

Lake Ainsworth Management Plan



NSW DEPARTMENT
OF PUBLIC WORKS
AND SERVICES

GeoLINK
environmental management and design



FOREWORD

Lake Ainsworth is important to the local and regional community for many reasons. Better management is needed not only to halt ongoing degradation, but also to rectify past damage, with the overall objective of achieving an integrated, balanced, responsible and ecologically sustainable use of the area in the future.

The framework adopted for the Lake Ainsworth Management Plan is taken from the NSW State Government's Estuary Management Manual and is detailed below:

Stage	Description
1. Form an Estuary Management Committee	A committee, to be chaired by a local council, should include representation from various stakeholders, including relevant authorities, local community groups and users of the estuary.
2. Assemble Existing Data	Provides a basis for assessing data deficiencies and future assessments of the estuary.
3. Estuary Process Study	Involves the definition of the "baseline" conditions of the various lake processes and the interactions between them.
4. Estuary Management Study	Utilises information from the Estuary Process Study, together with other studies, to define management objectives, options and impacts.
5. Draft Estuary Management Plan	Consists of a scheduled sequence of recommended activities that need to be undertaken to achieve the lake management objectives.
6. Review Estuary Management Plan	Public display and review of the Draft Estuary Management Plan to assess and comment on the recommended actions.
7. Adopt and Implement Estuary Management Plan	Council and Government (either collectively or separately) adopt and implement recommended actions in the Estuary Management Plan.
8. Monitor and Review the management process	Monitoring studies are needed to ensure management actions and controls have the desired effects on estuarine habitat quality and amenity.

The Lake Ainsworth Management process has progressed through Stages 1 to 4. This document forms the Draft Lake Ainsworth Management Plan. The Plan is designed to be a "stand alone" document, which details a brief background to the issues and the recommended management actions to be implemented following formal adoption (Stage 7).

More detailed discussion of the issues is contained in the Lake Management Study (MHL, 2001).

EXECUTIVE SUMMARY

Lake Ainsworth is one of the few freshwater lowland dune lakes in northern New South Wales. It covers an area of 12.4 ha and is located behind the frontal dunes at the northern end of Lennox Head, a coastal town on the north coast of New South Wales (see Illustration 1). The southern part of the lake and its foreshores are contained within a Crown Reserve for public recreation, with Ballina Shire Council as Trustees. There is a caravan park along the southern side of the lake and a Sport and Recreation Centre to the north. Residential areas of Lennox Head are located to the south and south west. The lake is an important natural area as well as providing a valuable recreational resource for the community and for visitors from the region and interstate. Therefore, it is important that the health and quality of the lake be maintained.

The importance of maintaining this natural resource has been recognised by Ballina Shire Council, which engaged Manly Hydraulics Laboratory to prepare a Management Study and Management Plan for Lake Ainsworth. The Management Study (DPWS, 2001) has been finalised and identifies planning and environmental issues applicable to the Study Area and possible options for their management. The Management Study provides the foundations for this Management Plan.

The Study and Management Plan have been undertaken pursuant to the State Government's adopted process for Estuary Management, and an outline of this process is contained within this report. The process provides for the identification and prioritisation of key issues relevant to the lake. This Management Plan seeks to further elaborate on the issues, and develop appropriate management objectives and actions relating to Lake Ainsworth. Through the implementation of recommended management actions, the qualities of Lake Ainsworth should be protected and, where required and/or possible, improved.

The Plan seeks to implement and regulate actions within the Lake Ainsworth area to ensure that competing uses and processes are managed so that the quality of the lake will be maintained and improved. It further seeks to address the community's concerns about the lake, and provide an educational tool for the local community and visitors. The Plan aims to create a balance between natural processes and surrounding land and recreational uses.

The Plan presents as a series of actions for each of the following categories:

- Management Structure
 - Water Quality
 - Coastal Dune Stability
-

- Traffic Management
- Recreation
- Ecology
- Planning and Development
- Erosion and Sedimentation
- Education
- Water Level and Flooding
- Aboriginal Heritage.

The management objectives for these categories are presented in the table below.

Management Objectives by Category	
Category	Objectives
Management Structure	To establish an integrated catchment management structure for the lake that allows for implementation, monitoring and review of the Lake Ainsworth Management Plan.
Water Quality	To maintain and improve the water quality of the lake to a level appropriate for recreational uses and for the protection of aquatic ecosystems.
Coastal Dune Stability	To maintain and enhance the coastal dune system to assist the survival of Lake Ainsworth as a freshwater lake and to protect the lake's natural values.
Traffic Management	To manage traffic flow and parking to enhance public safety and recreational opportunity, to improve access, reduce erosion and protect ecological values.
Recreation	To maintain and enhance the recreational opportunities, while managing the activities so as to minimise any impact on the lake's aesthetics and ecological values.
Ecology	To conserve and enhance the ecological values of Lake Ainsworth.
Planning and Development	To ensure coordinated management of all land in both the lake's surface and groundwater catchment.
Erosion and Sedimentation	To maintain and enhance the foreshore and catchment of the lake to protect the lake's aesthetic, ecological and recreational values.
Education	To develop systems and programs to educate and inform the community about the values of the lake and the impacts of human activity, to reduce adverse impacts and enhance the lake's values.
Water Level and Flooding	To minimise the impact of natural variations in water level of the lake, both high and low, so as to protect terrestrial and aquatic ecosystems, and to reduce foreshore erosion and disruption to access and recreational use.
Aboriginal Heritage	To understand, protect and respect the aboriginal heritage value of the lake.

The tables on the following pages present the proposed management actions, developed to achieve these objectives. The actions are grouped according to their priority as shown below:

- High : complete within a year
- Medium: complete within one to three years
- Low: complete as resources, e.g. funding, becomes available

Indicative cost categorises are provided for each action where:

- Low < \$50,000
- Medium \$50,000 to \$100,000
- High \$100,000 to \$500,000
- Very High > \$500,000

Note that costs for ongoing actions are annual costs and are only for the direct implementation for a particular action. These costs do not make allowance for unforeseen additional work required to implement an action, changes to employment or construction costs, or the cost incurred by the ratepayers. The costs are indicative only, and will need to be more accurately estimated when more detailed design work is completed in association with implementation of various actions.

High Priority Management Actions

Ref	Issue	Management Actions	Agency	Cost
Management Structure				
A1	Establishment of a Management Structure.	Formulate a Memorandum of Understanding between responsible agencies.	All	Low
A2	Establishment of a Management Structure.	Review Memorandum of Understanding and agency performance every two years.	All	Low
A3	Establishment of a Management Structure.	Arrange funding for the various management actions.	All	Low
A4	Establishment of a Management Structure.	Monitor Performance of Plan.	All	Low
Water Quality				
B1	Algal Blooms.	Continue current aeration practices.	BSC	Low
B2	Algal Blooms.	Set up an environmental database to monitor the effectiveness of the aeration system over time.	DLWC and BSC	Medium
B5	Monitoring.	Review current monitoring systems for the lake. Develop new guidelines and monitoring systems specific to Lake Ainsworth.	DLWC and BSC	Low
Coastal Dunes				
C1	Establishment of an effective buffer to coastal dunes to protect the lake.	Continue current dune rehabilitation management practices.	Lennox Head Dune Care Group and BSC	Low
C3	Ensure stability of dunal vegetation.	Remove and relocate existing powerline underground.	BSC	High

Ref	Issue	Management Actions	Agency	Cost
Traffic Management				
D1	Safety of the visitors to the lake and problems with access to the Sports and Recreation Centre during times of floods.	Restrict vehicular access along the eastern road alignment and discourage motorists from entering the Sport and Recreation Centre. Move the majority of the picnic tables and facilities to the western side of the road.	BSC	Medium
D2	Traffic numbers on existing eastern road.	Remove or relocate existing 4WD beach access.	BSC	Low-Medium
D3	Erosion in areas adjacent to the lake.	Prohibit foreshore parking and provide designated parking areas.	BSC	Medium
D4	Visitor amenity and safety at the lake and surrounds.	Close part of the existing road between the lake and the caravan park and create a new road from Ross Street, around the back of the caravan park to connect to the western access road.	BSC	Medium
Ecology				
F1	Spread of aquatic weeds.	Control the spread of water primrose and other aquatic weeds.	BSC, Lennox Head Dune Care and Lennox Head Residents' Association	Low
F2	Spread of terrestrial weeds.	Rehabilitation and restoration of areas infested with terrestrial weeds.	Lennox Head Dune Care, Lennox Head Residents' Association and lake Ainsworth Sport and Recreation Centre	Low

Ref	Issue	Management Actions	Agency	Cost
F3	Spread of introduced fauna.	Implement action plans to target specific species for their eradication.	BSC and DLWC	Low
F4	Implement ENVITE's Vegetation Management Plans when completed.	The need for restoration and rehabilitation requires effective guidelines for volunteers and others engaged in the maintenance of Lake Ainsworth.	ENVITE, Lennox Head Dune Care	Unknown
Erosion				
H1	Erosion of the foreshore of the lake and accumulation of sediments in the lake.	Implement Traffic Management Plan (See section Traffic Management Actions).	BSC	Medium-High
Aboriginal Heritage				
K1	Protection of areas of Aboriginal cultural significance.	Ensure areas of Aboriginal cultural significance remain relatively undisturbed through measures acceptable to the Local Aboriginal Land Council.	BSC and the Local Aboriginal Land Council	Low
K2	Protection of areas of Aboriginal cultural significance.	Liaison between Ballina Shire Council and the Local Aboriginal Land Council regarding culturally significant sites.	BSC and the Local Aboriginal Land Council	Low

Medium Priority Management Actions

Ref	Issue	Management Actions	Agency	Cost
Water Quality				
B4	Lake and Groundwater Quality.	Implement the suite of water quality improvement strategies.	DLWC and BSC	Medium
B5	Monitoring.	Continue ongoing monitoring.	DLWC and BSC	Low
Coastal Dunes				
C2	Need to address long-term recession of dunes.	Assess coastal hazards and suitable management strategies.	BSC	Unknown
Recreation				
E1	Potential erosion caused by sail craft.	Provide a launching area for sailboats and sailboards.	BSC	Medium
E2	Damage to vegetation by wood fires and increasing visitor enjoyment.	Upgrade picnic and BBQ facilities.	BSC	Medium
E3	Erosion and damage to vegetation by visitors walking in undefined areas.	Provide pedestrian access paths and walking tracks.	DLWC and BSC	Medium
E4	Use of area for markets.	Allow the Lennox Markets to continue.	BSC	Low
E5	Conflict between the different recreational users of the lake.	Provide designated swimming and watercraft areas.	BSC	Low

Ref	Issue	Management Actions	Agency	Cost
Planning and Development				
Erosion				
H2	Erosion of the foreshore of the lake and accumulation of sediments in the lake.	Continue and enhance current riparian flora management strategies.	Lennox Head Dune Care Group and BSC	Low
Education				
I1	Visitor awareness of the effects of their actions.	Provide an information display board at the south-eastern entrance to the Lake Ainsworth reserve.	BSC	Low
I2	Conflict between users of the lake in terms of potential collisions between sail craft and swimmers.	Erect signage to delineate the areas for swimming and sail craft use.	BSC	Low
Aboriginal Heritage				
K3	Protection of areas of Aboriginal cultural significance.	Erect signage to educate the community about the presence and significance of Aboriginal cultural sites, where deemed appropriate by the Local Aboriginal Land Council.	BSC and the Local Aboriginal Land Council	Low

Low Priority Management Actions

Ref	Issue	Management Actions	Agency	Cost
Water Quality				
B3	Algal blooms	Further investigate other strategies – sediment capping, biomanipulation, sediment removal etc.	DLWC and BSC	Medium
Planning and Development				
G2	Need for additional space for any future development of the Surf Life Saving Club.	Consider the future of the Surf Life Saving Club site to determine whether expansion or relocation is appropriate.	BSC	Low
Water Level and Flooding				
J1	The need to mitigate the effects of the natural variation of the lake's water level rather than implement a system to control and regulate the water level in the lake.	Ensure that littoral and riparian revegetation schemes incorporate species that are tolerant to infrequent but potentially prolonged periods of inundation.	BSC	Low
J2	The need to mitigate the effects of the natural variation of the lake's water level rather than implement a system to control and regulate the water level in the lake.	Placement of new and/or replacement of existing recreational facilities (BBQs, walking paths, etc) beyond levels likely to be inundated for prolonged periods.	BSC	Low

EXECUTIVE SUMMARY

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ACKNOWLEDGMENTS

The Study Team would like to thank Ballina Shire Council, the Lake Ainsworth Management Committee, the various Government representatives and the community for their contributions to the Lake Management Study and this Lake Ainsworth Management Plan. Much was gained from their local knowledge and experience.

