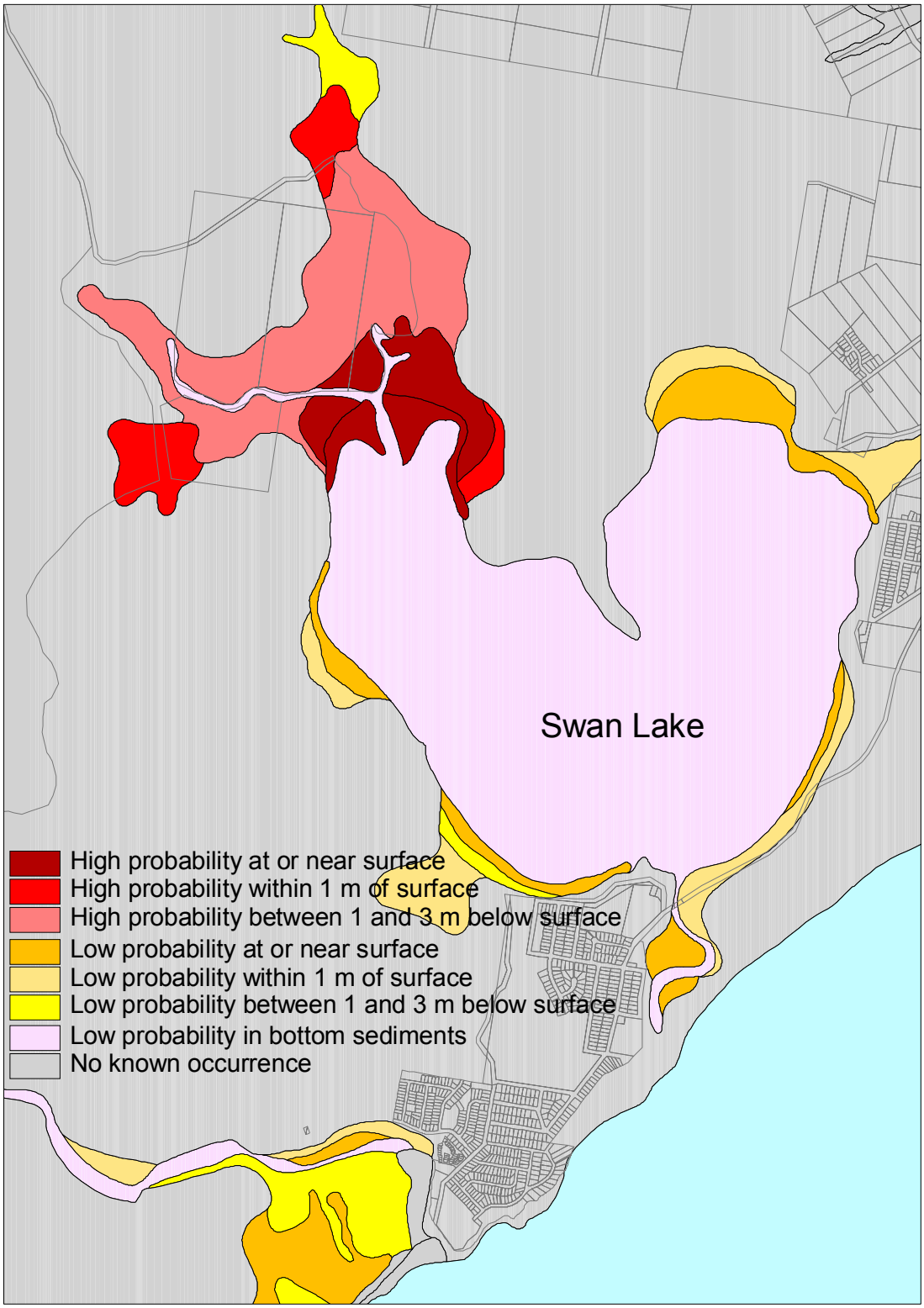

Figure 2-5. Risk of acid sulfate soils in areas around Swan Lake and Berrara Creek.

2.4 GROUNDWATER

The groundwater of the dunes to the east of Swan Lake have been studied as part of the environmental impact assessment and monitoring of the sewage effluent disposal area there. Groundwater levels east of Swan Lake vary in depth from about 18 metres below the ground surface in the north to about 1.4 metres below ground near the lake. In the period 1987 to 1999, the water table fluctuated in the order of 1 to 3 metres. The groundwater generally has low salinity but may be enriched with magnesium, sulphate, calcium or bicarbonate depending on location. Figure 2-4 shows groundwater flow is predominantly south easterly towards Cudmirrah Beach with some flow westerly into Swan Lake (PPK, 1999).

2.5 GEOLOGY AND SOILS

Swan Lake and Berrara Creek lie within the southern part of the Sydney Basin, a large sedimentary basin formed around 270 to 250 million years ago. The dominant geological unit is sandstone. The underlying geology of the areas is mainly composed of the Permian Conjola formation, a series of sandstone and shale units. This is overlain by large areas of Wandrawandian Siltstone around Swan Lake.

In addition to the old rocks described above, the area has a complex array of surface deposits formed during the past six thousand years. Many of these features are still actively changing. The Cudmirrah dunes form the Swan Lake sand barrier and are of high scientific value. They are the best-developed and highest dune system on the South Coast. Further unconsolidated sediments occur along the creek systems. These comprise alluvial, lagoonal and estuarine clays, silts and sands.

There is a high risk that potential acid sulfate soils would occur in some low lying areas around the lake and creek (figure 2-5).

2.6 VEGETATION

The following description of terrestrial vegetation is largely summarised from the draft plan of management for Cudmirrah National Park (NPWS, 1999) and two reports by Kevin Mills and Associates (Mills, 1995 and Mills and Jakeman 1996).

The vegetation of the area is associated with the sandstone soils, the coastline and the waterways. Woodlands are common, and there are some significant areas of forest and freshwater wetland.

Eighteen different vegetation communities have been identified. The most extensive communities are Scribbly Gum *Eucalyptus sclerophylla* and Bloodwood *Corymbia gummifera* woodlands with a heath understorey. Open forest communities dominated by Blackbutt *Eucalyptus pilularis*, Bangalay *Eucalyptus botryoides*, Bloodwood, Sydney Peppermint *Eucalyptus piperita*, Scribbly Gum or Forest Oak *Allocasuarina littoralis*, are found amongst the woodlands and on the dunes near Farnham Head. Bangalay open forest on the dunes has a distinct rainforest understorey.

Small areas of tall open forests of Blackbutt, Blue Gum *Eucalyptus saligna- Eucalyptus botryoides*, Rough-barked Apple *Angophora floribunda*, Turpentine *Syncarpia glomulifera* and Spotted Gum *Eucalyptus maculata* occur in more fertile locations such as along creeklines. Woollybutt *Eucalyptus longifolia* woodland occurs along drainage lines north of Swan Lake.

Closed shrubland of Coast Banksia *Banksia integrifolia* and Coast Teatree

Leptospermum laevigatum is found along the immediate coastline. The dunes behind Cudmirrah Beach support significant Bangalay - rainforest vegetation.

On the shores of Swan Lake are patches of Swamp Paperbark *Melaleuca ericifolia* shrubland and Swamp Oak *Casuarina glauca* forest. Numerous areas of sedgeland and reedland also occur along the lake and creek shores and other poorly drained locations. Species present include *Baumea juncea*, *Juncus kraussii*, *Isolepis nodosa* and *Phragmites australis* (Green and King, 1996)

Two threatened saltmarsh plants, *Wilsonia backhousei* and *Wilsonia rotundifolia*, occur on the rocky shores around Swan Lake (K. Mills, pers. comm.)

Beneath the waters of Swan Lake the Sea Tassel *Ruppia megacarpa* and various species of macroalgae cover parts of the lake bed. Seven species of macroalgae have been recorded in Swan Lake, the most common being the green algae *Lamprothamnion papulosum* and *Chaetomorpha indica* (McConville, 2000).

In Berrara Creek the seagrass *Zostera* sp. grows on the edges of channels (West *et al*., 1985).

A number of fresh to brackish water wetlands are present to the west of Swan Lake. Two are protected by SEPP No.14 (see figure 2-6). Brief descriptions of these wetlands are provided in Green and King (1996) and Winning and Brown (1994).

2.7 ANIMALS

The vertebrate fauna of the area includes a variety of fish, frogs, lizards, snakes, water birds, shore birds, forest birds, bats, and tree and ground dwelling mammals. A vertebrate fauna survey (Daly *et al*., 1998) was undertaken as part of a comprehensive regional assessment of the conservation and forestry values of the area. The full list of species found is available on the National Parks and Wildlife Service's Wildlife Atlas.

Common waterbirds present at times on the waterways include Black Swans, Pelicans, Egrets, and various species of Cormorants and Ducks.

Pollard (1994b) found 39 species of fish in Swan Lake, including 22 commercial species.

Threatened animal species that are known to occur in the area are listed in table 2-3.

Table 2-3. Threatened fauna known to occur in Swan/Berrara catchments (NPWS Wildlife Atlas and K. Mills, pers. comm.)

Green and Golden Bell Frog	*Litoria aurea*
Osprey	*Pandion haliaetus*
Sooty Oystercatcher	*Haematopus fuliginosus*
Pied Oystercatcher	*Haematopus longirostris*
Black Bittern	*Ixobrychus flavicollis*
Hooded Plover	*Thinornis rubricollis*
Glossy Black-Cockatoo	*Calyptorhynchus lathami*
Powerful Owl	*Ninox strenua*
Masked Owl	*Tyto novaehollandiae*
Sooty Owl	*Tyto tenebricosa*
Regent Honeyeater	*Xanthomyza phrygia*
White-footed Dunnart	*Sminthopsis leucopus*
Yellow-bellied Glider	*Petaurus australis*
Long-nosed Potoroo	*Potorous tridactylus*
Eastern False Pipistrelle (bat)	*Falsistrellus tasmaniensis*
Common Bent-wing Bat	*Miniopterus schreibersii*
Large-footed Myotis (bat)	*Myotis adversus*
Grey-headed Flying-fox	*Pteropus poliocephalus*
Greater Broad-nosed Bat	*Scoteanax rueppellii*

2.8 ABORIGINAL HERITAGE

Aboriginal heritage of the area was described as follows in a draft plan of management for Cudmirrah National Park (NPWS, 1999).

Swan Lake and Berrara Creek are situated within the lands of the Wandandian speaking people and Budawang/Murramarang tribes of the Dhurga language group. Today, the area is covered by the Jerrinja Local Aboriginal Land Council.

A 1997 survey of roads in the (then) Cudmirrah National Park (Kuskie, 1997a) found 20 Aboriginal sites in addition to nine sites previously recorded in the park. Most of the recorded sites are axe grinding grooves and artefact scatters. Shell middens and rock shelters have also been recorded in the park. The area is quite rich in Aboriginal sites due to its proximity to the coast, freshwater creeks and a variety of habitats that contain abundant food supply.

An important site is the Fishermans Rock Aboriginal complex on Berrara Creek, within the Conjola National Park. This consists of axe grinding grooves, a midden and an extensive artefact scatter. The site covers a large area but is threatened by erosion, souveniring of artefacts and lighting of picnic fires. Works have been undertaken to keep vehicles off the site. An interpretive shelter has been installed on site with a focus on Aboriginal cultural information. The Fishermans Rock site management plan (Kuskie, 1997b) has recommended other protection measures including erosion control works.