INTRODUCTION

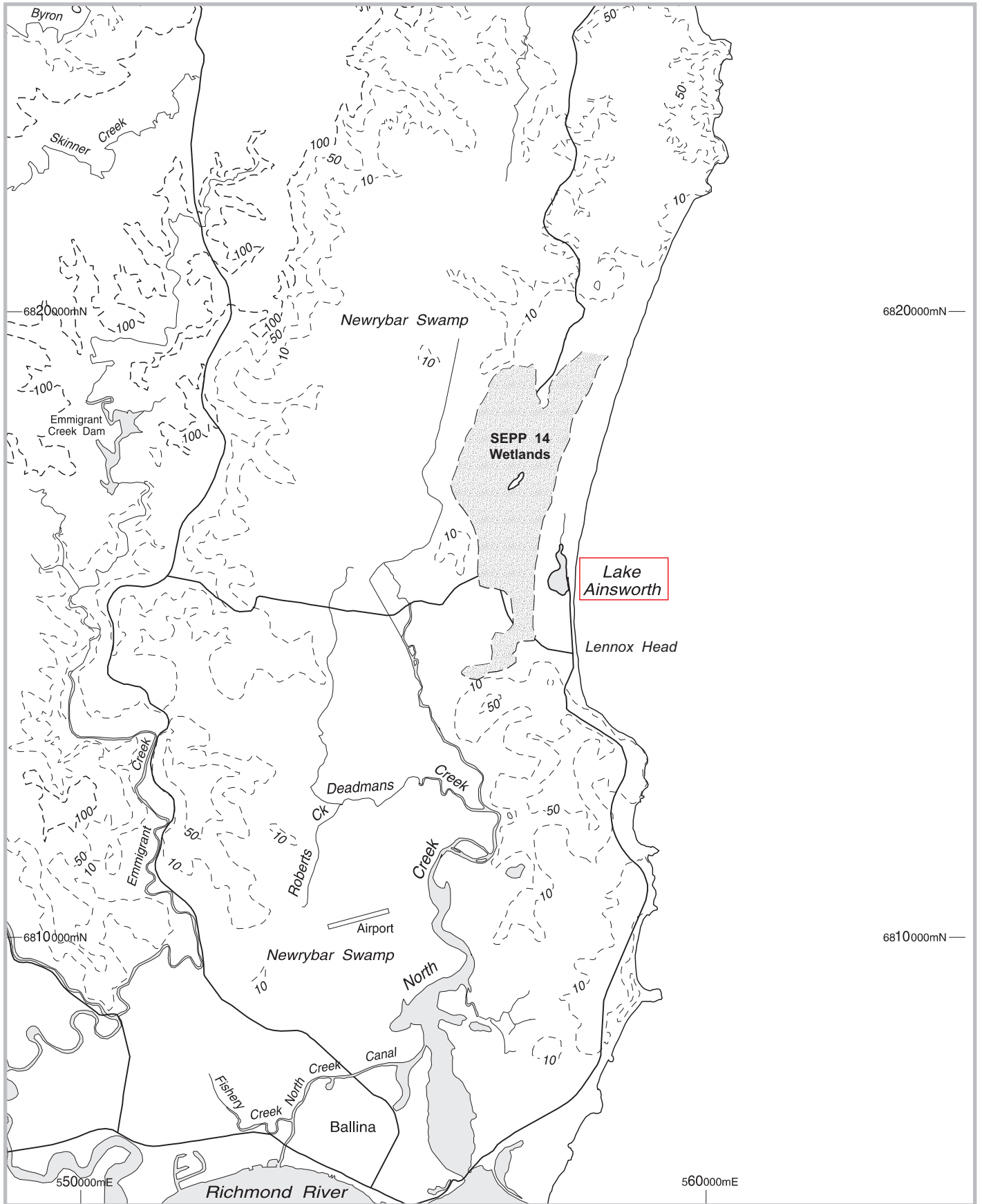
Background

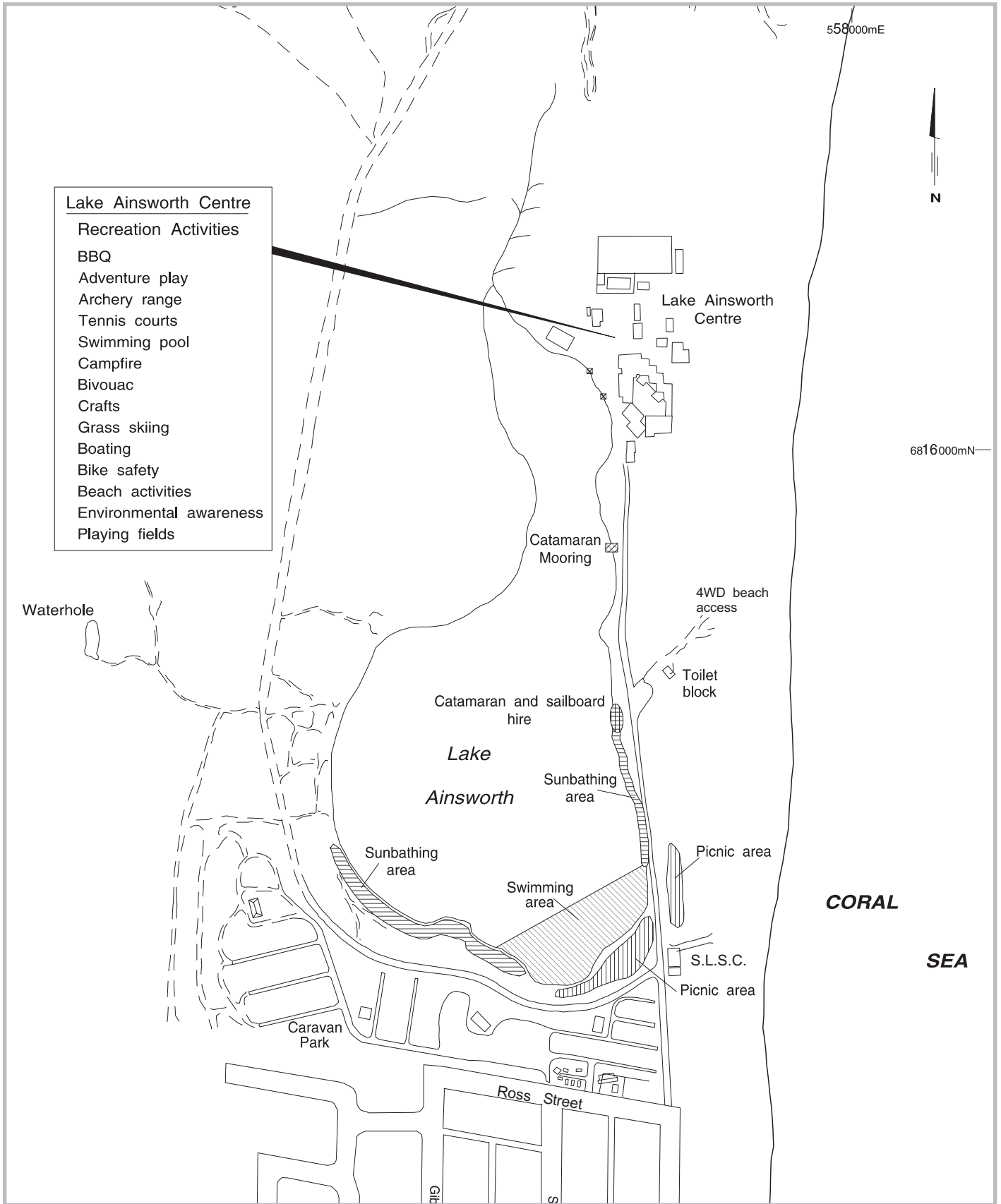
Lake Ainsworth is one of the few freshwater lowland dune lakes in northern New South Wales. It covers an area of 12.4 ha (Timms, 1982). It is located behind the frontal dunes at the northern end of Lennox Head, a coastal town on the north coast of New South Wales (Illustration 1). The southern part of the lake and its foreshores are contained within a Crown Reserve for public recreation, with Ballina Shire Council as Trustees. There is a caravan park along the southern side of the lake and a Sport and Recreation Centre to the north. Residential areas of Lennox Head are located to the south and south west of the lake. The lake is an important recreational area for the community and visitors from the region and interstate (Illustration 2). Therefore, it is important that the health and quality of the lake be maintained.

The importance of maintaining this natural resource has been recognised by Ballina Shire Council, which engaged Manly Hydraulics Laboratory to prepare a Management Study and Management Plan for Lake Ainsworth. The Management Study (DPWS, 2001) has been finalised and identifies planning and environmental issues applicable to the Study Area and possible options for their management. The Management Study provides the foundations for this Management Plan.

The Study and Management Plan have been undertaken pursuant to the State Government's adopted processes for Estuary Management, and an outline of this process is contained within this report. The process provides for the identification of key issues relevant to the lake, which have been given priorities accordingly. These issues relate to water quality, coastal dune stability, traffic management, recreation, ecology, planning and development, lake water level and flooding, erosion and sedimentation and aboriginal heritage. This Management Plan seeks to further elaborate on the issues, and develop appropriate management objectives and actions relating to Lake Ainsworth. Through the implementation of recommended management actions, the qualities of Lake Ainsworth should be protected and, where required, and/or possible, improved.

Lake Ainsworth
Management Plan





0 200m

Illustration 2

99125281

Source: Manly Hydraulics Laboratory

Date: November 2002

quality solutions sustainable future

Lake Ainsworth Recreational Uses

The Value of Lake Ainsworth

Lake Ainsworth is situated on the North Coast of New South Wales, approximately 10 km north of Ballina. It lies to the north of the coastal township of Lennox Head. The catchment for Lake Ainsworth falls within the Ballina Shire Local Government area. The lake is one of the few dunal lakes left in NSW, and its surrounding environs contain a wide diversity of native flora and fauna.

Lake Ainsworth has regional significance for the following reasons:

- the lake is an important 'natural' area in an otherwise urban environment;
- the lake is a popular active and passive recreational resource;
- there are a number of local businesses that rely directly on the lake area for their income, whilst others gain indirect benefit;
- Lake Ainsworth is valued as an important educational resource for the region;
- Lake Ainsworth is one of the largest dunal lakes on the north coast and the lake and environs contain a remarkable diversity of native biota, and
- The lake is a significant tourist destination on the Far North Coast of New South Wales.

Ballina Shire Council supports a population of around 40,000 with the population on the North coast expecting to increase from 420,000 to 600,000 by 2016 (NSW Premiers Dept, 1999). The lake is also close to other major north coast centres and tourist locations such as Lismore and Byron Bay. Brisbane is the closest capital city, located approximately 200 km to the north.

The Lake Ainsworth Caravan Park, which can accommodate up to 1,200 people and the Lake Ainsworth Sports and Recreation Centre, which can accommodate 210 people, both adjoin the lake. A number of local businesses rely directly on the lake for an income. Such commercial enterprises include tourist accommodation facilities and the Lennox Head markets. A sailing school and craft hire business previously operated at the lake, but has recently ceased operation. It is expected that a similar enterprise will take its place in the future. Other businesses within Lennox Head such as motels, general stores, cafes and restaurants benefit indirectly from the visitors to the lake.

The lake is an important recreational resource for both the local community and broader regional communities. It is particularly popular during the Easter, Christmas and school holidays. It provides opportunities for passive and active recreation. More specifically, the area is popular for sailing, windsurfing and it is a relatively safe place for beginners in swimming and other water sports. Lake Ainsworth is also an alternative for beach users when the beach is unsafe or unsuitable for swimming. The lake environs are visually pleasing for passive recreation, such as picnicking, bird

watching and walking. Facilities that are provided at the lake include picnic tables, barbeques and toilets.

The northern edge of the Lennox Head township borders the southern boundary of the lake. Relatively new residential development has occurred to the south west of the lake. Lennox Head has undergone significant urban expansion since the 1980s, reflecting the demand for coastal land and the fact that the North Coast is the fastest growing region in NSW. The town centre of Lennox Head is located approximately 500 m south of the lake and accommodates a range of village level commercial activities. The predominant land use to the west and the north of the lake is open space and much of this land is included within environmental protection areas. Other, more specific, land uses adjacent to the lake include to the south east, the Lennox Head/ Alstonville Surf Life Saving Club which is one of the largest surf clubs on the North Coast, and to the north, the Sports and Recreation Centre. The area to the south of lake is used once a month for markets, which attract a number of visitors to the area on the day.

Need for a Management Plan

Following a preliminary management study commissioned in 1994 by the Lennox Head Residents' Association, Ballina Shire Council resolved to prepare a management plan for Lake Ainsworth in accordance with the NSW Government's Estuary Management Policy. A management committee was established by Council in November 1994 to oversee the studies required, and the process of plan formation. As part of this management process, Council has commissioned a team of specialists to undertake the Lake Ainsworth Management Study and to prepare the Lake Ainsworth Management Plan. The study is being jointly funded by Council and the Department of Land and Water (DLWC).

A Management Plan is needed for Lake Ainsworth to:

- maintain and improve the environmental, social and economic values of the lake and its surrounds;
- define, prioritise and cost, management actions which aim to maintain or enhance the lake's environmental values; and
- provide recommendations with respect to the implementation of management activities.

The need for a comprehensive Management Plan was also prompted by blue-green algae blooms in Lake Ainsworth. In January 1994, an outbreak of *Oscillatoria* occurred, and outbreaks of *Anabaena* and *Microcystis* occurred in the spring and summer of 1995-96. These latter blooms

resulted in the erection of warning signs by Council advising water users of the potential human health problems caused by the algal blooms.

Objectives

The objectives of this Plan are:

- based on the findings from the Lake Ainsworth Management Study (MHL 2001), to develop and consolidate appropriate management strategies and actions which should be implemented to help preserve and enhance Lake Ainsworth;
 - describe and justify the recommended actions;
 - prioritise selected actions and indicate the barriers to effective implementation; and
 - provide indicative costs for the recommended strategies and actions.
-

MANAGEMENT PLAN FRAMEWORK

General Estuary Management Process in NSW

The State Government has recognised estuaries as places with important ecological values, although these values can be in conflict with their wide variety of uses. Estuaries are thus recognised as significant areas for environmental, social and economic purposes.

The regional importance of Lake Ainsworth has led to the recognition that the area should be effectively managed. Management of the lake must include consideration of all the different land uses within the area and ensure that land uses are compatible so as to achieve the objectives for the lake. This Lake Ainsworth Management Plan seeks to provide a coordinated approach to management. While Lake Ainsworth is not an estuary as such, the general management guidelines provided by the NSW Government's Estuary Management Policy are applicable to the lake environs.

For the Management Plan to be effective, it needs to:

- reflect the ideals and values of the community, interested parties, regulatory bodies;
- be formally adopted by Council and relevant government bodies;
- be incorporated into other policy and planning frameworks produced by Council or other relevant bodies; and
- be implemented by the relevant organisations

The Lake Ainsworth Management Process has been formulated in accordance with the NSW Government's Estuary Management Policy. The Estuary Management Manual, which has been produced by NSW Government to assist in the implementation of the Estuary Management Policy, has been referred to and the Lake Ainsworth Management Plan has been produced according to the guidelines in the manual. The Estuary Management Manual suggests a structured eight-step process which will lead to the eventual implementation and monitoring of an Estuary Management Plan. The steps are as follows:

Step 1	Form an Estuary Management Committee
Step 2	Assemble existing data
Step 3	Carry out an Estuary Processes Study
Step 4	Carry out an Estuary Management Study
Step 5	Prepare a draft Estuary Management Plan
Step 6	Review the Estuary Management Plan
Step 7	Adopt and Implement the Management Plan

Step 8 Monitoring and Review of the Management Plan.

This current Plan relates to steps 5 to 6 of the above processes. Step 2 of the process was completed in August 1996 by Australian Water and Coastal Studies in the form of The Lake Ainsworth Lake Processes Study. Step 4 of the process was completed in June 2001 by Manly Hydraulic Laboratory (DPWS) through the completion of the Lake Ainsworth Management Study.

Lake Ainsworth Management Committee

Estuary Management Plans are prepared under the guidance of an Estuary Management Committee. For Lake Ainsworth, guidance is given by the Lake Ainsworth Management Committee (LAMC). The LAMC is representative of key stakeholders, the community, government departments and local government. Specifically, individuals from the following organisations make up the committee:

- Ballina Shire Council
- Department of Land and Water Conservation
- Lake Ainsworth Sport and Recreation Centre
- Lennox Head Residents' Association
- Lennox Head Dune Care
- Ballina Environment Society

There are four representatives from Ballina Shire Council, one representative from the Department of Land and Water Conservation, Alstonville office and two representatives from the Algal Coordinating Committee, from the Grafton DLWC office, one representative from the Department of Sport and Recreation, two from Ballina Environment Society and two from the Lennox Head Residents' Association. There are also various staff from Ballina Shire Council who provide technical assistance to the Committee as required.

Since the LAMC was formed in 1994, its role has been to instigate and oversee a coordinated approach to the management of Lake Ainsworth. The Committee should continue to play a role in overseeing the implementation of the Management Plan.

Lake Processes Study

The Lake Ainsworth Lake Processes Study was completed in August 1996 by Australian Water and Coastal Studies (AWACS 1996). The aim of that study was to "define the 'baseline' conditions of the various estuarine processes and the interactions between them" (NSW Government, 1992).

The Processes Study sought to assess, define and describe the lake's physical, chemical and biological processes so as to provide a basis for the development of management strategies.

The issues highlighted in the Study can be summarised as follows:

Inadequate Reserve Facilities

- The community has expressed a view that there is a lack of facilities available and many of the existing facilities are dilapidated and require upgrading;
- The community has further identified a lack of defined shallow swimming areas for children;

Multiple Control of Lands

- There is a need for coordinated management between Ballina Shire Council, Lake Ainsworth Caravan Park, Sports and Recreation Centre and the Lennox Head Surf Life Saving Club which manage parts of the land surrounding the lake.

Lake Usage

- Overuse of the lake may have an impact on localised foreshore erosion;

Aboriginal Sites

- There is a lack of data on aboriginal sites around the lake. There appears to be a need for further identification of Aboriginal sites;

Flooding

- Infrequent flooding of the main access road to the Sport and Recreation Centre;

Flora

- Impact of riparian flora on the nutrient budget is unclear, the creation of fringing wetlands may result in the uptake of nutrients;
- The western and northern sections of Lake Ainsworth are considered to be well vegetated in the catchment and the riparian zone;
- Continued need to manage introduced flora and to encourage regrowth of native flora;

Fauna

- There is a suggestion from previous studies that very few native aquatic species inhabit the lake as exotic species, such as the cane toad (*Bufo marinus*), may be out competing the native species;
 - Continued need to manage introduced fauna and to encourage native fauna;
-

Surface Runoff

- The surface runoff catchment of the lake is relatively small. However, previous studies have indicated elevated nutrient levels in the stormwater entering the lake. This would suggest that management strategies relating to the control of surface runoff should be a priority;

Hydrogeology

- Groundwater enters the lake from the localised area. While there are high nutrient levels in the groundwater generally at Lennox Head, the majority of this groundwater does not enter the lake;

Sedimentation

- There has been a slow and gradual accumulation of sediments in the lake, which have high nutrient levels, that have accumulated from decaying vegetation. This is the major source of nutrients in the lake at present;
- The lake sediments are the major source of nutrients for the present nutrient budget;

Lake Foreshore Erosion

- While the study has found that foreshore erosion was not a significant problem, there are localised areas of erosion associated with runoff from roads, concentrated drainage paths, pedestrian access and wind;

Lake Water Levels and Water Budgets

- The major processes controlling the lake water budget are rainfall and evaporation;

Lake Water Quality and Mixing

- ANZECC guidelines for faecal coliforms were exceeded on about 20% of the samples taken. This peak occurred in 1990, although the NSW Health Department Guidelines have rarely been exceeded;
- Vertical stratification occurs in the lake, which inhibits vertical mixing and, in turn, affects dissolved oxygen and nutrient concentration gradients;
- Stratification is broken down by cooling, rainfall and wind;
- The nitrogen and phosphorus levels were found to be generally high during the study and exceeded the ANZECC guidelines;
- Algal cell counts at times exceeded ANZECC and NCRACC guidelines. It appears that low light penetration may be a key factor favouring buoyant cyanobacteria...the more turbid or highly coloured the water body, the higher the probability that cyanobacteria will dominate during the warmer months of the year;
- At low lake water levels, a possible mechanism for high nutrient concentrations in the surface waters is that water drains from areas with riparian macrophytes;

Coastal Dunes

- Coastal recession and lowering of the frontal dune could result in the lake being connected to the ocean
-

- Long term recession of the beach and dunal system has been calculated from photogrammetric analysis and was estimated to be approximately 0.9 mts. per year, (NSW Public Works 1994). The Ballina Shire Coastline Hazard Definition Study is currently in progress and will include an assessment of any further shoreward movement of the shoreline since 1994;
- It is important to note that ocean inundation may occur in an extreme storm event if the barrier has been degraded or removed to such an extent that it allows overtopping after a succession of storms;

Lake Ainsworth Management Study

The Lake Ainsworth Management Study was prepared by Manly Hydraulics Laboratory (DPWS) which, through investigation and community consultation processes, identified the key issues and the relevant management issues.

The Management Study obtained its background information from the Processes Study, combined with additional investigations derived from community consultation and research to define management objectives, strategies and impacts (NSW Government, 1992). The Lake Ainsworth Management Study generally sought to achieve the following:

- provide background information for the Lake Ainsworth Estuary Management Process;
- review the Lake Processes Study and provide an overview of the findings;
- identify the regional significance of the lake in terms of its natural and recreational values;
- identify the key features of the lake in terms of aesthetics, recreation, flora and fauna, socioeconomic and education factors;
- document current uses of the lake and identify any potential conflict that may arise between those uses.
- assess the existing uses on the lake's processes and environment and the potential impact of the future uses;
- summarise the management issues for the lake;
- identify the primary and secondary objectives for the lake's management;
- assess various management strategies that may be applied to address each management issue; and
- conduct a comparison of the various management strategies that may be employed.

For each key issue, the Study explored various management objectives and identified actions that would facilitate the implementation of those objectives. In evaluating the various management options, management strategies were assessed with respect to community views, the study team's

assessment, costs and the time period over which a particular strategy would be carried out. Considerations were given to advantages and disadvantages of environmental, social and economic considerations. The assessment process culminated in the provision of an aggregate score for each potential management action.

In the assessment and comparison of options, the background information from the Lake Processes Study and other investigative processes were used to assess the impacts of natural processes and recreational activities on the lake system.

LAKE AINSWORTH MANAGEMENT PLAN

Background

The management options identified in the Lake Ainsworth Management Study have been further refined into recommended actions to achieve the lake management objectives which are formulated into the Lake Ainsworth Management Plan. The Lake Ainsworth Management Plan consists of a sequence of recommended activities that need to be undertaken so as to achieve the lake management objectives. The finalised Lake Ainsworth Management Plan is to be formally adopted and implemented.

The Plan has been developed to be appropriate for present management practices. It is not intended to be a fixed or permanent document, but rather, a document that is subject to change over time, to ensure that the Plan remains current to the ongoing needs of the natural environment and community. Monitoring of the lake's health is important to ensure that any potential deterioration is detected early. It is also important to monitor the effects of the management practices adopted to ensure that the actions are achieving the management objectives. Monitoring helps develop a greater understanding of the lake's processes.

The following sections provide details of the Lake Ainsworth Management Plan.

Plan Development

This Plan has been developed with regard to the range of policies, strategies, plans and the recommendations of the NSW Government's Estuary Management Policy. The relevant documents that were considered included:

- State Rivers & Estuaries Policy
 - NSW Wetlands Management Policy
 - NSW Coastal Policy 1997
 - Crowns Land Foreshore Tenures Policy
 - State Environmental Planning Policies (SEPPs)
 - Ballina Local Environmental Plan 1987
 - Ballina Development Control Plans
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Plan Implementation

Some of the recommended management actions in this Plan may require alterations to Council's planning documents and cross referencing with other planning tools. To ensure consistency with the management actions outlined in this Plan, Ballina Shire Council may need to alter the range of land uses permissible in the zones applicable to Lake Ainsworth, or alternatively, a new zone in the Lake Ainsworth locality may assist Council in the implementation of this Plan. Any amendments to Council's Local Environmental Plan regarding Lake Ainsworth would need to be reflected in Council's Development Control Plan No.1 – Urban Lands; and Council's strategic planning documents.

In considering the implementation of the management actions outlined in this Plan, particularly those involving works in the vicinity of Lake Ainsworth, the following legislation should be considered:

- Environmental Planning & Assessment Act (1979)
 - Protection of the Environment Operations Act 1997
 - Local Government Act 1993
 - National Parks and Wildlife Act 1974
 - Threatened Species Conservation Act 1995
 - Native Vegetation Conservation Act 1997
 - Rivers and Foreshores Improvement Act 1948
 - Fisheries Management Act 1994
 - Soil Conservation Act 1938
 - Coastal Protection Act 1979
 - Crown Lands Act 1989
 - Environmental Protection and Biodiversity Conservation Act 1999
 - State Environmental Planning Policy No. 14 – Coastal Wetlands
 - State Environmental Planning Policy No. 26 (Littoral Rainforest)
 - NSW Government Estuary Management Policy
 - NSW Coastal Policy (1997)
 - Department of Lands Coastal Crown Lands Policy
 - Crown Land Foreshore Tenures Policy
 - Crown Lands Caravan Parks Policy
 - Bush Fires Act 1949
 - Catchment Management Act 1989
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What this Plan Delivers

The Plan seeks to implement and regulate actions within the Lake Ainsworth area to ensure that competing uses and processes are managed so that the quality of the lake will be maintained and improved. It seeks to address the community's concerns about the lake, and provide an educational tool for the local community and visitors. The Plan aims to create a balance between natural processes and surrounding land and recreational uses.

The preferred actions chosen for the lake have been formulated from a conglomerate of origins such as community consultation, findings of the Management Study and other studies. While there are some competing uses within the area of the lake and some unknown causes of negative environmental impacts, the management actions for the lake have been recommended to achieve equitable access to lake resources, whilst preserving the natural qualities and processes.

Actions have been formulated for the present conditions and uses of the lake, but they must be continually reviewed as issues and demands may change or evolve over time, placing pressure on the lake. Community opinion may also change through increased awareness and education as to why particular actions may, or may not, be appropriate.

The Lake Ainsworth Management Plan offers recommendations as to how actions should be carried out and by whom, but it does not provide approval for such actions. The relevant procedures still need to be undertaken, and adhered to, when implementing the management actions.

This Management Plan has developed specific actions for each of the following issues:

- Water Quality
- Coastal Dunes Stability
- Traffic Management
- Recreation
- Ecology
- Planning and Development
- Lake Water Level and Flooding
- Erosion and Sedimentation
- Aboriginal Heritage

The actions chosen have been selected to best achieve the management objective for each issue and the overall objectives of the Management Plan, as outlined earlier in the report. The selection

process had regard to community consultation, the study team's assessment and the actual needs and costs associated with each action.