2.9 EUROPEAN HERITAGE

The non-Aboriginal history of the area includes occupation, logging, quarrying and grazing.

Selective logging of hardwoods such as Blackbutt and Turpentine was carried out in the catchments of Swan Lake and Berrara Creek prior to their reservation as national park. The logging has changed the structure of the forests and left numerous vehicle tracks.

Shoalhaven City Council's Heritage Study identified the following items of significance:

- Mondayong farm house, to the west of the lake
- Swan Cabins (The Springs) at Swanhaven
- Glanville family cemetery at Berrara

The predominance of small, freestanding cottages gives the three villages their present character as holiday centres.

2.10 RESOURCE USE

2.10.1 Waterways

Table 2-4 shows participation rates for recreational activities in the area.

The area's ocean beaches are very popular for swimming and surfing.

Recreational uses of Berrara Creek are limited by the small size of the waterway, but it is appreciated for its scenic value and the entrance is used for passive recreation and swimming. A small amount of recreational fishing and bait collection are done in the creek but the small size of the waterways limits fish stocks. Canoeing is also done in the creek. There is a public boat ramp in the creek, but the whole waterway is subject to an 8 knot speed limit.

Swan Lake is a larger waterway and supports a greater amount and diversity of recreation. The lake is used for swimming, recreational fishing and prawning, canoeing, recreational sailing, water-skiing and, to a lesser extent, use of personal watercraft (eg jet skis). In general, waterway usage increases greatly during the summer months and holiday periods. Prawning is limited by the history of lake entrance opening and closing.

There is some commercial fishing in the lake, with an average annual catch of almost 10 tonnes for the years 1984 to 1999. However, Table 2-5 shows that the catch varies greatly from year to year. This is probably related to the history of entrance opening in the years prior to fishing, as most species of commercial interest do not breed in the lake. In addition to the general statewide controls on the use of nets, there are two restrictions on the use of nets for specific areas of Swan Lake:

- the waters adjacent to Swanhaven are closed to all nets except prawn dip or scoop nets
- there is a closure on the use of prawn running nets in the entrance inlet and the southern part of the lake body.

Berrara Creek is closed to the use of nets other than dip or scoop nets, push or scissors nets and 6 metre hand hauled nets for taking prawns.

The lake and creek are currently not zoned (shown as uncoloured on the LEP map). However, all development within the waterways requires Council's consent under Clause 36 of the LEP and the lake body is designated as being of ecological sensitivity under Clause 21 of the LEP. This latter clause aims to minimise adverse impacts of development on natural features and ecological processes.

The bed of Swan Lake is Crown Land and is subject to the Crowns Lands Act 1989. The bed of Berrara Creek is National Park.

Table 2-4 . Percentage of survey respondents (238 in total - refer to section 1.6) that participate in various recreational activities in the Swan/Berrara area.

Area	*Activity*	*%*
Water based activities	Swimming/surfing in sea	92%
	Swimming in lake/creek	81%
	Fishing in lake/creek	58%
	Prawning	27%
	Canoeing/rowing boats	57%
	Water skiing	14%
	Jet skiing	2%
	Sailing	28%
	Other - beach fishing, watching others enjoy, model sail boat, snorkelling/diving, sailboarding, boating, dog swimming, studying wildlife, surfski, unspecified	12%
Foreshore activities	Picnics	56%
	Walking	89%
	Biking	65%
	Other - beachcombing, watching birds/wildlife, viewing scenery/enjoying peace/open air, art, jogging, dog walking, unspecified	6%
Other natural areas	Walking	79%
	Four wheel driving	18%
	Horse riding	1%
	Other - watching birds/wildlife/wildflowers, biking, motorbiking, unspecified	7%

Table 2-5. Commercial fish catch (kg) for Swan Lake (NSW Fisheries, unpublished)

	84/85	85/86	86/87	87/88	88/89	89/90	90/91	91/92	92/93	93/94	94/95	95/96	96/97	97/98	98/99
Finfish															
Bream, Black and Yellowfin	141	260	184	3,991	3,116	234	1,725	1,744	1,833	787	285	47	288	429	344
Drummer								6							
Eel, Longfin River							62	15	3,720					342	
Eel, Shortfin River								179	224					1,480	487
Eel, Short-finned Conger										70	1,008				
Eel, Unspecified				549		1,187	8		480						
Fish, Unspecified Estuary		42		272	306	4	27	4	81	18	34		55		2
Flathead, Dusky	30	146	18	146	164	152	20	277	2	14		3	27	26	16
Flathead, Unspecified							2			15					
Garfish, River			540	105	18	93	79	212	16						
Garfish, Sea				7											
Leatherjacket, Unspecified	7	1	10	927	550			5							
Luderick	75	2,168	933	9,972	15,252	722	1,633	1,481	1,562	461	455	208	2,200	887	2,750
Mullet, Fantail				1,267	255		1	78							
Mullet, Sea	601	2,797	7,344	5,781	6,385	597	5,273	9,745	3,572	2,370	1,446	1,133	7,778	6,072	4,293
Mullet, Unspecified								289	30						
Mulloway				1	4			38							
Shark, Unspecified		250	2			9									
Silver biddy				934	285			1,351							
Snapper			3	59	79										
Stingray								10							
Tailor	21	71	126	609	988	15	34	40	60	35			15		
Tarwhine	14	7	11	1,719	434			34		4	4		4		3
Trevally, Silver		2	63	534	285		3	140					4		2
Whiting, Sand	8	40	11	438	690	21	17	724	3				1		1
Whiting, Trumpeter				4	8			25							
Yellowtail				239											
Finfish Total	*897*	*5,784*	*9,245*	*27,554*	*28,819*	*3,034*	*8,884*	*16,397*	*11,583*	*3,774*	*3,232*	*1,391*	*10,372*	*9,236*	*7,898*
Molluscs															
Shellfish, Unspecified		11													
Squid				176											
Molluscs Total		*11*		*176*											
Crustaceans															
Crab, Mud	17	103		3		3	1	4				2			
Crab, Sand				2											
Prawn, Eastern King								59						11	333
Prawn, Greasyback														54	1
Prawn, School								11						44	
Prawn, Unspecified Estuary							93	56							
Crustaceans Total	*17*	*103*		*5*		*3*	*94*	*130*				*2*		*109*	*334*
Lake Total	*914*	*5,898*	*9,245*	*27,735*	*28,819*	*3,037*	*8,978*	*16,527*	*11,583*	*3,774*	*3,232*	*1,393*	*10,372*	*9,345*	*8,232*

2.10.2 Land

Swan Lake, Cudmirrah and Berrara are popular tourist destinations for families, caravanners and water skiers. Tourist accommodation is restricted to the letting of a small number of holiday houses, cabins, and a range of caravan, cabin and camping accommodation in the five caravan parks. The peak tourist season is over the summer holiday period. The area is connected to the Sussex Inlet sewerage system.

Land use in the area is subject to the Illawarra Regional Environmental Plan No 1 and the Shoalhaven Local Environmental Plan (LEP) 1985. Figure 2-6 shows the land use as at May 2001 and the area of land in the catchments is summarised in Table 2-6.* Land ownership is shown in Figure 2-7.

Within the villages, there is a mix of urban zones, with most of the ocean foreshore zoned for recreation.

Approximately 98% of the Berrara Creek catchment and 65% of the Swan Lake catchment is reserved as national park. A plan of management for the national park is being prepared by the NPWS.

Most other public land is Crown land managed by the Department of Land and Water Conservation or Shoalhaven City Council.

These areas of public land, in addition to their conservation values, may be used as a recreational resource (especially for walking and nature observation) by residents and visitors (table 2-4).

There are areas of unreserved Crown land west of Cudmirrah that have been zoned for residential use under the Shoalhaven LEP. A Crown land assessment is currently being undertaken by the Department of Land and Water Conservation to determine the capabilities of this land and identify the preferred future uses which may include residential, community or public purposes, environmental protection and nature conservation. The draft assessment will be exhibited for public comment before being finalised.

Most privately owned land that is zoned for residential development has been built on, but about half these dwellings are not permanently occupied (SCC, undated).

Table 2-6 Zoning categories and land areas as at May 2001 (see notes on next page).

Land Use Category	Approx. land area (hectares) in Swan catchment	Approx. land area (hectares) in Berrara catchment
Zoned 1 (c2) Rural deferred from LEP Amendment 127	144.6	
Zoned 1 (d) Rural (General Rural)	195.0	
Zoned 2 (a1) Residential	28.7	27.8
Zoned 2 (b1) Residential (flats)	0.5	
Zoned 2 (c) Residential (Living Area)	21.0	11.9
Zoned 2 (d) Residential (tourism)	10.7	5.8
Zoned 6 (a) Open Space – Recreation (Existing)	150.9	8.9
Zoned 6 (c) Open Space – Recreation (Proposed)	5.4	0.4
Zoned 7 (a) Environment Protection (Ecology)	59.9	
Zoned 7 (d1) Environment Protection (Scenic)	3.1	
Zoned 7 (d2) Environment Protection (Special Scenic)		0.3
Zoned 7 (f2) Environment Protection (Coastal Reservation)	35.9	
National Park	2055.7	3605.8

*notes

1. In Table 2-6 and Figure 2-6 recently created national park has been subtracted from the other zones and added to the area shown as national park. Thus the national park category includes some areas that have not yet been rezoned to national park even though that is the actual land use.
2. The areas shown in the table generally do not include road reserves which are mostly unzoned. This is particularly relevant to the residential zones where inclusion of the road reserves would increase the apparent area of urban land significantly.
3. Not all land zoned for a particular use (eg, residential) has necessarily been developed for that use.

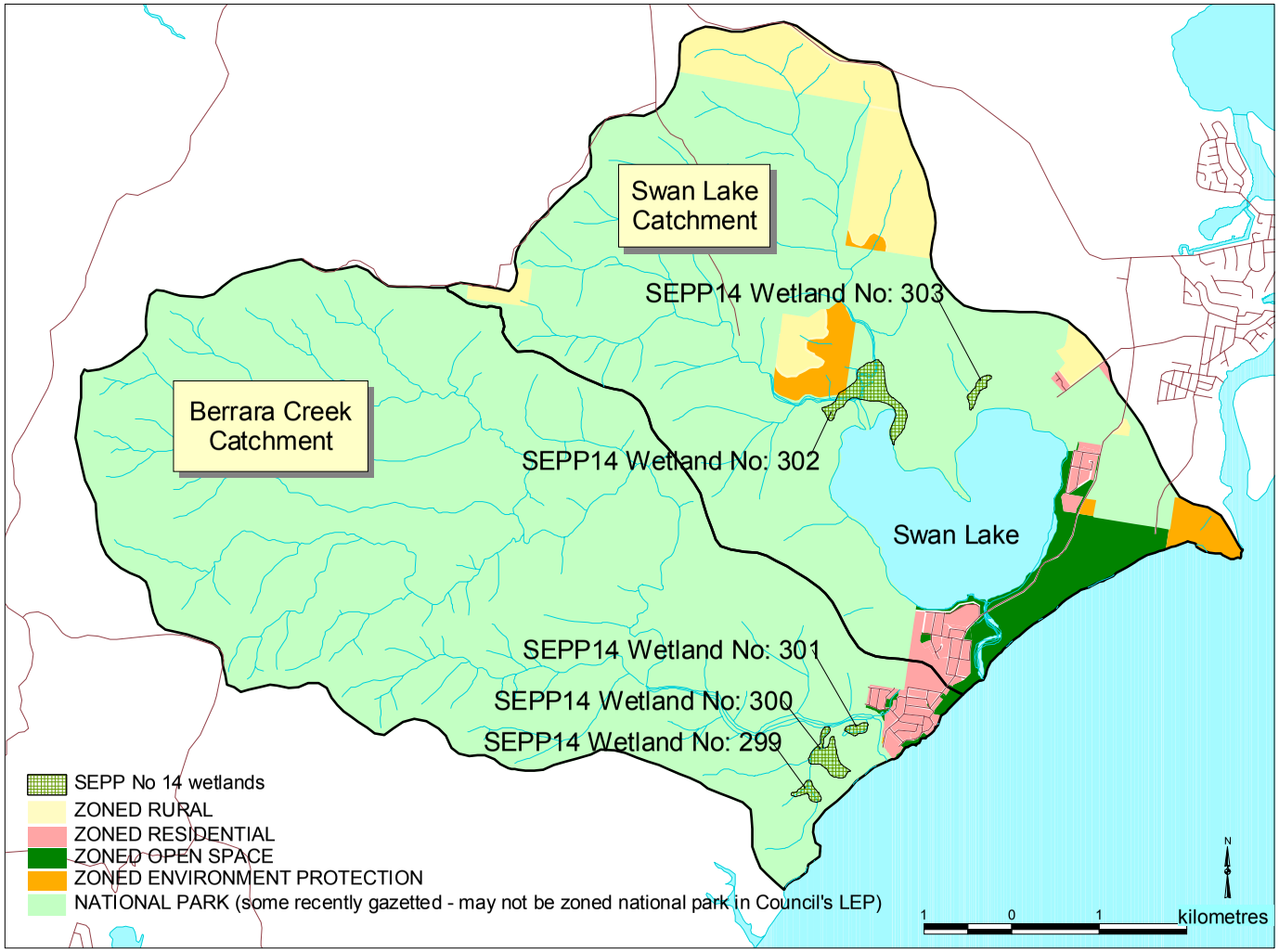

Figure 2-6. Land use in Swan Lake and Berrara Creek catchments

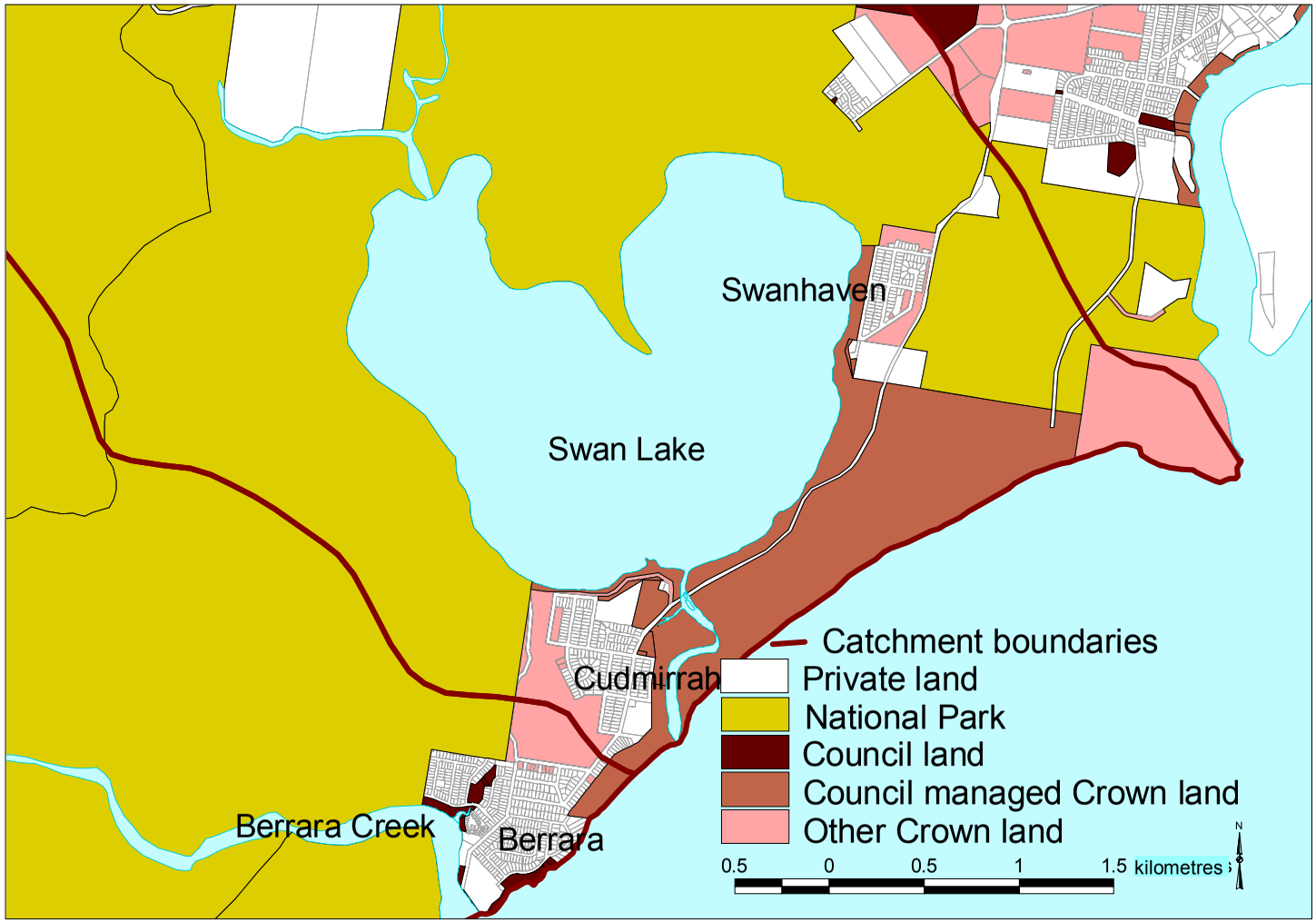

Figure 2-7. Land ownership in the eastern part of Swan Lake and Berrara Creek catchments. (The western part of Swan Lake catchment has large areas of national park with some private rural residential land in the north. The western part of Berrara Creek catchment is all national park.)

3 VALUES AND ISSUES

3.1 VALUES - WHAT'S IMPORTANT ABOUT THE PLACE

To equitably manage a resource requires identification of the key ecological, social and economic values that people with an interest in the area consider important and wish to see preserved into the future. Values can be important in a local, regional or national sense.

Through identification of the values of the area's resources and the threats to the condition of the resources, objectives for future management of the area can be developed.

Table 3.1 contains statements of what is important about Swan Lake, Berrara Creek and their catchments. They have been taken from records of public meetings, Task Force meetings and from other research on the area. These are what the Swan/Berrara Natural Resources Management Strategy will be trying to protect.

3.2 ISSUES - THINGS THAT MIGHT DETRACT FROM VALUES

Key issues and conflicts associated with the area were identified by the community, task force members, Shoalhaven City Council and NSW Government representatives, and from previous studies and reports.

Concerns have been raised about pressures on some of the area's natural resources and degradation that may occur in the future.

Table 3.2 contains a range of issues or problems, which, if left unchecked, might damage those things about Swan Lake, Berrara Creek and their catchments that we want to retain. They are discussed in detail in the management plan section of this NRMS and, where appropriate, management actions are proposed for dealing with them.

3.3 COMMUNITY OPINIONS

To help with the preparation of the Swan/Berrara NRMS, a questionnaire was distributed to gauge the Swan/Berrara community's opinions on a draft set of values and issues, and to collect information on recreational use of the area's natural resources and the history of Swan Lake entrance opening.

Approximately 1300 papers were distributed in February 2001 by the following means:

- letterbox drop at Cudmirrah, Swanhaven, Berrara and surrounding rural areas
- mail to all ratepayers with a postal address outside the catchments
- delivery to five caravan parks in the catchments
- mail to others that have expressed an interest in natural resource management of the area, including private citizens, non-government organisations, Federal and State agencies, local politicians, all councillors and many council staff.

243 responses were received by the end of March 2001.

The percentages of responses for each value and issue are presented in the following tables sorted according to community ratings. The rating order was established by creating an index that takes into account the number of ticks in the first three boxes. To calculate the index, for each questionnaire a score of plus one was attributed to a tick in the first column, zero to a tick in the second column and minus one to a tick in the third column, and these were summed for all questionnaires. The index is then the sum of these three values. For

ease of comparison, this value was then divided by the total number of questionnaires returned so that the index is a number between one and minus one. The list below is ordered according to the index. This gives a slightly different order to that resulting if they were to be ordered according to just the first column or just the last column, but is a fairer representation of what the community as a whole thinks because it takes into account scores for all three columns. The categories of most highly rated, moderately highly rated and least highly rated have been arbitrarily assigned to break up the list a little.

Table 3-1. Things that people value about Swan Lake, Berrara Creek and their catchments.

Values	importance			
	high	medium	low	index
Most highly rated				
The scenic quality of the lake, creeks, foreshores, dunes, beaches and headlands	95.1%	4.1%	0.8%	0.94
Water quality of the lake and creeks	94.7%	4.5%	0.4%	0.94
Populations of water birds, fish and other aquatic animals	88.5%	9.9%	0.8%	0.88
The landscapes to the west and south	86.0%	10.7%	2.5%	0.84
Swimming	85.2%	10.7%	2.5%	0.83
Healthy seagrass, algae and foreshore vegetation	83.1%	14.0%	2.1%	0.81
Habitat for threatened and common native animals and plants	82.3%	14.8%	1.2%	0.81
Moderately Highly Rated				
Recreational destination for families with a safe environment for young children	81.9%	12.3%	3.3%	0.79
The forests in the west and south of the catchments	81.1%	16.0%	2.1%	0.79
The coastal bushland adjacent to the villages	80.2%	16.5%	2.5%	0.78
Relative isolation and small size of Swanhaven, Cudmirrah and Berrara	81.9%	9.5%	7.0%	0.75
The wetlands around the lake	77.0%	16.9%	4.1%	0.73
Nature-based recreation, such as bird watching or walking, in the bush and parks	75.3%	18.5%	4.5%	0.71
Low key, coastal residential lifestyle	75.7%	17.7%	5.8%	0.70
Least Highly Rated				
Sailing/canoeing	67.1%	24.7%	7.0%	0.60
Native animals in the villages	66.3%	24.3%	8.2%	0.58
Fishing	59.7%	25.9%	11.1%	0.49
Aboriginal sites around the foreshore areas	44.0%	28.8%	25.1%	0.19
Old style free standing cottages and holiday cabins	27.6%	39.1%	31.3%	-0.04
Water skiing	16.9%	15.2%	62.6%	-0.46
Jet skiing	7.4%	4.9%	79.4%	-0.72

Table 3-2. Natural resources management issues at Swan/Berrara.