Table 1: Management Objectives

Category	Objective
Management Structure	To establish an integrated catchment management structure for the lake that allows for implementation, monitoring and review of the Lake Ainsworth Management Plan.
Water Quality	To maintain and improve the water quality of the lake to a level appropriate for recreational uses and for the protection of aquatic ecosystems.
Coastal Dune Stability	To maintain and enhance the coastal dune system to assist the survival of Lake Ainsworth as a freshwater lake and to protect the lake's natural values.
Traffic Management	To manage traffic flow and parking to enhance public safety and recreational opportunity, to improve access, reduce erosion and protect ecological values.
Recreation	To maintain and enhance the recreational opportunities, while managing the activities so as to minimise any impact on the lake's aesthetics and ecological values.
Ecology	To conserve and enhance the ecological values of Lake Ainsworth.
Planning and Development	To ensure coordinated management of all land in both the lake's surface and groundwater catchment.
Erosion and Sedimentation	To maintain and enhance the foreshore and catchment of the lake to protect the lake's aesthetic, ecological and recreational values.
Education	To develop systems and programs to educate and inform the community about the values of the lake and the impacts of human activity, to reduce adverse impacts and enhance the lake's values.

Category	Objective
Water Level and Flooding	To minimise the impact of natural variations in water level of the lake, both high and low, so as to protect terrestrial and aquatic ecosystems, and to reduce foreshore erosion and disruption to access and recreational use.
Aboriginal Heritage	To understand, protect and respect the aboriginal heritage value of the lake.

Layout and Terminology

The Lake Ainsworth Management Plan has been divided into the following sections, based on the identified management issues:

- A. Management Structure
- B. Water Quality
- C. Coastal Dunes
- D. Traffic Management
- E. Recreation
- F. Ecology
- G. Planning and Development
- H. Erosion and Sedimentation
- I. Education
- J. Water Level and Flooding
- K. Aboriginal Heritage

For each section, the following information is provided:

- A general background discussion of each issue
- A Management Aim
- An Overall Strategy to achieve the management aim
- A table outlining the issue, the management action/s, the reason/s for their selection

Each Table categorises the priority of each action as shown below:

- High : complete within a year
 - Medium: complete within one to three years
 - Low: complete as resources, e.g. funding, becomes available
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The **Agencies** are described as authorities or groups which have:

- a significant interest in implementing the management action
- provide and/or source funds to implement the management action

Agencies involved in the implementation of the Lake Ainsworth Management Plan are:

- Ballina Shire Council (BSC);
- Department of Land and Water Conservation (DLWC);
- Lake Ainsworth Sport & Recreation Centre;
- Lennox Head Residents' Association;
- Lennox Head Dune Care; and
- Local Aboriginal Land Council (LALC).

The **Costs** are broad estimates for planning purposes (i.e. subject to detailed design, etc.) The cost classifications are:

- Low < \$50,000
- Medium \$50,000 to \$100,000
- High \$100,000 to \$500,000
- Very High > \$500,000

All costs are only for the direct implementation for a particular action. No estimate of costs have been made where an action may have "follow on" effects, such as recommendations for additional work, changes to land prices, employment, etc. Note that costs for ongoing actions are annual costs.

The costs are indicative only, and will need to be more accurately estimated when more detailed design work is completed in association with implementation of various actions.

A. Management Structure

Background

The management of Lake Ainsworth has been overseen by the Lake Ainsworth Management Committee since November 1994. Historically, the area has been managed by Ballina Shire Council, although State Government bodies have been active in various management aspects. To date, there has been little coordination. Today, there is a greater awareness of catchment management and an understanding of the need for an overall Management Plan for the lake.

The need for a Management Plan was identified by the Lennox Head Residents' Association following the outbreak of blue green algae blooms in the lake in the mid 1990s. This was considered to be a significant issue for the lake as it had a negative impact on the recreational use of the lake. Often it was closed due to public health concerns. The release of nutrients from the sediments during periods of stratification has been identified as a significant contributor to these outbreaks and to the lake's water quality problems generally. Clearing around the lake since the 1960s is thought to have contributed to the build up of these sediments in the lake.

To ensure that the lake's environmental qualities are well managed, there is a need to implement an effective management structure which can deliver an holistic management approach. Within this structure, there needs to be an awareness of the different responsibilities of individuals and organisations, and the need to seek approval for actions and to locate funds to implement management strategies.

Overall Strategy for Management Structure

Management Objective: To establish an integrated catchment management structure for the lake that allows for implementation, monitoring and review of the Lake Ainsworth Management Plan.

In formulating the overall strategy for the management structure it should be recognised that:

- Ballina Shire Council alone does not have the resources to implement the Plan;
- the management structure's performance should regularly be reviewed;
- the LAMC has been active in pursuing the State Government's Estuary Management Policy and should continue with an active involvement;
- the Department of Sport and Recreation has been funding the study together with Ballina Shire Council; and
- the Lennox Head Residents' Association has been active in the process and will continue to play an important role in implementing the Plan.

The overall strategy recommended is to operate under the banner of a Memorandum of Understanding (MOU) which would include Ballina Shire Council, Department of Land and Water Conservation, Department of Sport and Recreation, Lake Ainsworth Caravan Park and the Lennox-Alstonville Surf Life Saving Club.

The LAMC will continue to operate in an advisory capacity as a committee of Ballina Shire Council, which will be responsible for the ongoing management of the lake through implementation of the Lake Ainsworth Management Plan. Every two years the Management Plan should be reviewed in terms of performance and effectiveness.

The actions recommended for setting up the management structure are shown in the table below.

Table A Management Structure Actions

Ref	Issue	Management Actions	Reason for Selection	Priority	Agency	Cost
A	Establishment of a Management Structure	1. Formulate Memorandum of Understanding between responsible agencies.	All responsible agencies need a defined management role for the efficient overall management of Lake Ainsworth.	High	All	Low
		2. Review Memorandum of Understanding and agency performance every two years.	Agency interests, roles, responsibilities and abilities to undertake management actions for Lake Ainsworth may change.	High	All	Low
		3. Arrange funding for the various management actions.	It is recognised that the agencies identified as responsible for a management action will need external funding to implement the action.	High	All	Low

Ref	Issue	Management Actions	Reason for Selection	Priority	Agency	Cost
		4. Monitor Performance of Plan.	Regular review of the coordination of the implementation of the Management Plan will be needed to ensure that the actions are being implemented and the Plan is working successfully.	High	All	Low

B. Water Quality

Background

The water quality of the lake has been affected by the presence of algal blooms, which has led to the need for warning signs and the closure of the lake at certain times. These algal blooms are linked to high nutrient levels, with the major source of high nutrient levels being within existing sediment on the lake floor. This sediment has accumulated over time from the decay of plant and animal matter and from the loading in groundwater and surface runoff. It is important to note that the long term and seasonal variability in water quality is unclear due to the lack of long term data.

The natural qualities of the lake, such as the tea-tree colour of the water, prevent light penetration. This allows colder water to become “trapped” beneath the warmer surface waters, which is called “stratification”. When a water body stratifies, algae sink into poorly illuminated depths where they cannot grow. This results in cyanobacteria species flourishing due to the lack of competition. The flourishing of this species can lead to the blooms that have been experienced at Lake Ainsworth.

Blue-green algal blooms are a serious problem as they affect the health and recreational use of the lake. Other water quality problems have occurred from faecal coliform contamination, which appeared to peak in 1990. Various possible sources of faecal contamination were identified in the Lake Processes Study, with the most likely sources being from animal contamination (dogs) and surface runoff, as there was found to be high faecal coliform counts in the drain near the caravan park. The NSW Health Department guidelines for faecal coliforms have rarely been exceeded although this parameter will continue to need careful monitoring.

Groundwater does not appear to be a major source of nutrients to the lake at the present time. Prior to the construction of a sewerage system in Lennox Head, when there were only septic systems, groundwater and surface drainage may have resulted in high nutrient loads flowing to the lake. Other factors that may contribute to high nutrient levels occur during times of low water levels, when water may drain from areas with riparian macrophytes, resulting in high nutrient concentrations in the surface water.

The high level of nutrients and chlorophyll-a are issues that need to be addressed, as both exceed ANZECC environmental guidelines, although there is general compliance with the ANZECC recreational use criteria for these physio-chemical parameters.

Overall Strategy for Water Quality

Management Objective: To maintain and improve the water quality of the lake to a level appropriate for recreational use and for the protection of aquatic ecosystems.

Algal Blooms

The main issue for the management of water quality is to address the high nutrient loads and the occurrence of blue-green algal blooms. The major source of nutrients in the lake comes from the thick organic layer of fine sediments existing on the lake bed.

The management options thought to be most effective at addressing algal blooms include:

- In the short-term, a continuation of the aeration system that is currently being trialled. Qualitative evidence suggests that the system has had some degree of success. However, ongoing monitoring is needed to ensure its continual success and determine why it is not always successful in preventing an algal bloom, such as occurred in Easter 2000.
- Council should compile an environmental database from evidence obtained from the continued monitoring of the aerator's performance. This data set could then form the basis of a reasonably detailed assessment of inter-annual variability algal counts and the environmental factors, such as solar radiation, rainfall, water level, nutrients, etc.

While the degree of mixing produced by the aerator has been sufficient to break down thermal stratification, and possibly prevent phosphorus release from the sediment (internal loading), it is unlikely to produce the amount of turbulent mixing required to make the lake an entirely unsuitable habitat for cyanobacterial growth in the long term. In terms of potential long-term management strategies to deal with the algal bloom problem, the following strategies, in order of highest to lowest ranking, were considered most worthy of further consideration and investigation.

Biomanipulation

This option relates to the ongoing control of algae numbers and types by "natural" means. The major constraint to this process is the need for further study of the existing food web, which would be costly. Prior to being able to be implemented, this technique requires detailed assessment of its viability and potential impacts on the lake. The costs associated with this method are uncertain and it is unknown whether the method would be effective in an aquatic ecosystem such as Lake Ainsworth.

Sediment removal

This option involves removing the existing sediment from within the lake. The main impediment to implementing this method is the disposal of the material to be dredged. The result of the dredging would also create uneven lake floor contours. Another environmental concern with this method is the resuspension of sediments that would result and the liberation of nutrients and toxic substances. In addition this has associated disposal problems and has high costs.

Sediment capping (Lime, Aluminium, Proprietary Product dosing)

In this option, the existing sediment would be capped, effectively blocking the release of sediment into the water column. This process is only a short term option. Recurrent dosing may be required and the method may impact on the humic layer of the lake. In addition, the aluminium capping technique can change the natural conditions of the lake and result in increased light and alterations to the pH of the lake. The likely success of this method is questionable and the costs are considered to be medium to high and ongoing.

Enhanced flushing by groundwater

The restriction associated with this method is the uncertainty of its impact on the groundwater and the Newrybar Swamp. Before this method could be implemented a further assessment of the groundwater resource and associated pumping requirements.

It is recommended that the LAMC investigate these options further before committing any resources to their implementation.

Lake and Groundwater Quality

The water quality improvement strategies which are thought to be most effective in addressing lake and groundwater quality, include (Illustration 3):

- Construct water quality improvement systems, such as mini-wetlands, at the outlets of the existing five stormwater drains to settle out sediments, provide treatment of nutrients and help reduce / dissipate flow velocities. Whilst standard gross pollutant traps (GPTs) are probably not warranted due to the diffuse nature of litter sources and the limited catchment of each of the drains, modern smaller units may be of benefit in reducing the amount of litter and other pollution that enters the lake.
 - Cultivation of further reed beds around the lake foreshore. While they have the potential to reduce nutrients from the lake, they may also provide additional benefits such as reducing foreshore erosion and providing habitat for aquatic fauna;
 - Treatment of runoff from road/parking areas through filter swales. The runoff from the road / parking areas would be deliberately designed to remain diffuse to reduce concentration of flows and increased velocities. This diffuse runoff would be directed over grassed / vegetated
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areas (filter swales) to trap sediment and other associated pollutants (hydrocarbons, PARs, heavy metals, etc) and slow flow velocities to help prevent erosion in accordance with recent water sensitive road design;

- Tighter controls and policing of controls, to reduce the amount of faecal contamination from domestic pets (dogs, horses). In this regard, no animals should be allowed in the lake itself, and dogs should only be allowed within the immediate area if leashed;
- Bund storage and refuelling areas (Sport and Recreation Centre and Caravan Park) to reduce risk of hydrocarbon contamination;
- Remove grass clippings when mowing grass to reduce nutrient influx;
- Improve the distribution of litter bins and regular emptying of bins. Bins should be readily accessible to high use areas. However, they should be located in such a way as to minimise their impact on the recreational and visual amenity of the lake. There will need to be a means of preventing the litter in the bins from being removed by seagulls and other animals;
- Encourage swimmers and sun bathers to 'cover up' as a means of sun protection rather than using excessive amounts of sunscreen. The occurrence of sunscreen-related 'slicks' has been reported during peak usage periods; and
- Minimise erosion and sediment influx to the lake (see Erosion and Sedimentation).

Apart from an improvement in water quality, some other reasons for implementation of these strategies include:

- Some strategies, such as the removal of grass clippings and frequent emptying of garbage bins, merely involve a modification or firming of current practice, with minimal cost involved;
- Strategies such as cultivation of reed beds and construction of mini-wetlands can incorporate a significant component of community involvement, perhaps through the involvement of Lennox Head Dune Care and the Ballina Environment Society; and
- Funding for stormwater runoff improvement strategies, i.e. mini-wetlands and filter swales, may be available through the EPA's stormwater grant system.

Monitoring

A comprehensive review of the existing database and monitoring systems for Lake Ainsworth should be undertaken with the aim of developing an integrated set of biological, physical and chemical indicator trigger levels and monitoring system specific to Lake Ainsworth.