Issues	major issue	small issue	not an issue	don't know	index
Biggest issues					
Sewage disposal or potential overflows	86.0%	6.6%	2.5%	4.5%	0.84
Introduced animals including foxes, cats, black rats and rabbits	83.5%	11.9%	1.6%	2.5%	0.82
Littering and dumping of garden and other waste in the bush and foreshores	81.5%	14.4%	0.8%	2.1%	0.81
Pollutants in the stormwater run off from villages	78.2%	13.2%	4.1%	3.7%	0.74
Public health risks in the lake and creeks from bacterial contamination	77.0%	14.8%	3.7%	4.1%	0.73
The threat to fish stocks from commercial fishing	76.5%	12.3%	4.5%	5.8%	0.72
Loss or degradation of sensitive ecosystems and habitat for animals and plants	73.7%	20.2%	4.1%	1.2%	0.70
Moderately Rated Issues					
Pollutants from rural residential areas	71.6%	17.3%	4.1%	6.2%	0.67
The spread of weeds in native bushland and on foreshores	69.1%	23.0%	3.3%	3.7%	0.66
Whether or not the lake is allowed to open naturally	67.1%	18.1%	4.5%	9.1%	0.63
Dogs and cats roaming free in villages and bush	71.6%	14.8%	11.1%	2.1%	0.60
Clearing of foreshore vegetation	62.6%	26.7%	7.8%	2.1%	0.55
Unauthorised opening of the lake to the sea	64.2%	16.0%	10.7%	8.2%	0.53
Water level at which the lake is opened by Council	53.5%	21.0%	10.7%	11.9%	0.43
Noise from powerboat and jet ski usage	56.8%	25.1%	14.0%	1.6%	0.43
Disturbance of wildlife by boaters	56.0%	25.9%	13.6%	3.3%	0.42
Foreshore erosion	49.4%	37.4%	8.2%	4.1%	0.41
Odours from the lake	55.1%	24.7%	16.0%	2.1%	0.39
Conflict between swimmers and boaters	50.6%	30.5%	12.8%	4.1%	0.38
Illegal access to and camping on the foreshore	44.9%	39.5%	11.1%	2.9%	0.34
Least Highly Rated Issues					
Standard of recreational facilities such as picnic areas	42.4%	42.0%	13.6%	0.4%	0.29
Erosion from unsealed roads, verges and driveways in urban and rural areas	39.5%	44.0%	11.9%	3.3%	0.28
Location at which the lake is opened to the sea	43.2%	23.0%	18.5%	12.3%	0.25
Damage to aboriginal sites	42.0%	30.5%	17.3%	8.2%	0.25
Overcrowding and overuse of the recreational areas	42.8%	32.5%	19.8%	1.6%	0.23
Standard of boating facilities such as boat ramps	25.9%	45.3%	24.3%	3.3%	0.02
The threat to fish stocks from recreational fishing	22.2%	38.7%	33.3%	4.9%	-0.11

4 MANAGEMENT PLAN

4.1 STRUCTURE OF PLAN

This management plan is grouped into six management areas:

1. Water Quality
2. Erosion and Sedimentation
3. Nature Conservation
4. Entrance Management
5. Recreation
6. Visual Quality

Each management area is discussed in further detail in the following sections. For each management area the plan contains values, objectives, issues, strategies and actions.

Values are statements of what is important about Swan Lake, Berrara Creek and their catchments. These are what the Swan/Berrara Natural Resources Management Strategy will be trying to protect.

Management **objectives** were developed to ensure that the area's key values are maintained or improved. The objectives developed address the seven management areas identified.

The **issues** of concern are documented in detail. Issues are problems, which, if left unchecked, might damage those things about the area that we want to retain.

Management **strategies** have been written to achieve the management objectives by addressing identified issues.

Actions required to implement the strategies are detailed for each management area, as are the environmental **performance measures** necessary for gauging the effectiveness of the actions in achieving environmental outcomes.

The various actions consist of:

- planning and development controls
- protective and remedial works
- education programs
- monitoring and research.

4.2 IMPLEMENTATION

Responsibility for implementation of the Management Plan and its individual components lies with the various organisations and individuals listed in the strategy and action tables for each management area. The Swan/Berrara Estuary Management Task Force will oversee this implementation.

Following adoption, the task force will work with government departments, community groups, the Southern Catchment Management Board and funding agencies to implement the plan.

Regular meetings will be required to assess the progress of implementation. Task Force members (community and government) will have responsibility for doing the work, or organising others to do the work.

Timing for implementation of strategies is indicated. Three timeframes for implementation were chosen: short (present to June 2004), medium (July 2004 to June 2007) and long term (July 2007 to June 2012).

Implementation will depend on cost of the strategies and available funds. Consequently, some low priority strategies may be implemented in the short term because they require little or no additional funding for implementation. Indicative costs of strategies are given in the tables.

4.3 FUNDING SOURCES

Council and NSW Government agencies provide funding to implement the actions set out in the NRMS. However, the level of resourcing

provided will depend on the availability of funding.

A wide range of funding sources (both State and Commonwealth) is presently available to assist with implementation of this NRMS. Tables 4-1 and 4-2 indicate State and Commonwealth funding programs respectively and the administering Department.

Some of these programs accept grant applications at any time during the year whilst others have fixed submission periods. The organisations and individuals responsible for implementation of the NRMS will have to develop and submit applications for funds in a timely manner.

4.4 ADAPTIVE MANAGEMENT - REVIEW

The Management Plan will be reviewed on an annual basis. The success of the NRMS will be judged against specific environmental performance measures and targets developed to assess actions and strategies against objectives. The NRMS will be updated as new data and feedback from the performance measures become available, as strategies are implemented and as community values or issues change.

Table 4-1 State Funding Sources

Department	Program
Department of Land and Water Conservation	• Estuary Management Program • Coastal Management Program • Waterways Program • Floodplain Management Program • Native Vegetation Incentive Program • Public Reserves Management Fund • Country Towns Water Supply and Sewerage • Farming for the Future
Waterways Authority	• Waterways Asset Development and Management Program
Roads and Traffic Authority	• Roadside Vegetation Corridors
NSW Fisheries	• Recreational Fishing Trusts • Fisheries Conservation Trust • Weir Review Program
EPA	• Environmental Trust • Stormwater Trust

Table 4-2 Commonwealth Funding Sources

Department	Program
Agriculture, Fisheries and Forestry Australia	• Natural Heritage Trust (including Fisheries Action Program, National Landcare Program, etc)
Environment Australia	• Natural Heritage Trust (including Coast and Clean Seas, Bushcare, etc)
Dept of Employment	• Work for the Dole • Community Work
Conservation Volunteers Australia	• Green Corps

5 WATER QUALITY

5.1 VALUES

Water quality is one of the key factors determining the ecological character of an estuary. It is also important to people using the estuary for recreational or commercial purposes and for those living on its foreshores and adjacent areas.

The waters of Swan Lake and Berrara Creek are important in supporting a range of plants and animals. The water quality of Swan Lake is generally excellent. The water quality of the Berrara Creek is generally good. A summary of water quality information from council's 1998/2000 State of the Environment Report is shown in Figures 5-1 to 5-7.

If the biological communities and habitats of ecological value found in the creek and the wide variety of recreational opportunities are to be maintained, it is essential the water is of an acceptable standard.

The guideline values in figures 5-3 to 5-7 are based on ANZECC 1992 (Australian Water Quality Guidelines for fresh and marine waters) and NHMRC guidelines for recreational waters. In some cases, such as for nutrients, a value has been chosen from the range given in ANZECC based on background data for the Shoalhaven generally. These have proven to be reasonably consistent with broad guideline values suggested by the EPA as part of the water reform process and interim water quality values.

The 2000 ANZECC Australian Water Quality Guidelines for fresh and marine waters are a lot more complex and suggest a determination of trigger values based on background investigation, but the default low risk trigger values are similar for estuaries eg TP 0.03 mg/l (Shoalhaven .05) and TN 0.3 mg/l (Shoalhaven 0.5). Based on work carried out on a number of intermittently open south coast lakes (eg, Wiecek 2001), there is some evidence that the natural background levels of nutrients in Swan Lake are likely to be higher than other types of estuaries and this does not necessarily mean that there is any problem. To establish appropriate low risk trigger levels that take account of the natural attributes of the waterway (including high background levels of nutrients), extensive work would need to be done specifically on Swan Lake.

5.2 OBJECTIVES

To ensure that water quality in the creeks is adequate for the protection of:

- aquatic ecosystems,
- visual amenity,
- primary contact recreation,
- secondary contact recreation, and
- human consumers of cooked fish, shellfish and crustaceans[1].

5.3 ISSUES

If water quality is not protected, several key estuarine attributes can degrade as follows:

- the ecology of an estuary (i.e. the diversity and abundance of plant and animal communities) may degrade if water quality levels deteriorate sufficiently (e.g. excessive sediment levels in the water may degrade seagrass beds, which in turn may affect fish and prawn populations)
- the visual characteristics and aesthetic appeal of estuarine water may diminish (eg the water may appear 'dirty', or contain nuisance algae)

[1] This objective is based on the NSW Government's water quality interim environmental objectives.

- the recreational characteristics of an estuary may be seriously affected (e.g. people do not want to swim in 'dirty' water)

Local industry which relies on existing attributes of an estuary may be affected through reduced tourist interest.

Other issues investigated during the preparation of this NRMS were:

- The Swan Lake Inlet has high levels of nitrogen which may explain the growth of macroalgae seen in this area. However the biomass of macroalgae in the main body of Swan Lake was considered by McConville (2000) to be relatively low when compared to Lake Illawarra and Lake Wollumboola. Observations of similar lakes with little or no nearby development, such as Termeil and Meroo, have shown similar nutrient levels. The naturally poor flushing characteristics of these lagoons may be a factor here.
- The drainage line that runs into Berrara Creek between Waterhaven Ave and Meadow Lake Avenue repeatedly shows higher levels of contamination from urban runoff (high faecal coliforms and low dissolved oxygen). The dilution of this creek with Berrara Creek as well as the flushing effect of the ocean (when the creek is open) significantly reduces the pollutant loads down stream (so as to be undetectable).
- Occasional overflows of sewage into waterways have occurred.
- Expected population growth will require increased capacity in sewage treatment facilities if water quality is to be protected.