Summary

The management actions that should be implemented to address water quality are:

- to continue with the aeration treatment in the lake;
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- implement various water quality improvement strategies (see Illustration 3);
- continue monitoring while developing new guidelines and monitoring systems specific to Lake Ainsworth;
- further develop and investigate the feasibility of other possible strategies to address algal blooms e.g. sediment capping, enhanced flushing by groundwater, bio-manipulation.

Maintaining and improving the quality of water of the lake will assist in the achievement of the other objectives such as enhancing the quality of flora and fauna and ensuring that the lake is open for recreational and tourist pursuits

Table B Water Quality Management Actions

Ref	Issue	Management Actions	Reason for Selection	Priority	Agency	Cost
B	Algal Blooms	1. Continue current aeration practices.	This system has already been installed and there is evidence to suggest there has been some degree of success.	High	BSC	Low
		2. Set up an environmental database to monitor the effectiveness of the aeration system over time.	Adequate monitoring is required over a longer time frame to effectively evaluate the problems and potential of the system.	High	DLWC and BSC	Medium
		3. Further investigate other strategies – sediment capping, enhanced flushing by groundwater, bio-manipulation, sediment removal.	The strategies are relatively cost efficient and, in some cases, only involve a change of current practices. Some can incorporate significant community involvement.	Low	DLWC and BSC	Medium
	Lake and Groundwater Quality	4. Implement the suite of water quality improvement strategies (mini wetlands, banning of animals, and the like).	The strategies are relatively cost efficient and, in some cases, only involve a change of current practices. Some can incorporate significant community involvement.	Medium	DLWC and BSC	Low

Ref	Issue	Management Actions	Reason for Selection	Priority	Agency	Cost
	Monitoring	5. Continue ongoing monitoring.	Ongoing water quality monitoring is essential to obtaining a detailed understanding of the processes leading to poor water quality and algal blooms in Lake Ainsworth. The data available at present is not sufficient to draw conclusions.	Medium	DLWC and BSC	Low

Other

Set up an environmental database to monitor the effectiveness of the aeration system over time.

Review current monitoring systems and develop new guidelines and monitoring systems specific to Lake Ainsworth.

Tighter controls on dogs and horses.

Continue ongoing monitoring

Provide new clusters of locally endemic wetland species including sedges and peripheral aquatic plants

Implement water quality improvement strategies

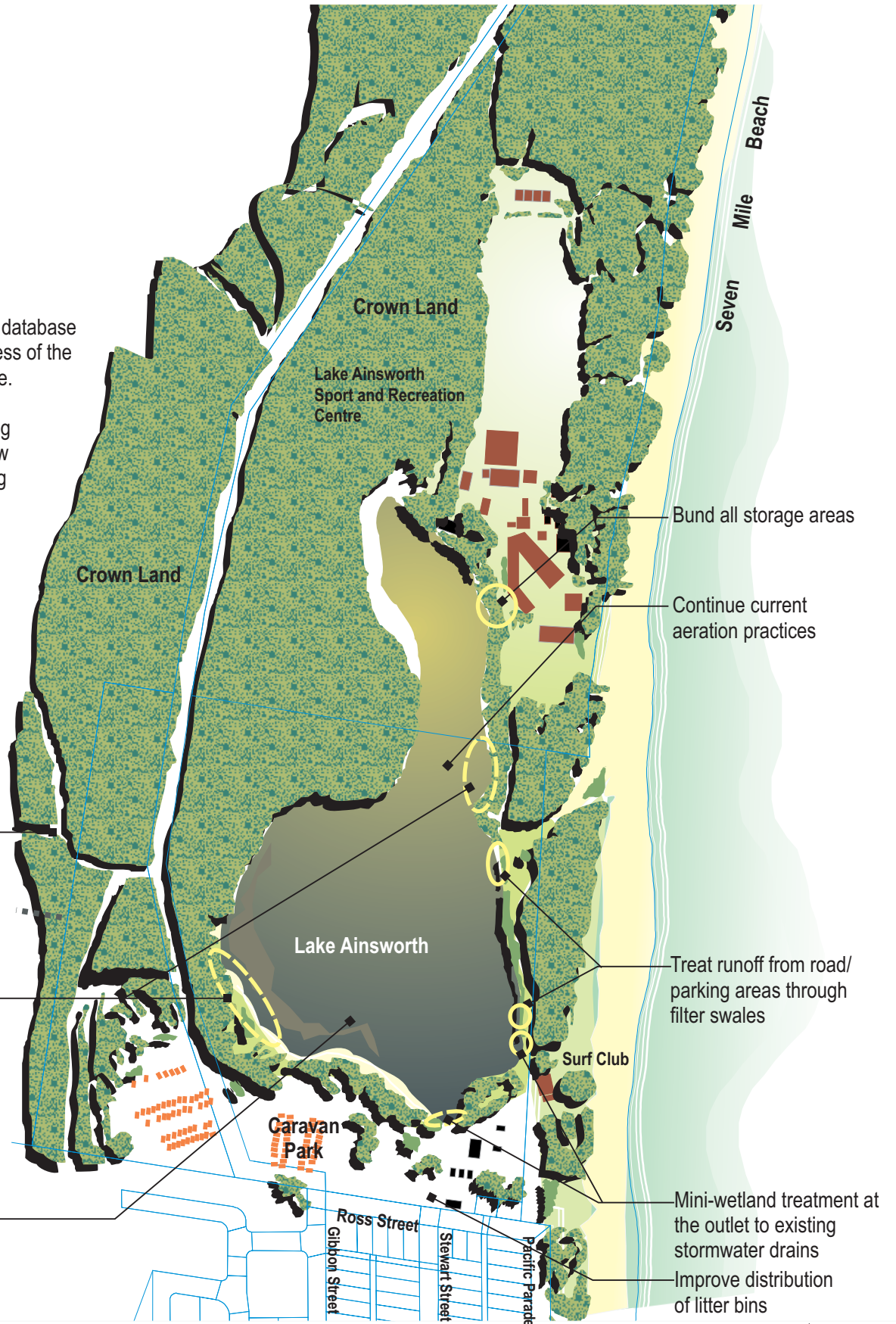


Illustration 3

Water Quality Management

99125804

Source: GeoLINK

Date: November 2002

quality solutions sustainable future

C. Coastal Dune Stability

Background

The long term recession of the dunal system on Seven Mile beach may result in changes to the dunal system in front of the lake. This is the natural process of progressive landward movement of the back beach escarpment that is occurring along much of the NSW North Coast. The dunal system can recover from low intensity storm events although this continual net landward movement of the escarpment may lead to the risk of oceanic inundation of the lake area. This would most likely occur by waves overtopping or destroying the dunal system. Given that Lake Ainsworth is a fresh water lake, breaching of the dunes and salt water inundation of the lake would drastically affect its ecological balance.

The long-term recession of the beach has been calculated from photogrammetric analysis at approximately 0.9 m/year (NSW Public Works, 1994) and earlier calculated at 1.0 m/year (Lennon, 1983). Observations by DLWC in 1996 indicated that the scarp was stable over a 2 year period. AWACS (1996) attributed this to good dune management practices and a period relatively free from major storm events. The Ballina Shire Coastline Hazard Definition Study is currently in progress and will include an assessment of any further shoreward movement of the shoreline since 1994.

Short term movements of the scarp due to storm action can be much greater, however, there is subsequent recovery of the dune as sand is redistributed by the beach process. A storm in 1996 resulted in the dune scarp moving approximately 13 metres landward. There is always a possibility that a succession of strong storms may lead to oceanic inundation of the lake.

The dunal system in front of Lake Ainsworth is well vegetated and any affects from wind erosion are reduced due to the sand being bound by dunal vegetation. Whilst the dunes remain well vegetated, it is unlikely that blowouts or migrating dunes will move into the Lake Ainsworth area.

It has been suggested that the 4WD track has the potential to create a "wind tunnel" for sand to be transported from the beach into the lake area (Warren, 1994). However the winds in the locality are predominately from the south-east, and the track runs in a north-easterly direction. Therefore, the track is not considered to create a major hazard. It does, however, provide a "weak point" in the dunal system and may, in a large storm event, allow entry of salt water storm surge.

The Greenhouse Effect is thought to result in increasing sea levels, which is predicted to accelerate over time. The scenario of a rising sea level associated with the postulated warming of the atmosphere, (the enhanced Greenhouse effect), will result in beach recession and a change to predominant weather patterns. Shoreline position and alignment may change as foreshores adjust to increased storminess, higher waves, increased sea levels and any changes to the direction of wave attack (NSW Government 1990). The future changes in storm frequency and intensity and the associated realignment of foreshores to new weather patterns is not well defined at present. These possibilities are generally accommodated through the implementation of management strategies which are flexible and robust; able to accommodate or be adapted to a range of possible future changes. These potential changes need to be accommodated in planning coastal development.

The revised predictions of sea level rise (IPCC 1995) are best estimates of the likely impact of climate change over the next 100 years. These predictions have been made on the basis of improved models that generate results with increased confidence. A method for estimating foreshore recession associated with a sea level rise based on the near shore slopes and the depth of the active profile has been postulated by Bruun (1962) and may be generally applied to sandy beach systems. As an example, for an average beach slope of 1 (vertical) in 40 (horizontal), a landward recession of 9 m would occur following a 0.23 m sea level rise over a 50-year period. The postulated sea level rise of 0.04 m over the next ten years equates to a 1.5 m landward movement of the dune scarp. The only protection available for the lake involves maintaining a stable and well-vegetated dune system between it and the ocean.

Overall Strategy for Coastal Dune Stability

Management Objective: To maintain and enhance the coastal dune system to assist the survival of Lake Ainsworth as a freshwater lake and to protect the lake's natural values.

The existing dune care works, as coordinated and undertaken by the Lennox Head Dune Care group, should be continued and possibly expanded. The aim of this work is to restore and maintain the natural dune buffer between the lake and the ocean to accommodate allowance for storms.

Observations of beach scarp by DLWC in 1996 indicated that the scarp had been stable in the two-year period following the last date of photogrammetric analysis (i.e. 1994). AWACS (1996) attributed this to a combination of good dune management undertaken in the area, and the fact that the locality has been relatively free of major storm events.

The purpose of an effective dune vegetation management system is to provide stability to the dune system, and to aid in the quick recovery of the dunes following severe storms. Whilst stabilising the dunes, such a system provides the means for the community to enjoy the widest possible range of coastal oriented activities without degrading the resource base which supports them (Coastline Management Manual 1990). While such a system can serve to buffer the effects of coastal erosion on a receding coastline as has been identified at Seven Mile Beach, it can only serve to reduce the rate of shoreline recession, rather than stop the recession altogether.

It should be noted that Ballina Shire Council has engaged consultants to undertake a coastline hazard definition study, which would include analysis of aerial photography up to and including the most recent photography. The findings of such a study would provide a more up-to-date assessment of the coastal hazard throughout Ballina Shire and would provide the opportunity to reassess management strategies for the whole of Seven Mile Beach, including the section adjacent to Lake Ainsworth. This will provide the opportunity to reassess the degree of hazard and suitable management strategies for the whole of Seven Mile Beach, including the section adjacent to Lake Ainsworth.

Ultimately, as shoreline recession proceeds and natural processes are no longer able to regenerate the dune following storm events, intervention works of some description will most likely be required to maintain the dune buffer.

The continuation of the current dune care strategy promotes a high level of community involvement, which has flow-on benefits of promoting community awareness and education, as well reducing the immediate need for 'harder' and more costly protective measures.

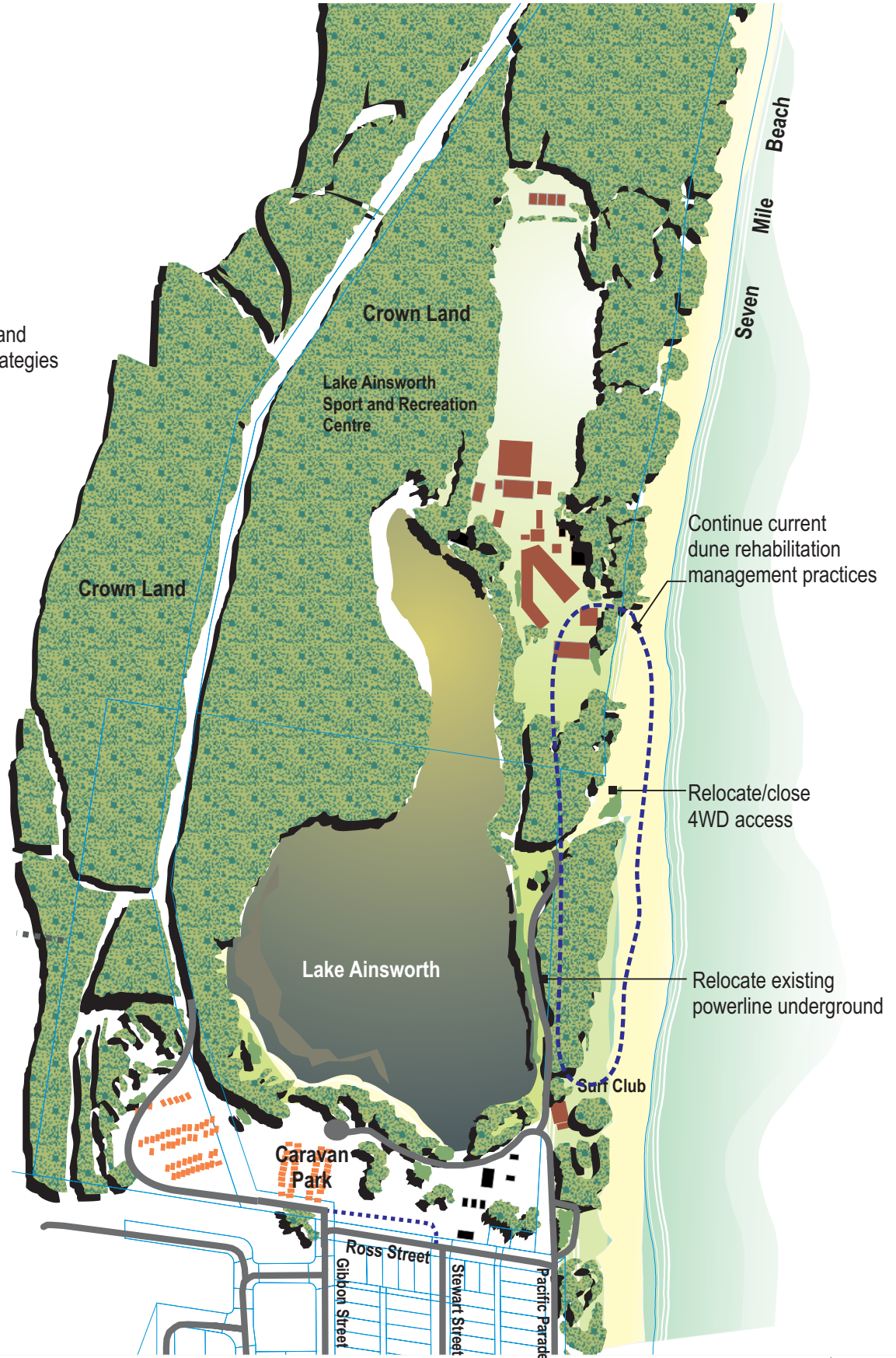
Some long-term management strategies that might be considered to augment the dune rehabilitation activities, in accordance with the NSW Government's Coastline Management Manual, include:

- beach scraping;
 - beach nourishment; and
 - terminal revetment (Sea Wall).
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Table C Coastal Dune Management Actions

Ref	Issue	Management Action	Reason for Selection	Priority	Agency	Costs
C	Establishment of an effective buffer with coastal dunes to protect the lake.	1. Continue current dune rehabilitation management practices and provide appropriate funding/resources.	The aim of this work is to restore and maintain the natural dune buffer between the lake and the ocean to provide protection for the lake against storm events.	High	DLWC, BSC and Lennox Head Dune Care Group	Low
	Need to address long-term recession of dunes.	2. Assess coastal hazards and suitable management strategies.	This will provide the opportunity for the BSC to consider suitable management strategies for Seven Mile Beach, such as consider other strategies that will assist rehabilitation strategies.	Medium	BSC	Unknown
	Ensure stability of dunal vegetation.	3. Remove and relocate existing powerline underground.	This will ensure the establishment of mature trees on the dunal system, increasing stability and preventing erosion.	High	BSC	Unknown

Other
Assess coastal hazards and
suitable management strategies



D. Traffic Management

Background

Traffic in and around Lake Ainsworth has been identified as an issue of concern to the community. This is relevant in terms of access, safety and layout of the service areas.

Lake Ainsworth has a road to its east which is used to access the lake, the Sports and Recreation Centre and the 4WD access road. The eastern road has problems in terms of safety, as picnic tables are provided east of the access road, meaning visitors have to cross the road to get to and from the lake and picnic tables.

Other problems that currently exist include accessing the Sports and Recreation Centre during times of flooding, as the eastern road becomes inaccessible and the western road must be used. The existence of two access roads around the perimeter of the lake has been questioned as an effective management tool.

The 4WD drive access onto Seven Mile beach is via the end of the eastern road into Lake Ainsworth, which has the effect of increasing the traffic into the area as well as contributing to erosion via the opening through the coastal dunes. Further erosion is thought to occur through informal carparking which leads to parking into the dune and vegetated areas.

The high visitation to the lake during weekends and holiday periods increases the problems of safety and access to the lake. This issue has been identified by the community as being worthy of careful consideration.

Overall Strategy for Traffic Management

Management Objective: To manage traffic flow and parking to enhance public safety and recreational opportunity, to improve access, reduce erosion and protect ecological values.

The range of management measures recommended is shown on Illustration 5. As shown, it is recommended that the lake entrance road, adjacent to the surf club at the south-east of the lake, be realigned so that the left turn and movement along the southern foreshore becomes the priority. Additional parking is also proposed in this immediate area, by utilising the north-east corner of the caravan park.

The southern foreshore road, which currently connects to the existing unsealed road to the west and north of the lake, will be terminated at a cul-de-sac, with a new connection road to the western access being provided off Ross Street and aligned around the western end of the caravan park.

Together with the closure of the 4WD access track, this will reduce traffic numbers, by diverting or removing traffic not directly associated with the lake.

Within the eastern road, it is recommended that, as far as is practical, picnic facilities be located to the west, between the road and the lake, so that there is no need for children to cross the road. Although opportunities are limited, it is also recommended that this road be slightly realigned so as to introduce gentle curves. Such realignment can be achieved in limited spaces by a very slight shift to the east. No trees are to be removed for this, and no excavation into the base of the dune is proposed.

In the vicinity of the existing amenities and 4WD track, the turn-around area is to be reconfigured to provide a minimum sized cul-de-sac with parking optimised. The entrance into the Sport and Recreation Centre is also to be reconfigured and sign-posted so that it is clear that access is to that facility only.

In reconfiguring this eastern road, drainage measures can be implemented such that run-off from the road can be discharged to the eastern side, collected and treated prior to discharge.

As indicated above, additional parking is recommended in the south-east corner, utilising a small section of the caravan park. It is also recommended that parking in Ross Street be optimised by shoulder widening/sealing (if needed) and line marking.

By implementing the management measures shown in Illustration 5, the issues of safety, erosion and continual access to the various facilities around Lake Ainsworth can be addressed. By formalising the access roads and carparking, the erosion caused from vehicles parking into the dunes and driving off the roads can be minimised or avoided. The movement of the majority of the picnic tables to the western side of the eastern road will reduce the problems with safety as people will no longer need to continually cross the road. Access will be continued to the Sports and Recreation Centre to the east and west, therefore there will not be problems associated with access during times of flooding.

The relocation of this southern foreshore road will allow for the provision of further open space areas, available for picnicking and the like. On the remaining section of road, additional nose-in parking can be provided, increasing overall parking availability as well as formalising a location for the local markets.

This management option will improve safety and increase pedestrian amenity and recreational facilities in the area east of Lake Ainsworth. Further safety and pedestrian amenity will be achieved by reducing vehicle and pedestrian conflicts through the introduction of formalised carparking and reducing the vehicle traffic through the removal of the 4WD track from this vicinity. The designated vehicle turning area will be a safer option than turning in front of the picnic and lake area. The creation of a recreation area to the western end of the road between Lake Ainsworth and the caravan park will increase visitors' amenity and appreciation of the area.

There are some issues of concern that need to be considered when implementing these traffic management measures. Vehicle access to the Sports and Recreation Centre will not be quite as direct as currently available. The relocation of the picnic tables will result in a loss of shade to some of the tables. The recreation areas will thus be intensified on the lake fringe. This could result in additional stress to the lake's banks through processes such as erosion.

The 4WD access area will be closed in the existing location, and possibly relocated to the north, although this will be the decision of the Coastal Management Committee. This area will be redeveloped into additional car parking spaces and a vehicle turn-around area. If an alternative 4WD track is to be provided, in deference to Council's current policy of allowing 4WD access to this section of Seven Mile Beach, then this could be provided to the north of the Sport and Recreation Centre utilising the western road for access.

Table D Traffic Management Actions

Ref	Issue	Management Action	Reason for Selection	Priority	Agency	Cost
D	Safety of the visitors to the lake and problems with access to Sports and Recreation Centre during times of floods	1. Reconfigure the eastern road alignment and discourage motorists from entering the Sport and Recreation Centre. Move the majority of the picnic tables and facilities to the western side of the road.	This will maintain access to the Sports and Recreation Centre but will reduce traffic flow through the closure of the 4WD track. The majority of the picnic tables on the western side of the road will reduce conflict with pedestrians and traffic. The meandering road alignment will slow the traffic and improve pedestrian safety.	High	BSC	Medium
	Traffic numbers on existing eastern road	2. Remove or relocate existing 4WD beach access.	This will reduce traffic usage, as 4WD vehicles will no longer use this road.	High	BSC	Low - Medium
	Erosion in areas adjacent to the lake	3. Prohibit foreshore parking and provide designated parking areas.	This will reduce foreshore erosion associated with carparking.	High	BSC	Medium
	Visitor amenity and safety at the lake and surrounds	4. Close part of the existing road between the lake and the caravan park and create a sealed road from Ross Street, around the back of the caravan park to connect to the western access road.	This will reduce through traffic adjacent to the southern foreshore and improve the safety of visitors to the area. It will also provide additional useable open space and areas for parking. The sealed road will ensure that access will be maintained to the north.	High	BSC	Medium



E. Recreation

Background

The lake is a popular place for recreational activities. It provides a safe place for children to swim and provides safe waters for amateur sailboarding and sailing. The lake also provides a relaxing atmosphere for swimming as well as being a preferred option for beach users when the beach is unsuitable. It is also well used for passive recreation such as barbeques, walking and bird watching. Markets are held to the south of the lake on the second and fifth Sunday of every month, except in peak holiday times such as Christmas and Easter. Dogs are currently permitted at Lake Ainsworth, provided they are leashed.

A summary of the recreational activities undertaken at the lake is provided below:

- | | |
|---------------------------------|--|
| Waterway Recreation: | <ul style="list-style-type: none">• swimming• sailing/sailboarding• canoeing/kayaking/ski paddling |
| Catchment/Foreshore Recreation: | <ul style="list-style-type: none">• picnicking• walking• bird watching• markets• photography/painting• dune care/revegetation• relaxation/meditation• sunbathing• enjoying wildlife (e.g. feeding ducks)• horse riding, dog walking• Sport and Recreation Centre educational and recreational activities |

Until recently, sailboards, catamarans and single and double skis were available for hire on the eastern shores of Lake Ainsworth. The hire operator also offered sailboarding lessons. It is expected that another operator will take up the licence to operate this facility in the future.

The number of visitors to the lake is considered rather consistent throughout the year with approximately 400 cars per day, although significant increases occur over holiday periods, to

approximately 1000 cars per day (Ballina Shire Council, 1996). Through a social survey of the carrying capacity of Lake Ainsworth, it was estimated by Jones (1988) that the lake's carrying capacity is about 560 people. At peak times, numbers reach double this figure, therefore it is understandable that overcrowding and associated problems were noted as a concern for the community.

Overall Strategy for Recreation

Management Objective: To maintain and enhance recreational opportunities, while managing the activities so as to minimise any impact on the lake's aesthetics and ecological values.

The following strategies are recommended to improve recreational amenity at the lake in order of priority (Illustration 6):

- provide pedestrian access paths and walking tracks;
- continue to provide designated swimming and watercraft areas. Signage to delineate the two zones should be made clearer. The provision of an offshore pontoon would help to delineate the two zones as well as easing foreshore congestion during peak periods;
- upgrade existing BBQ and picnic facilities. In particular, the replacement of wood-fired BBQs with electric BBQs would reduce damage to vegetation caused by people gathering kindling to light fires;
- the Lennox Markets should be allowed to continue at the lake on the proviso that the preferred traffic management strategies are implemented. However, if the southern foreshore road is to continue to operate and if alternative parking areas are not provided, then consideration will need to be given to finding a suitable location to relocate the markets; and
- the provision of a launching ramp and pontoon or jetty would provide improved access to the lake under varying water levels and reduce localised erosion in the vicinity of launching areas.

Providing a launching area for sailboats and sailboards would involve upgrading the existing area on the eastern foreshore with a launching ramp and foreshore facilities (e.g. jetty and/or pontoon) or alternately, providing new launching facilities elsewhere (e.g. south-west of the swimming area).

The provision of new electric BBQs and improved picnic facilities, and replacement of existing wood-fired BBQs with electric BBQs would upgrade the picnic and BBQ area and increase visitors' enjoyment. The provision of pedestrian access paths and walking tracks would involve constructing pedestrian access paths and walking tracks/ boardwalks around the lake. Concrete paths could be provided on the eastern and southern foreshore areas that could also serve as bicycle tracks. It has been suggested that a minimum impact raised timber boardwalk be provided on the western side

of the lake that could link with a similar structure to be constructed from the Sport and Recreation Centre in the north. This walkway would be designed to pass through all of the vegetation types with educational plaques at strategic locations to explain the various habitats.

Designated swimming and watercraft (sailing/canoeing) areas, particularly during high usage months, would help reduce conflict between the various recreational users of the lake. This would ensure that these areas are adequately delineated through appropriate signage and education. The existing swimming area is difficult to distinguish from the water, which may lead to sail craft inadvertently straying into this zone. An information board at the entrance to the lake and in the vicinity of the launching areas, which provides a map of the lake showing the various uses permitted in different zones, may be useful. When hiring sailing equipment, clients should be made aware of the restricted areas (see Education).