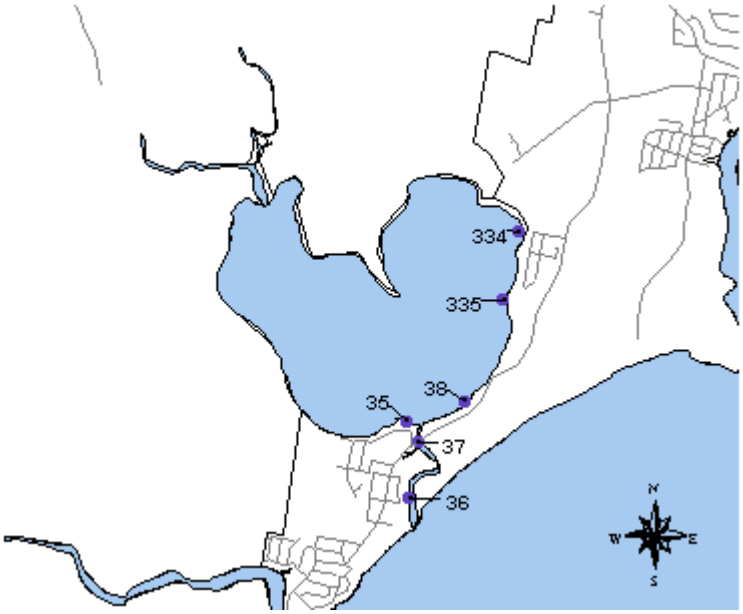

Figure 5-1 - Water Quality Sampling Locations for Swan Lake Catchment

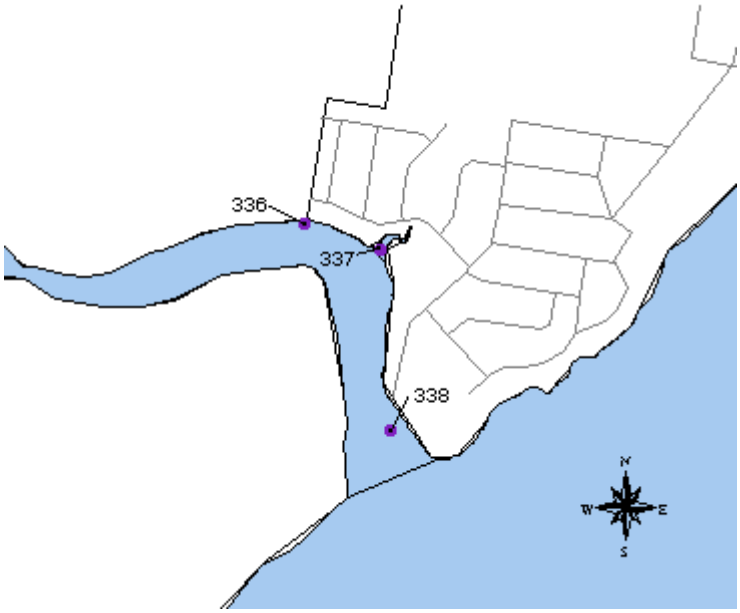

Figure 5-2 - Water Quality Sampling Locations for Berrara Creek Catchment

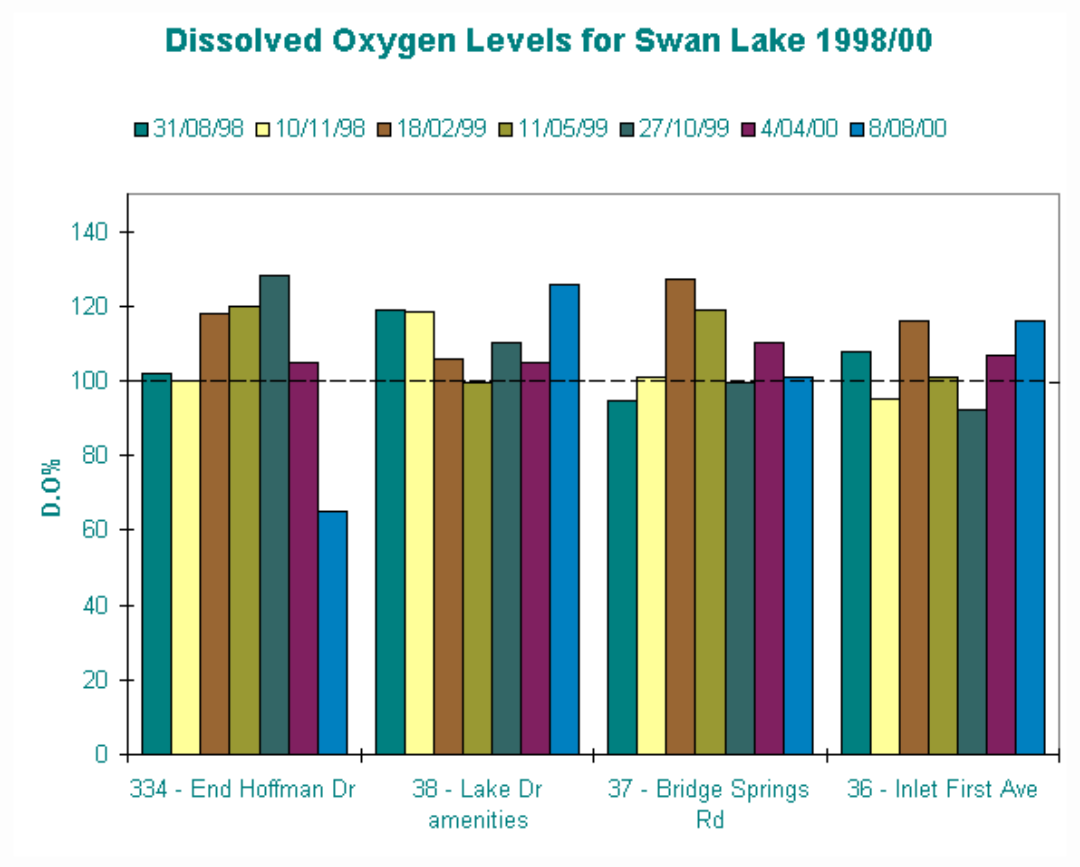

Figure 5-3 - Dissolved Oxygen Levels Swan Lake

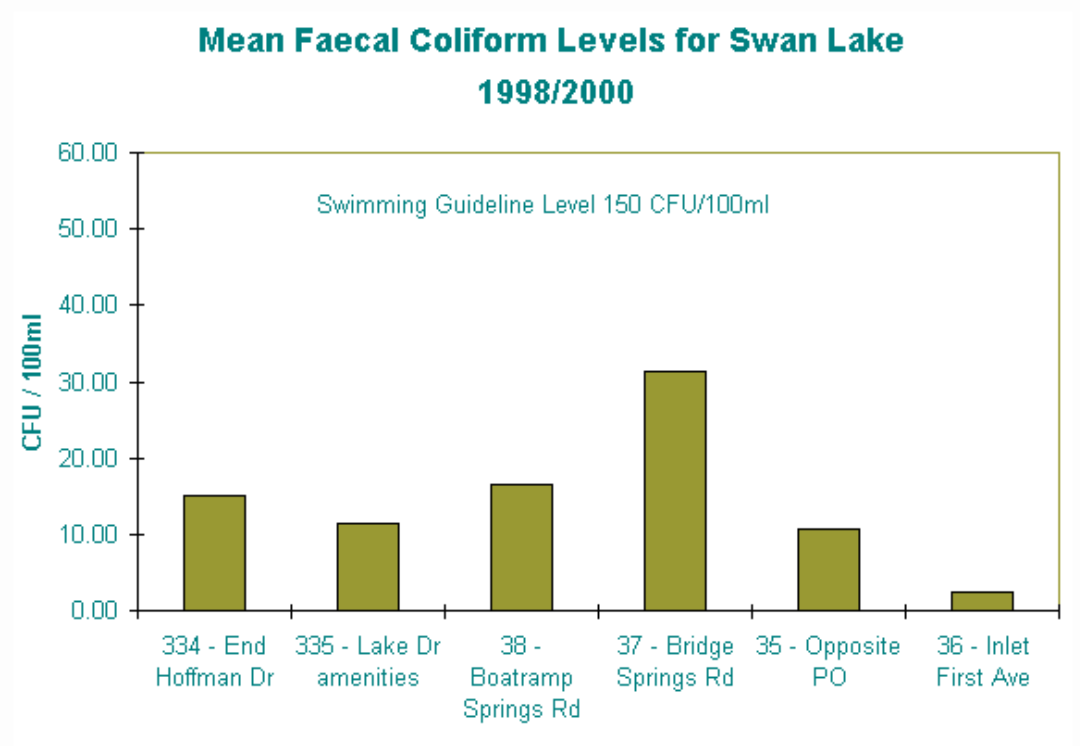

Figure 5-4 - Mean Faecal Coliform Levels Swan Lake

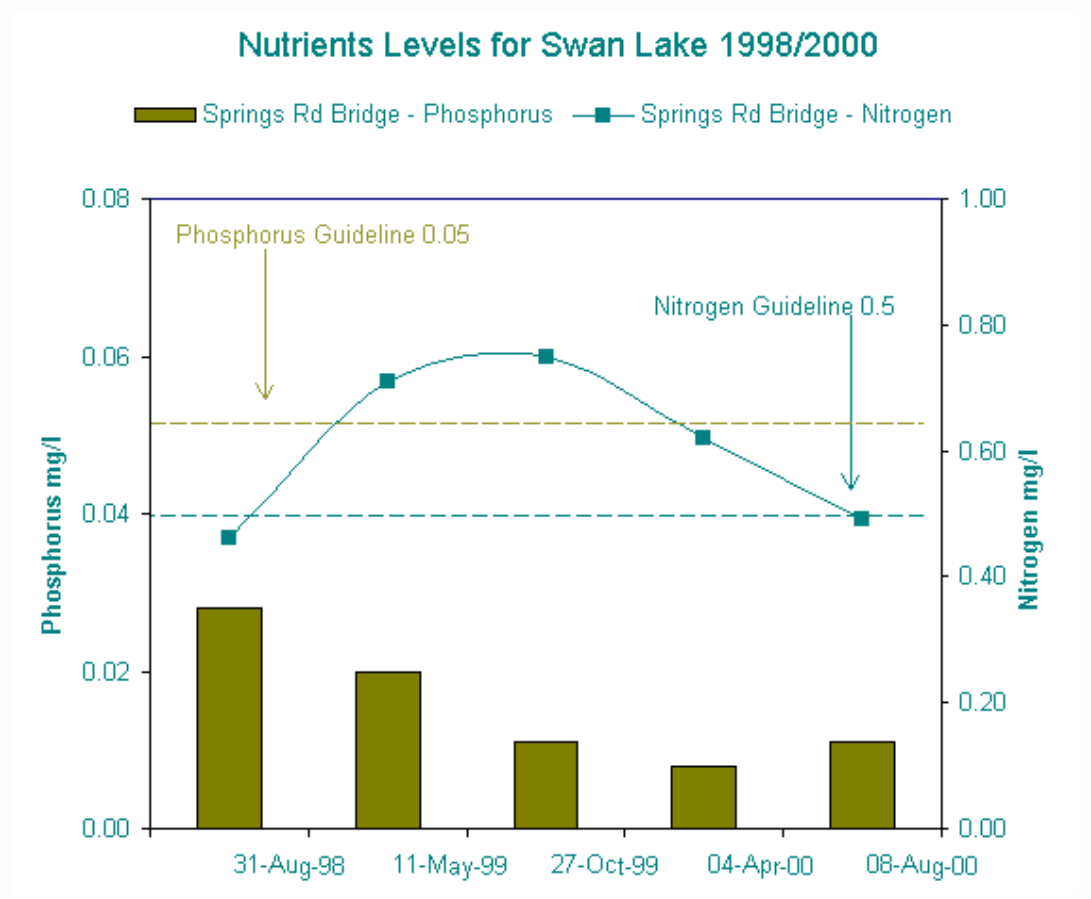

Figure 5.5 - Nutrient Levels Swan Lake

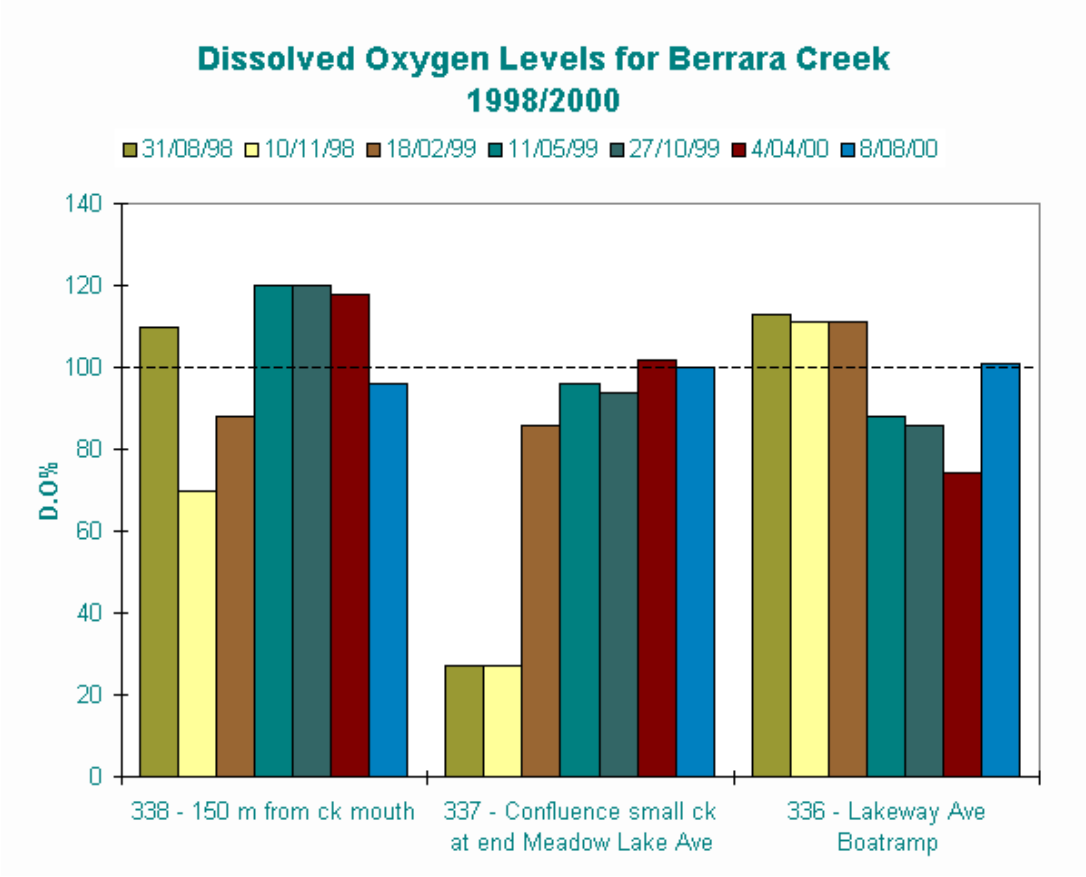

Figure 5.6 - Dissolved Oxygen Berrara Creek

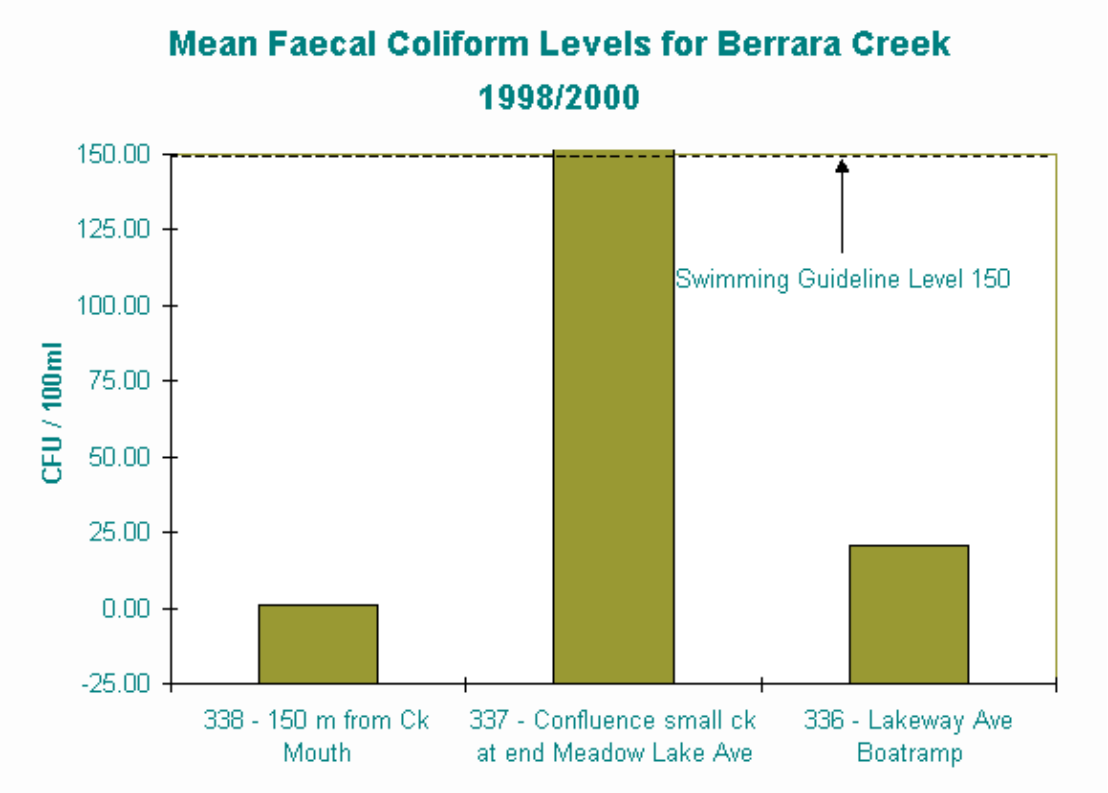

Figure 5.7 - Mean Faecal Coliform Levels Berrara Creek

5.4 STRATEGIES

Strategy	Action	Priority	Timing	Estimated Cost	Responsibility	Performance Evaluation
WQ1 - Minimise sewage contamination of Swan Lake and Berrara Creek from existing sewage management systems	1. Review council data on sewage overflows	High	Short	$1000	SCC	Data reviewed
	2. Investigate options for bunding at overflow points	Medium	Short	$2000	SCC	Bunding options established
	3. Identify source of contamination of drainage line that runs into Berrara Creek between Waterhaven Ave and Meadow Lake Avenue	High	Short	$5000	SCC	Source of contamination identified
	4. Review cost-effective measures for reducing sewage contamination of waterways	High	Short	Uncosted	SCC	Review completed
	5. Continue to monitor Lake and Creek for indication of sewage contamination	High	Ongoing	No additional cost	SCC Community	Quarterly testing completed
WQ2 - Improve system for reuse and disposal of effluent from reticulated sewerage scheme	6. Augmentation of existing facilities by using open basin sand dune exfiltration system, subject to environmental impact assessment	Medium	Depends on availability of funds	$833,000	SCC DLWC	Augmentation completed, subject to environmental impact assessment
	7. Further investigate reuse of some reclaimed water on Thomson Street Reserve, Sussex Inlet	High	Short	$30,000	SCC	Investigation completed

Strategy	Action	Priority	Timing	Estimated Cost	Responsibility	Performance Evaluation
	8. Increase awareness amongst rural land owners on possible uses of water reclaimed from sewage	Medium	Medium	-	SCC	Consultation completed
WQ3 - Control other pollutants at source	9. Educate pet owners to collect animal faeces and dispose of in sewer or compost	Medium	Medium	$1000	SCC	Education program completed
	10. Educate residents on appropriate use of chemicals and fertiliser in house and garden	Medium	Medium	$1000	SCC Community	Education program completed
	11. Ensure minimal sediment and nutrient export from all new developments in rural areas	High	Short	No public cost	SCC	Development controls in place
	12. Ensure that areas with high risk of acid sulfate soils are not drained or excavated without appropriate development controls	High	Ongoing	Uncosted	SCC	No acid runoff to creek
WQ4 - Minimise pollutant transport in stormwater drains	13. Retain vegetation lining in 'soft' drains	High	Short	No additional cost	SCC	Strategy adopted by Council
	14. When necessary, remove sediment from drains in sections, leaving time for one section to recover before disturbance of next section	Medium	Short	No additional cost	SCC	Strategy adopted by Council
	15. Ensure new or remodelled drains are designed with adequate capacity to incorporate vegetation	Medium	Medium	Variable	SCC	SCC internal design guideline adopted

Strategy	Action	Priority	Timing	Estimated Cost	Responsibility	Performance Evaluation
	16. Continue to educate Council field staff in best practice for stormwater management	Medium	Short	$1000	SCC	Education program completed
	17. Use best practice sediment controls when working in drains	High	Short	No additional cost	SCC	SCC internal design guideline adopted
	18. Investigate need for devices to intercept pollutants at stormwater outlets in Goonawarra Drive, Collier Drive, Koolyn Drive, Lakeland Avenue and Waterhaven Avenue	Low	Medium	$1000	SCC	Investigation completed
WQ5 - Ensure boating is not contaminating lake water	19. Test lake water for contaminants indicative of fuel and boat motor exhaust and if necessary investigate methods of control	Medium	Short	$2000	SCC	Testing completed
WQ6 – Monitor water quality	20. Continue monitoring of water quality in lake and creek and inform task force of results	Medium	Ongoing	No additional cost	SCC	Quarterly testing completed
	21. Investigate information requirements for utilisation of 2000 ANZECC Australian Water Quality Guidelines	Medium	Medium	Uncosted	SCC	Investigation completed
WQ7 - Educate residents and visitors on stormwater issues and solutions	22. Implement Stormwater Management Plan education initiatives	Medium	Short	Refer Stormwater Management Plan	SCC	Education programs completed

6 EROSION AND SEDIMENTATION

6.1 VALUES

Stable soils and creek banks mean that land remains productive, either for sustaining ecological communities or supporting human uses. Coastal waterways are subject to some natural infilling by sediment transported from the catchment and eroded from banks.

6.2 OBJECTIVES

To minimise the erosion of soil from the catchments and creek banks and to protect Swan Lake and Berrara Creek from excessive sedimentation.

6.3 ISSUES

Accelerated sediment deposition has a detrimental effect on ecology of waterways.

The sediment loads of Swan Lake and Berrara Creek are contributed to from erosion of tracks and old gravel pits in the national park, as well as erosion of unsealed road verges and stormwater drains in the villages and rural residential areas.

Soil washed or driven off building sites enters the stormwater system and ultimately the waterways.

There is bank erosion in some of the more heavily used recreational areas on the eastern shore of Swan Lake.

There is bank erosion adjacent to the Berrara Creek Flats Reserve.