The use of buoys to delineate swimming zones from other areas has been suggested, however it has proved difficult to maintain buoys in Lake Ainsworth in the past due to theft and/or vandalism. Another suggestion has been to provide a floating pontoon offshore from the swimming area that could serve to delineate the swimming area from the rest of the lake, as well as easing the load on the foreshore from swimmers during peak periods.

Table E Recreation Management Actions

Ref	Issue	Management Action	Reason for Selection	Priority	Agency	Cost
E	Potential erosion caused by sail craft	1. Provide a launching area for sailboats and sailboards.	This will prevent further erosion of the lake's edge and will also help delineate the two zones.	Medium	BSC	Medium
	Damage to vegetation by wood fires and increasing visitor enjoyment	2. Upgrade picnic and BBQ facilities.	By replacing the BBQs with electric BBQs it will prevent the damage to vegetation caused by people gathering kindling for fires. The upgrade of picnic tables will allow greater enjoyment for visitors to the lake.	Medium	BSC	Medium
	Erosion and damage to vegetation by visitors walking in undefined areas.	3. Provide pedestrian access paths and walking tracks.	This will ensure that pedestrians do not disturb vegetated areas, gain greater appreciation of the area, and provide safety for visitors walking on paths rather than roads.	Medium	DLWC and BSC	Low/ Medium
	Use of area for markets	4. Allow the Lennox Markets to continue.	This would be continued on the basis that the traffic management strategies are implemented.	Medium	BSC	Medium
	Reduce conflict with the different recreational users of the lake	5. Provide designated swimming and watercraft areas. Signage should be made clearer. An offshore pontoon would assist to separate swimming zones from the rest of the lake.	This will help to avoid conflict between swimmers and those using water crafts.	Medium	BSC	Low



F. Ecology

Background

To the north of the lake there is an extensive area of low-lying heath dominated by coastal banksia (*Banksia integrifolia*), wallum banksia (*Banksia aemula*), broom heath (*Monotoca elliptica*) and coastal wattle (*Acacia sophorae*). There is a wide diversity of flora and fauna in this area, with over 60 plants species being identified in the coastal strip south from the Sports and Recreation Centre (Don Apps, pers. comm.).

The dunal system to the east of the lake includes bitou bush (*Chrysanthemoides monilifera* spp. *rotundata*), coast banksia (*Banksia integrifolia*), coastal wattle (*Acacia sophorae*), and tuckeroo (*Cupanopsis anacardioides*). The land to the south of the lake contains the Lennox Head Caravan Park, although a few paperbark (*Melaleuca quinquenervia*) trees are scattered near the lake's edge, with a few cycads in the north-eastern corner.

Low lying heath, similar to that found to the north of the lake, is also located to the west. Further west of the site is an area dedicated as SEPP 14 Wetland. Some clearing for boating and camping purposes on the western fringe of the lake has interrupted the established cumbungi (*Typha orientalis*). The Ecology Lab, which carried out the flora and fauna assessment for the Lake Processes Study, suggested that recreational use of the foreshore may be preventing cumbungi (*Typha orientalis*) from recolonising more of the south-western corner. However, the heavy rainfall in 1999 caused the level of the lake to rise considerably and to remain at a level that was higher than the southern access road to the Sport and Recreation Centre. This elevated water level is more likely to have led to a decline in cumbungi in recent times rather than recreational activities.

The north western corner of the lake contains a variety of macrophytes such as waterlilies, creepers, water primrose (*Ludwigia peploides* spp. *Montevidensis*), rushes (Family Juncaceae and Cyperaceae), grasses (Family Gramineae) and several free floating species (Family Azollaceae and Lemnaceae). The riparian vegetation in this area is mostly paperbark, with an understorey of ferns (Family Dennstaedtiaceae), tea-tree and other heath species. Patches of macrophytes, including the introduced yellow waterlily (*Nymphaea mexicana*), native water snowflake (*Nymphoides indica*), the noxious salvinia (*Salvinia molesta*) and duckweed (*Lemna* sp.) occur along the eastern perimeter of the lake. Rushes (Family Juncaceae), sedges (Family Cyperaceae) and grasses (Family Poaceae) are poorly developed due to the elevated water levels experienced in recent years.

During the 1960s, most of the eastern and southern portions of the lake were cleared of nearly all riparian and littoral vegetation to provide areas for recreation. There are a few remaining strands of

cumbungi (*Typha orientalis*) and some paperbarks. In recent years the Lennox Head Residents' Association have planted mainly broad-leaved paperbark (*Melaleuca quinquenervia*) and some self-sown Casurinas sp. along the lake's foreshore in an attempt to improve the water quality and restore the foreshore (Don Apps, pers. comm.). These plantings are now well established in clumps. Trampling along the foreshore has prevented the establishment of rushes and sedges, although some exist around the paperbarks that are close to the lake water's edge in the north-eastern corner. There is also a large stand of water lilies (*Nymphaea violacea*) in this area.

More recently, however, water primrose (*Ludwigia peploides* spp. *montevidensis*) has extended extensively into the lake. Water primrose was also well established along the eastern shoreline but was removed by hand and used for mulch on the frontal dunes (Don Apps, pers. comm.).

The Ecology Lab described the few aquatic fauna studies undertaken at Lake Ainsworth as not comprehensive. However, firetailed gudgeons (*Hypseleotris gali*) and the freshwater or eel-tailed catfish (*Tandanus tandanus*) were reported (Timms 1982, Saenger 1988 cited in Ecology Lab 1996) and more recently, bass (*Macquaria novemaculeata*) have been captured (Don Apps, pers. comm.) The ubiquitous mosquito fish (*Gambusia holbrooki*) was reported by the Ecology Lab and noted during site inspections undertaken for this management study.

Two species of freshwater turtle/tortoise have been recorded in the lake by Phil Buckland of the Lake Ainsworth Sport and Recreation Centre. These are the saw-shelled turtle (*Elseya latisternum*) and eastern long-necked tortoise (*Chelodina longicollis*). Phil Buckland has also recorded nine species of frogs although the most common species is the introduced cane toad (*Bufo marinus*).

Invertebrates in Lake Ainsworth were studied by Bayly (1964), Timms (1982) and Saenger (1988). Timms suggested that the presence of the fish and the paucity of littoral vegetation accounted for a reduction in diversity and abundance of invertebrates compared to what he expected. The benthos sampled included several species of insect larvae (see Timms 1982; Saenger 1988), and the zooplankton contained a single species of crustacean, the copepod *Calamoecia tasmanica*, and occasionally a planktonic watermite (Timms 1982). *Eucyclops nicholli* was often found in the littoral region, occasionally accompanied by *Macrocyclus albidus* (Bayly 1964).

Since the Lake Processes Study was completed, opportunistic or incidental fauna records from the Sport and Recreation Centre environs have been gathered by Phil Buckland. These include nine frog species, 21 lizards and snakes, eight mammals including the threatened common planigale, (*Planigale maculatus*) and 115 species of birds.

Overall Strategy for Ecology

Management Objective: To maintain and enhance the ecological values of the lake by managing weeds and introduced fauna, and undertaking continued foreshore planting.

The following strategies should be undertaken to enhance the lake's ecological values (Illustration 7):

- Management of aquatic weeds within the lake. Of particular concern is the spread of water primrose. Council should liaise with, and provide assistance to, community stakeholder groups (i.e. Lennox Head Dune Care and Lennox Head Residents' Association) in this regard.
 - Management of terrestrial weeds and native planting around the lake's margin and the coastal dunes. Past efforts by the Lennox Head Dune Care group, and more recently the Lennox Head Residents' Association and Lake Ainsworth Sport and Recreation Centre, have resulted in an increase in species richness around the lake. Such programs should be supported and continued. Once again, Council should liaise with, and provide assistance to, community stakeholder groups in this regard.
 - Management of introduced fauna. The development and introduction of introduced species should be monitored and steps taken to eradicate them where practical. While programs to eradicate or reduce the density of species such as the mosquito fish are unavailable at this time, research in this area should be monitored for possible future application. Revegetation of some of the grassy margins around the lake is recommended as a means of reducing the development of the cane toad population.
 - Implementation of Vegetation Management Plans written for Lake Ainsworth by ENVITE.
-

The management of aquatic weeds within the lake strategy involves ensuring that the spread of water primrose and other aquatic weeds is controlled. A trial hand removal program of water primrose has been conducted by Don Apps of Lennox Head Dune Care over a two-year period along the lake's eastern margin. This program amply demonstrated that five man-days in the first year followed by four days in the subsequent year were sufficient to remove the major infestation of water primrose. A similar effort is urgently required along the western lake margin as water primrose currently covers a significant portion of the lake. Other aquatic species (e.g. salvinia) are of lesser concern but require monitoring. There has been release of a biological control agent to combat salvinia in the lake. This was believed to have occurred a number of years ago with NSW Agriculture at Grafton having been involved. This may be the reason why salvinia is now of lesser concern.

The management of terrestrial weeds around the coastal dunes and the lake margin has been successfully undertaken over the past decade by the Lennox Head Dune Care group. More recently, the Lennox Head Residents' Association and the staff, especially Mr Phil Buckland, of the Lake Ainsworth Sport and Recreation Centre, have undertaken some significant regeneration and management programs.

The increase in species richness as a result of these programs is remarkable and contrasts with areas of coastal dunes to the south of the site which are heavily infested with bitou bush. Much of the dune management work in the immediate vicinity of the lake and Sport and Recreation Centre has been completed. However, bitou bush is known to spread seeds at a rate of 4,000 per m² and will require monitoring and management for a considerable period of time.

The management programs undertaken to date allow for accurate predictions of the effort and costs required to complete them. Council should liaise with the stakeholder groups to determine their needs and priorities, and continue to support their endeavours.

Two introduced vertebrate species, the mosquito fish and cane toad, are known to impact on native animal assemblages. The Scientific Committee, established by the *Threatened Species Conservation Act*, recently made a final determination to list predation by *Gambusia holbrooki* (mosquito fish or plague minnow) as a key threatening process under Schedule 3 of the Act. However, programs to eradicate or reduce the density of this species are unavailable.

The cane toad is also known to impact on native fauna and some management strategies have been recommended to reduce their density. The most practical management option is the revegetation of riparian margins and the reduction of grassed areas near water bodies (Seabrook 1991).

Table F Ecology Management Actions

Ref	Issue	Management Action	Reason for Selection	Priority	Agencies	Cost
F	Spread of aquatic weeds.	1. Control the spread of water primrose and other aquatic weeds.	Reduce the effects of stratification of water column and low dissolved oxygen levels.	High	BSC, Lennox Head Dune Care and Lennox Head Residents' Association	Low
	Spread of terrestrial weeds.	2. Rehabilitation and restoration of areas infested with terrestrial weeds.	The reduction of weed species around the perimeter of the lake and the adjoining dunal areas will reduce the competition with native species. If necessary, planting around the lake of endemic native species may help assist the reduction of erosion and reduce weed species becoming re-established.	High	Lennox Head Dune Care, Lennox Head Residential Association and Lake Ainsworth Sport and Recreation Centre	Low
	Spread of introduced fauna.	3. Implement action plans to target specific species for their eradication.	Specific plans are needed to address specific strategies for particular introduced fauna such as the mosquito fish and the cane toad.	High	BSC, DLWC	Low/ Medium

Ref	Issue	Management Action	Reason for Selection	Priority	Agencies	Cost
	Control and reduce weed species around the lake's edge.	4. Implement ENVITE's Vegetation Management Plans when completed.	The need for restoration and rehabilitation requires effective guidelines for volunteers and others engaged in the maintenance of Lake Ainsworth.	High	ENVITE, Conservation Volunteers, 'Work for the Dole', Lennox Head, Dune Care, Lennox Head Landcare.	

Other
Implement action plans
to target specific introduced
fauna for eradication

Control the spread
of aquatic weeds



G. Planning and Development

Background

The Lake Ainsworth area is within Crown Reserve 82783 for Public Recreation, which covers the southern half of Lake Ainsworth and the Lake Ainsworth Caravan Park, and is managed by Ballina Shire Council. The northern portion is within Crown Reserve 84109 for National Fitness and Physical Education which is managed by the Department of Sport and Recreation.

Currently the Lake Ainsworth area is enjoyed for a variety of land uses, such as:

- Lake Ainsworth Caravan Park directly to the south and urban development further south;
- Lennox Head/Alstonville Surf Life Saving Club to the south-east;
- Lake Ainsworth Sport and Recreation Centre land to the north and west, and Camp Drewe further to the north; and
- Aboriginal lands further to the north and west.

Land use in the local area is controlled under the Ballina Local Environmental Plan 1987. Ballina Shire Council zonings and reserve boundaries are shown in Illustration 8. Pursuant to this Plan, the lake itself, together with the majority of the surrounding land, is zoned 7(f) Environmental Protection (Coastal Lands). The objectives of this zone are shown below:

A. *The primary objectives are:*

(a) to protect environmentally sensitive coastal lands; and

(b) to prevent development which would adversely affect or be adversely affected, in both the short and long term, by the coastal processes.

B. *The secondary objective is to enable the development of public works and recreation amenities where such development does not have significant detrimental effect on the habitat, landscape or scenic quality of the locality.*

C. *The exceptions to these objectives are:*

(a) to permit the development of public works, outside the parameters outlined in the primary and secondary objectives, only in cases of demonstrated and overriding public need and subject to the impact on the coastal lands being minimised, as much as is reasonably practical; and

(b) development of surf life saving, environmental education facilities and like facilities.