6.4 STRATEGIES

Strategy	Action	Priority	Timing	Estimated Cost	Responsibility	Performance Evaluation
ER1 - Accommodate natural processes of lake and creek bank erosion and accretion, but reduce human-induced erosion	23. Ensure new developments comply with development control plan for foreshores and statutory requirements	High	Case by case	Variable	SCC DLWC	No further encroachment on creek banks
	24. Disallow further development that would cause lake or creek bank erosion and retain and/or re-establish riparian vegetation along creek banks	High	Ongoing	-	SCC DLWC	Erosion reduced
ER2 - Reduce amount of sediment entering the creeks, lake and wetlands from the catchments by controlling erosion at its sources	25. Undertake sediment and erosion control on building sites	Medium	Short	Variable	Builders SCC	Best management practices widely used
	26. Educate builders on appropriate soil, waste and water management on building sites	Medium	Short	$1000	SCC	Education program completed
	27. Enforce anti-pollution laws on building sites and other areas where there is soil disturbance	High	Ongoing	-	SCC	Minimal soil washing from building sites
	28. Develop a strategy between Council and the community for the stabilisation and vegetation of unsealed road verges in urban areas	High	Short	$5000	SCC	Strategy agreed and adopted

Strategy	Action	Priority	Timing	Estimated Cost	Responsibility	Performance Evaluation
	29. Stabilise unsealed road verges in the village and rural areas	High	Short	$20000	SCC	No soil mobilised from road verges
	30. Maintain vegetation in road verges to minimise erosion and trap pollutants	High	Short	-	Community SCC	Stable vegetation road verges
	31. Stabilise fire trails and other unsealed vehicle tracks	Medium	Medium	$50000	NPWS DLWC SCC Integral Energy	Track upgrade complete
	32. Stabilise access road to Swanhaven boat ramp reserve (Springs Reserve)	Medium	Short	$2000	SCC	Road stabilised
	33. Stabilise old gravel pits in national park	Medium	Medium	$30000	NPWS	Pits stable

7 NATURE CONSERVATION

7.1 VALUES

Swan Lake, Berrara Creek and their catchments support a range of relatively undisturbed ecological communities, which is important from a conservation perspective and is also an attractive attribute of the area for many residents and visitors. The following specific nature conservation values were identified during the preparation of this NRMS:

1. Swan Lake, Berrara Creek and their catchment support a great variety of habitats. The area is known to be a biodiversity hotspot, with nearly 500 plant species, 150 bird species, and at least 23 native mammal species known to occur in the area.
2. There is little development in the catchments and large areas of land remain in unspoilt condition with their original floristic composition and structure. Most of the catchment areas lie in the Conjola National Park.
3. The fish, shellfish, crustaceans and other aquatic species are a valuable resource. There are links between the animal populations that live in the lake and creeks and those in the sea.
4. Healthy seagrass, algae and foreshore vegetation provide important habitats, oxygenate the water and assist to stabilise the sediments on the lake and creek beds.
5. A range of internationally protected wading birds use the foreshore vegetation, sand and mud flats, rocky shores, beach sands and wetlands for feeding, resting and breeding sites. Large populations of swans and other water birds are present on the lake when conditions are favourable. Over 10,000 White-eyed Duck (*Aythya australis*) were recorded in August-September 2001, as well as large numbers of Black Swan (*Cygnus atratus*) which represent the overflow from Lake Wollumboola (Coast and Wetlands Society, 2002). The lake is home to White Bellied Sea Eagles (*Haliaeetus leucogaster*) and, at certain times of the year, to migratory species including Spine-tailed Swift (*Hirundapus caudacutus*) and Whiskered Tern (*Chlidonias hybrida*), as well as Little (*Ardea garzetta*), Intermediate (*Ardea intermedia*) and Great Egret (*Ardea alba*). These species are variously covered by international agreements (CAMBA/JAMBA/Bonn Convention), and/or protected under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 and the NSW National Parks and Wildlife Act 1974."
6. Wetlands to the north of Swan Lake and at the mouths of Mondayong and Teatree Creeks are protected under Coastal Wetlands State Environmental Planning Policy No 14. Other wetlands to the west and south are also significant.
7. Other vegetation types include heathlands, woodlands and some forests. Significant Bangalay-rainforest vegetation is present on the sand dunes to the east of Swan Lake.
8. Populations of a number of rare or threatened plant and animal species are known to exist in the area. These include Black Bittern, Pied Oystercatcher, Sooty Oystercatcher, Osprey, Hooded Plover, Powerful Owl, Glossy Black Cockatoo, Regent Honeyeater and the saltmarsh plants *Wilsonia backhousia* and *Wilsonia rotundifolia*. The Hooded Plover (Endangered) and Pied

Oystercatcher (Vulnerable) have been recorded nesting at the entrances to both Swan Lake and Berrara Creek. They nest from October to February and may be affected if the lake is opened artificially during this time. This is one of the most important locality of Hooded Plovers in Australia (NPWS, 2002).

9. Native animals can still be seen *in* the villages.

7.2 OBJECTIVES

To maintain or, where appropriate, restore the ecological integrity and biodiversity of Swan Lake, Berrara Creek, their foreshores and their catchments.

7.3 ISSUES

The issues investigated during the preparation of this NRMS were:

1. Introduced animals, including foxes, domestic and feral cats and dogs, black rats and rabbits, threaten native animal and plant populations.
2. Weeds, although scarce overall, are prevalent in some areas where they threaten native plant communities.
3. Dumping of garden refuse and other material causes damage to bushland. This dumping is illegal. Council officers are authorised to take action against dumpers and can issue on-the-spot fines.
4. Artificial opening of Swan Lake to the sea affects the natural fluctuations in populations of fish and other aquatic species and affects foreshore vegetation and wetlands. This is dealt with in section 7.
5. Significant vegetation and populations of threatened and rare species exist on land that is not part of a reserve system.
6. There is some damage and clearance of vegetation on foreshores and other areas.
7. There is a risk that the invasive marine seaweed *Caulerpa taxifolia* could be introduced to the lake. This presents a threat to the biological diversity, amenity and economic viability of local tourist industries that depend on healthy coastal lakes in the Shoalhaven.

7.4 STRATEGIES

Strategy	Action	Priority	Timing	Estimated Cost	Responsibility	Performance Evaluation
NC1 - Protect significant ecological communities and populations of rare or threatened species that are not in reserve system	34. Establish voluntary conservation agreements with private land owners	Medium	Medium	-	NPWS DLWC Community	VCAs established
	35. Manage the dune forest between Cudmirrah Beach and Swan Lake for conservation purposes	Medium	Medium	-	DLWC DMR SCC Community	Forest preserved
	36. Investigate capability and appropriate uses of Crown land to west of Cudmirrah	Medium	Short	-	DLWC	Land assessment completed
NC2 - Retain the natural state of the Cudmirrah dunes	37. Develop and implement management options for preventing serious human-induced erosion of the Cudmirrah dunes, in close consultation with the community and community groups including the Cudmirrah/Berrara Dune Care Group	High	Short	Uncosted	SCC	Human-induced erosion reduced
NC3 - Protect the natural values of foreshores and wetlands	38. When next rezoning any land in the area, incorporate objective of having environmental protection for foreshores and wetlands, and consider appropriate zoning	Medium	Medium	-	SCC	Rezoning completed

Strategy	Action	Priority	Timing	Estimated Cost	Responsibility	Performance Evaluation
NC4 - Educate visitors and residents on importance of protecting natural values	39. Prepare brochures and interpretive signs about foreshores and urban bushland for education of residents and visitors	High	Short	$2000	SCC	Brochure prepared and distributed
	40. Identify most likely sources of dumped lawn clippings and garden waste in bushland and on dune.	Medium	Short	$1000	SCC	Investigation completed
	41. Conduct targeted campaign to alter behaviour of garden waste dumpers	Medium	Short	$1500	SCC NPWS DLWC	Absence of rubbish in bushland areas
NC5 - Remove piles of garden waste from public areas	42. Focus Clean Up Australia volunteers on collection of dumped garden waste from public areas	Medium	Short	-	Clean up Australia volunteers	Rubbish removed from natural areas
	43. Remove rubbish mound from road reserve near Berrara Beach accessway	High	Short	$5000	SCC Adjacent land owners	Rubbish removed
	44. Educate owners or management and staff of properties adjacent to public reserves on appropriate waste disposal	High	Short	$2000	SCC	Rubbish no longer dumped
NC6 - Control weeds in bushland areas	45. Survey weeds in bushland and develop a weed control action plan	High	Short	$1000	SCC	Plan prepared
	46. Train bush care volunteers in implementation of weed control action plan	Medium	Medium	$6000	SCC NPWS	Training completed

Strategy	Action	Priority	Timing	Estimated Cost	Responsibility	Performance Evaluation
	47. Establish weed removal program for Berrara Creek Flats Reserve and intersection of Waterhaven and Lakeland Avenues	High	Short	$5000	SCC Community	Weeds reduced
	48. If necessary, establish project under labour provision program (eg, Greencorp, Work for the Dole, Community Service) to target weed infestations in bushland areas	High	Short	$3000	SCC NPWS DLWC	Weeds reduced
NC7 - Protect lake and creek from introduction of *Caulerpa taxifolia*	49. Conduct education (signs, brochures, etc) to reduce likelihood of infestation or to improve chance of early detection if it is introduced	High	Short	$2000	NSW Fisheries SCC	Infestation prevented or detected
NC8 - Maintain or establish buffer zones between developed areas and sensitive habitats, where possible	50. Maintain existing areas of native vegetation, particularly on foreshores	High	Ongoing	-	SCC NPWS DLWC Community	No loss of foreshore vegetation
	51. Restore some areas of native vegetation on Berrara Creek Flats Reserve, Lakeland Avenue Reserve, Errol Bond Reserve, eastern foreshore of lake and Berrara headland, whilst maintaining access to waterways	Medium	Short	$5000	SCC Community	Revegetation program completed

Strategy	Action	Priority	Timing	Estimated Cost	Responsibility	Performance Evaluation
	52. Protect existing vegetation from vandalism on foreshores, eg, adjacent to Goonawarra Drive, the eastern foreshore of Swan Lake and Berrara Headland	Medium	Short	-	SCC	Enforcement effective
NC9 - Control populations of introduced animals in natural areas	53. Develop and implement joint feral animal control program	Medium	Medium	$10000	SCC DLWC NPWS	Plan implemented
NC10 - Reduce impact of roaming domestic animals on native animal populations	54. Educate residents and visitors on their obligations under the Companion Animals Act	Medium	Short	$4000	SCC	Education campaign implemented
	55. Enforce provisions of Companion Animals Act	High	Ongoing	-	SCC	Enforcement effective
NC11 – Reduce impact of motor vehicle drivers on wildlife populations	56. Review speed limits on roads outside urban areas	Medium	Medium	-	SCC NPWS	Number of road kills reduced
	57. Identify animal road kill black spots and signpost	Medium	Medium	$2000	NPWS SCC NANA	Number of road kills reduced

8 ENTRANCE MANAGEMENT

8.1 VALUES

Swan Lake is typical of many south coast lagoons in that it is usually closed to the sea by a sand bar.

The condition of the lake's entrance plays an important part in the state of the estuarine ecosystem.

Figure 8-1 shows the entrance in both open and closed conditions.

8.2 OBJECTIVES

To reinstate, in the longer term, natural entrance behaviour and hence natural rates of change in water levels.

8.3 ISSUES

The entrance to Swan Lake has, in the past, been artificially opened by Shoalhaven City Council when the lake water reaches a designated level (1.25 m above AHD).

The designated level at which the lake may be opened is well below the level to which the lake has been allowed to fill in recent years.

The most recent opening of the lake was caused by floodwaters, not by human intervention, and the lake level reached 2.5 m above AHD on that occasion. There is localised flooding when the lake reaches this level, just south of the Collier Drive bridge at Cudmirrah, and on the access track to The Springs holiday cabins at Swanhaven.

It is claimed that the location at which the entrance opens affects the level to which the lake water drops because of the presence of an underlying rock shelf. It is also claimed that this affects the length of time that the entrance stays open and affects surfing spots.

There have been a number of unauthorised openings of the lake by members of the public.

Figure 8-1. **Top** – entrance closed May 1998.
Bottom – 4 days after opening August 1998.

8.4 STRATEGIES

Strategy	Action	Priority	Timing	Estimated Cost	Responsibility	Performance Evaluation
EM1 - Develop and adopt entrance management policy	58. Survey low level assets	High	Short	$6000	SCC	Assets surveyed
	59. Investigate possible effects on entrance behaviour from 1968 dredging and spoil disposal and other construction in inlet	Medium	Short	$1000	SCC	Investigation completed
	60. Undertake Review of Environmental Factors	High	Short	$10000	SCC	REF prepared
	61. Develop policy, including review of interim lake opening level and location (see below)	High	Medium	$10000	SCC	Policy adopted
EM2 – Minimise intervention in natural entrance behaviour, with full reinstatement in the longer term	62. Remove or flood proof low lying assets	Medium	Long	Uncosted	SCC	Entrance behaves naturally
	63. Do not locate new assets in areas subject to inundation	Medium	Long	-	SCC	Entrance behaves naturally
	64. Review minimum floor height requirement for new developments	High	Medium	$1000	SCC	Review completed
EM3 - Adopt interim entrance management policy	65. Instigate consultation/approval processes for opening of lake when water level approaches 2.4 metres above AHD	High	Short	-	SCC	In short term, Lake only opened at appropriate level

Strategy	Action	Priority	Timing	Estimated Cost	Responsibility	Performance Evaluation
	66. Open lake at southern side of entrance spit so that water flows over rock shelf	High	As required	-	SCC	Lake only opened at southern location
EM4 - Prevent illegal opening of lake entrance	67. Maintain signs at entrance accessways	Medium	Ongoing	$2000	SCC DLWC	Lake not opened illegally
	68. Prosecute people found attempting to open lake	Medium	As required	-	SCC DLWC NSW Fisheries	Lake not opened illegally

9 RECREATION

9.1 VALUES

Swan Lake and Berrara are used for a diverse range of aquatic recreational activities including sailing, canoeing, water skiing, jet skiing, fishing, prawning, swimming, and birdwatching.

The foreshores and natural areas around the waterways are used for picnicking, walking, biking, horse riding and other recreational activities.

The area is a recreational destination for families, with a safe environment for young children.

9.2 OBJECTIVES

To ensure that recreational activities do not have undue effects on the nature and enjoyment of the area.

9.3 ISSUES

Powerboat usage in the Swan Lake may adversely affect swimming and other water-based activities.

Noise from powerboats is offensive to some people.

Powerboat usage can disturb wildlife, particularly water birds.

At peak times there can be some overcrowding of recreational facilities.

The standard of environmental protection at some facilities such as picnic areas and boat ramps is not adequate for the level of usage.

Access along foreshore of Berrara Creek is impeded by creek below Waterhaven Avenue.

9.4 STRATEGIES

Strategy	Action	Priority	Timing	Estimated Cost	Responsibility	Performance Evaluation
R1 - Zone different parts of lake for appropriate uses	69. Prepare a detailed waterway usage management plan with the aim of protecting environmental and social values, including creation of waterbird refuges as required, and considering noise, water pollution, shoreline erosion, etc. The plan will be based on, amongst other things, noise measurements, a wave climate study and information from NPWS and NSW Fisheries	High	Short	Uncosted	Waterways	Plan prepared
	70. Assess effectiveness of trial swimming area adjacent to Errol Bond Reserve and speed limit in inlet	High	Short	Uncosted	Waterways	Assessment completed
	71. If trial judged successful, create permanent swimming area adjacent to Errol Bond Reserve and speed limit in inlet	Medium	Short	Uncosted	Waterways	Permanent boating controls in place
	72. Consider creation of swimming area adjacent to beach at Swanhaven (see figure 9-1)	Medium	Short	Uncosted	Waterways	Assessment completed

Strategy	Action	Priority	Timing	Estimated Cost	Responsibility	Performance Evaluation
	73. Retain Swanhaven ramp for launch/retrieval by small craft and ensure that signage indicates types of craft that can be used there and location of alternative facilities for other craft	High	Ongoing	Uncosted	SCC	
	74. Based on further consultation and collection of further information, including information on usage patterns and safety issues, investigate possible future restriction on Swanhaven ramp that would only allow manhandling of boats into the lake	Medium	Medium	Uncosted	SCC	
	75. Provide appropriate educational material on boating restrictions on lake	High	Short	Uncosted	Waterways	Refuge and swimming areas clearly marked
	76. Investigate possible methods of making vessel operators and swimmers aware of swimming areas, such as by use of signs at ramps or provision of maps, to avoid use of visually intrusive floating markers	Medium	Medium	Uncosted	waterways	

Strategy	Action	Priority	Timing	Estimated Cost	Responsibility	Performance Evaluation
	77. Encourage all user groups to educate their membership of the importance of adhering to boating rules and respecting the interests of other waterway users	High	Short	Uncosted	SCC Community	
	78. Draw on expertise from NSW Waterways, NPWS, other agencies and the community to devise and conduct an education campaign to raise and maintain awareness amongst all recreational users of potential impacts of their activities on waterbirds, water quality, noise etc	High	Short	Uncosted	SCC	
R2 - Protect foreshores and public reserves from degradation due to recreational use	79. Provide access stairs or ramp to small beach area in Errol Bond Reserve, Cudmirrah	Medium	Medium	$5000	SCC	Accessway built
	80. Formalise roads and parking in Swan Lake boat ramp reserve	Medium	Medium	$20000	SCC	Vehicle access rationalised
	81. Investigate extent, causes and possible solutions to foreshore erosion near the main Swan Lake boat ramp	High	Short	$3000	SCC	Investigation completed
	82. Assess damage caused by launching and retrieval of boats other than at designated ramps	Medium	Medium	$1000	SCC	Assessment completed

Strategy	Action	Priority	Timing	Estimated Cost	Responsibility	Performance Evaluation
R3 - Provide access to public foreshore land next to Berrara Creek	83. Investigate feasibility of building a pedestrian bridge over the unnamed creek below Waterhaven Avenue	Medium	Long	$5000	SCC	Bridge built
R4 - Reduce impacts of motor vehicle drivers on recreational users of forest roads	56. Review speed limits on roads outside urban areas	Medium	Medium	-	SCC NPWS	Review completed

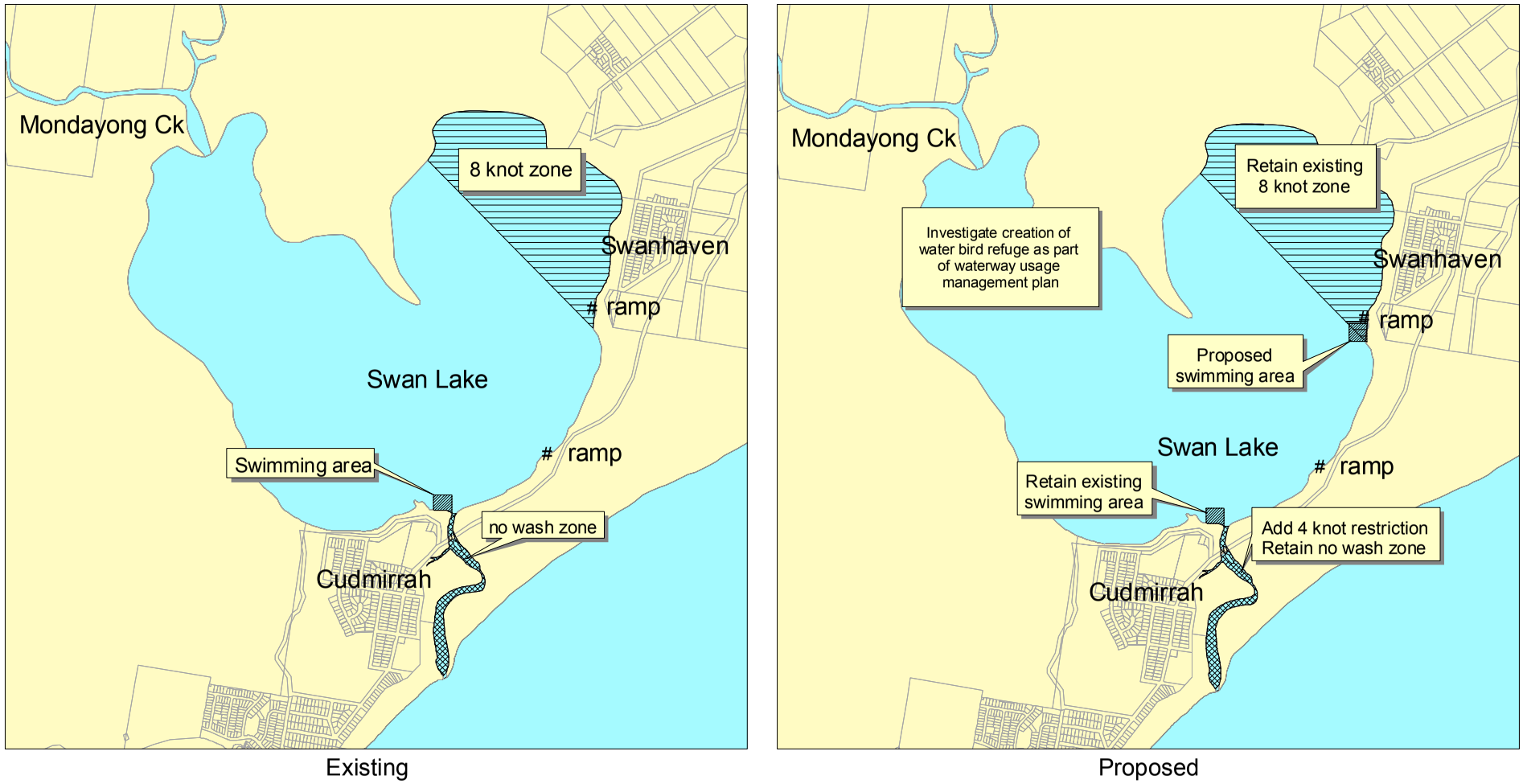

Figure 9-1. Existing boating restrictions and proposed changes on Swan lake

10 VISUAL QUALITY

10.1 VALUES

The scenic qualities of the area are major assets for both residents and visitors. The values derive from the creeks and their foreshores, the near and distant coastline (including the sea itself, beaches, headlands and cliffs), the large areas of native vegetation and the wildlife.

10.2 OBJECTIVES

To maintain, rehabilitate where necessary and enhance where appropriate the high visual qualities of Swan Lake and Berrara Creek.

10.3 ISSUES

Rubbish is washed onto beaches and into creeks and is dumped on public areas.

Native vegetation is being removed from foreshore land.

Buildings and other structures can degrade coastal scenery.

10.4 STRATEGIES

Strategy	Action	Priority	Timing	Estimated Cost	Responsibility	Performance Evaluation
VQ1 - Maintain or restore visual character of natural landscapes and landforms	50. Maintain existing areas of native vegetation, particularly on foreshores	High	Ongoing	-	SCC NPWS DLWC Community	No loss of foreshore vegetation
	51. Restore some areas of native vegetation on Berrara Creek Flats Reserve , Lakeland Avenue Reserve, Errol Bond Reserve, eastern foreshore of lake and Berrara headland, whilst maintaining access to waterways	Medium	Short	$5000	SCC Community	Revegetation completed
	84. Remove rubbish from bushland and beaches	Medium	Short	Uncosted	SCC NPWS Community	No visible rubbish
	85. Conduct public education on impact of rubbish on environment	Medium	Medium	$1000	SCC	Education program completed
VQ2 - Ensure built forms do not impact adversely on coastal scenery	86. Ensure new developments comply with development control plan for foreshores	High	Case by case	-	SCC	Visual quality maintained

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