These objectives are obviously aimed at protecting the coastal environment, and this is further emphasised by the following 'Special Provisions' of the Plan:

Clause 23 – Development within Zone No. 1(d), 7(c), 7(d), 7(f), or 7(i)

A person shall not, on land within Zone No. 1(d), 7(c), 7(d), 7(f) or 7(i):

- A. notwithstanding clause 8 of the Environmental Planning and Assessment Model Provisions 1980, cut down, top, lop or otherwise destroy a tree (other than a tree planted for commercial or landscape purposes); or*
- B. clear, fill or otherwise alter the surface level of land, without the consent of the council.*

Clause 32 – Concurrence of Director – Zone No. 7(f)

- A. The council shall not consent to the carrying out of development within Zone No. 7(f) for any purpose except with the concurrence of the Director.*
- B. In considering whether to grant concurrence under subclause 1, the Director shall take into consideration:
 - (a) whether any environmental issues are involved in, or raised by, the proposed development;*
 - (b) if so, whether adequate safeguards and rehabilitation measures have been, or will be, made to protect the environment;*
 - (c) whether the development complies with the objectives of Zone No. 7(f) as set out in the Table to clause 9.**

Clause 35 – What is exempt and complying development?

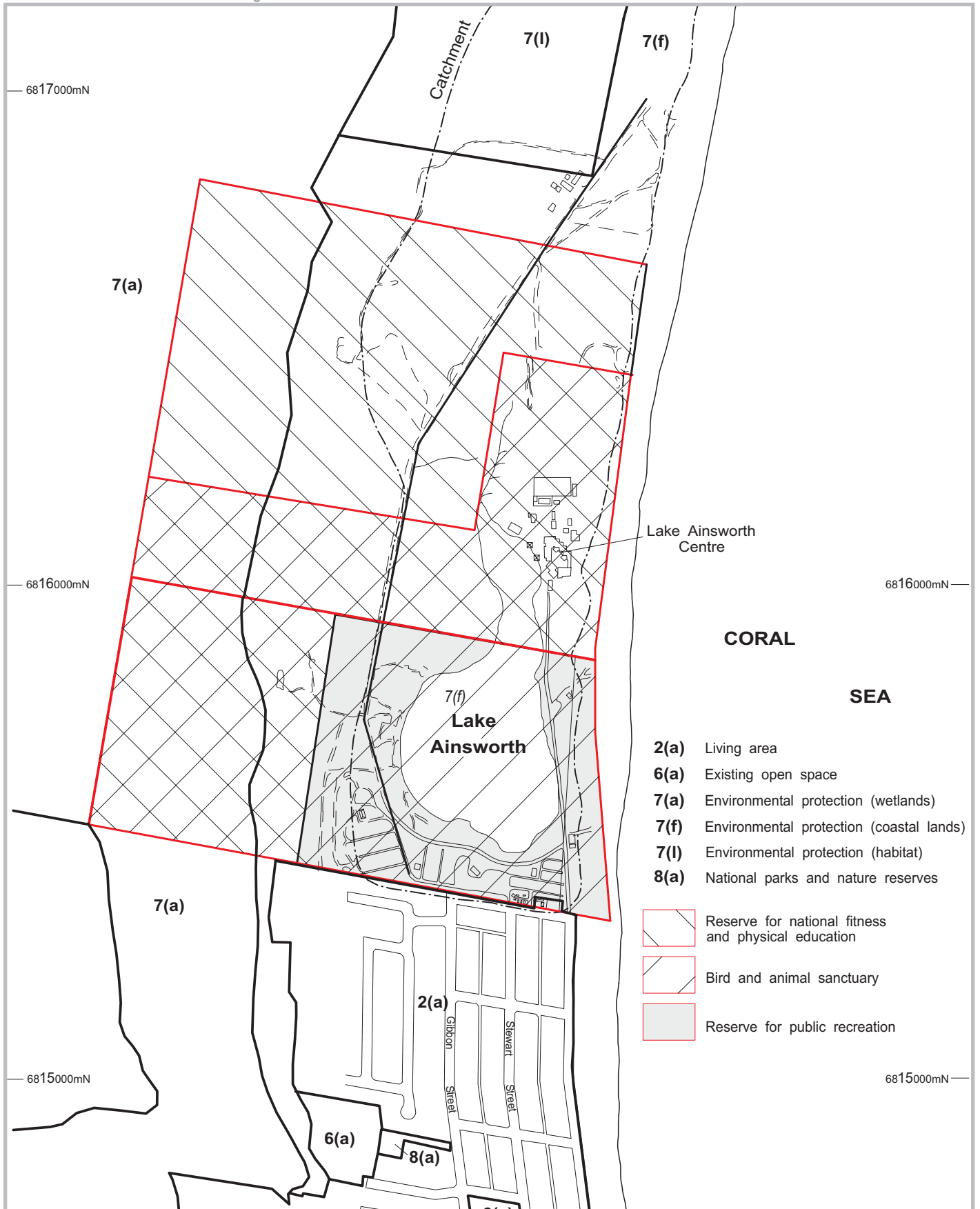
This clause allows a range of public works to be conducted on the land without development consent under the provisions of Part V of the *Environmental Planning and Assessment Act 1979*.

Future use of the area will be guided, in part, by the provisions of Ballina Local Environmental Plan 1987. As described earlier, the lake and its surrounds are zoned 7(f) Environmental Protection (Coastal Lands). Within that zone, there is no development allowed without the consent of Council (although there are some minor uses or public work uses that are 'exempt' and do not require consent). Listed within the Plan as being permissible with development consent in this zone are:

- agriculture; beach amenities; bush fire hazard reduction; camping grounds; caravan parks; community buildings; drainage; dwelling-houses; environmental educational facilities; environmental protection works; forestry; golf courses; helipads; home industries; open space;
-

pipelines associated with aquaculture; picnic grounds; recreational establishments; recreation facilities; refreshment rooms; roads; surf club houses; utility installations.

All other development is prohibited in the 7(f) zone.



0 500m

To the north and west of the immediate lake area, land is zoned 7(a) Environmental Protection (Wetlands). The object of this zone is to protect sensitive wetlands areas and prohibit development which might result in environmental harm. This wetland area is further protected by the provisions of State Environmental Planning Policy No. 14 – Coastal Wetlands. This State Policy specifies a number of controls designed to assess the level of environmental impact associated with any proposed works within the protected area and prevent development that may result in significant impact.

The lake is also included within Schedule 1 of State Environmental Planning Policy No. 71 – Coastal Protection, as a 'coastal lake'. As such, the lake, and land within 100 m of its shore, are defined as a '*sensitive coastal location*' for the purposes of that Policy. Any applications made for development within such a location are required to be forwarded to PlanningNSW for comment. In some specified cases, the Minister for Planning becomes the determining authority. The Policy also establishes a range of matters that need to be considered in any application for development within a sensitive coastal location.

The NSW Government have also held an inquiry into Coastal Lakes, highlighting their importance to the community generally. The inquiry found cause for concern in regard to the future management of these lakes and has recommended that the Government take a firmer approach to the control of activities in and around coastal lakes. It is expected that a State Environmental Planning Policy specifically addressing coastal lakes will be proposed in the near future.

In addition to the environmental planning controls summarised above, the following may also be applicable to any future management or development of the lake area:

- Ballina Shire Development Control Plans
 - Ballina Shire Council Strategic Plans
 - Environmental Protection and Biodiversity Conservation Act 1999
 - NSW Government Estuary Management Policy
 - NSW Coastal Policy (1997)
 - Department of Lands Coastal Crown Lands Policy
 - Crown Land Foreshore Tenures Policy
 - Crown Lands Caravan Parks Policy
 - Bush Fires Act 1949
 - Catchment Management Act 1989
 - Coastal Protection Act 1979
 - Crown Lands Act 1989
 - Local Government Act 1993
 - National Parks and Wildlife Act 1974, and
-

- Protection of the Environment Operations Act 1997

An overview of the variety of recreational uses at Lake Ainsworth along with some of the conflicts that have been identified between users of the lake are outlined below.

Conflict with and between sail craft and swimmers

- sail craft moving into designated swimming area (this is thought to occur because of the inexperience of many sailors); and
- risk of collision between catamarans and sailboards (again thought to be because of the inexperience of many sailors and sailboard riders). Jones (1988) found that 98% of sailboarders interviewed felt threatened by the presence of catamarans but this may have been exaggerated due to the windy weather conditions.

Conflict between motor vehicles and other users

- alienation of, and damage to, grassy foreshore areas which could be used for recreation due to haphazard parking arrangements;
- child safety crossing the eastern road to the beach. Sight distance is poor due to informal car parking along the road. Jones (1988) found that 89% of those surveyed felt the risk of children being involved in an accident was too high; and
- vehicles using the western road around the lake can conflict with users of southern foreshore area (e.g. markets).

Alienation of Crown Reserve

- public foreshore use is restricted due to the proximity of the caravan park; and
- there is a large area of undeveloped Crown land under the control of the Department of Sport and Recreation which could be developed sensitively for passive recreation (e.g. walking trails) to decrease pressure on the developed reserve (encroachment of picnickers onto Sport and Recreation Centre already occurs). Jones (1988) noted that the Crown land reserves were under-utilised for walking.

Overcrowding and overuse

- overcrowding of the three main areas around the lake (south, south-east and east sides of lake) occurs during peak periods. This estimated usage far exceeds estimated social carrying capacity; and
- overuse of the water body can be an issue during peak periods.

Significant activities that have impacted on lake processes since the commencement of European settlement have included:

- clearing of much of the original native vegetation;
-

- the expansion of the township of Lennox Head which impacts on the drainage patterns and the water quality of Lake Ainsworth;
- the development of the National Fitness Camp, now the Department of Sport and Recreation Centre, with impacts on clearing of vegetation and Lake Ainsworth water quantity and quality; and
- sand mining in the 1960s and 1970s with impacts on the vegetation and topography of the beach dune system including the introduction of exotic vegetation in the dune rehabilitation process.

These activities have modified surface and groundwater flow patterns and quality, modified the lake nutrient budget and varied the composition and abundance of flora and fauna. Existing and future uses of the lake have the potential to similarly affect the natural processes of the lake if not adequately managed. Significant issues associated with the impact of existing lake uses on lake processes have been included in Section 4.4 of the study.

The Department of Sport and Recreation has concept plans for the future expansion of their facility. Such plans include upgrading the existing accommodation, the provision of a purpose-built indoor recreation/sporting facility, and the upgrading of existing sporting fields. Such upgrades will provide for increased use of the facility for its various sporting/educational programs, and would also provide for greater community use of both the indoor and outdoor facilities.

Increasing present activities has the potential to have the following effects in the future:

- impacts may occur on the biological values of Lake Ainsworth in varying magnitude and degree. Nutrifaction has been addressed previously and contributes to the proliferation of alien plant species (e.g. blue-green algae, water primrose and salvinia) and lower dissolved oxygen levels and consequent impacts on lake fauna assemblages;
- recreational activities along the lake's edge may have an increased adverse impact on littoral vegetation and result in localised erosion; and
- car parking too close to the lake's edge and the use of the southern access road has the potential to introduce pollutants and nutrients into the lake.

Overall Strategy for Planning and Development

Management Objective: To ensure coordinated management of all land in both the lake's surface and groundwater catchment.

Given the restrictions in place under the Ballina Local Environmental Plan, the additional controls applied under the provisions of State Environmental Planning Policy No. 71, and the likelihood of a new SEPP addressing Coastal Lakes, it is considered that the likelihood of approval of inappropriate development is extremely low. There is therefore no need for any amendment of the existing planning instruments applying to the area.

The future development requirements of the Lennox Head–Alstonville SLSC need to be considered by Council. The surf club is one of the largest on the Far North Coast of New South Wales and is growing more rapidly than other clubs. The space currently available to the SLSC is deemed to be insufficient to meet the projected future needs. Specifically, a substantial storage area of about 150 to 200 m² is required somewhere close to the club to house the larger equipment such as rescue boats, rescue vehicle, skis and boards. This storage area would need to have ready access to both the beach and the lake (public submission, Lennox Head–Alstonville SLSC).

Land availability nearby to the surf club is limited. Development of land adjacent to the existing club would involve encroachment onto the dune system and/or existing parking facilities. The caravan park currently occupies the land opposite the surf club.

Illustration 9 outlines the planning and development management actions for Lake Ainsworth.

Table G Planning and Development Management Actions

Ref	Issue	Management Action	Reason for Selection	Priority	Agency	Cost
G	Need for additional space for any future development of the surf club.	2. Consider the future of the surf club site in terms of whether expansion or relocation is appropriate.	This will allow an assessment of the area and an informed decision can be made as to the future land uses of the site.	Low	BSC	Low



H. Erosion and Sediment Management

Background

Foreshore erosion has been identified as a problem by local residents. Areas of foreshore erosion have been observed during times of lake level rise after rain, which has resulted in killing of the grass cover. When the lake water level recedes, the area is left without grass cover and is eroded by foot traffic and wind (B. Smith, pers. comm.). A reduction in grassed areas, which may be replaced with vegetation such as paperbarks, may help to reduce foreshore erosion from rising lake levels.

The dominant wind for the area is south-east which would only lead to erosion on the northern side of the lake, but only if the distance across the lake is quite substantial. The sail craft activity on the lake is not of a scale that would lead to significant foreshore erosion.

The erosion observed at the lake is mostly related to:

- vehicular traffic driving on the fringes of the roads beyond the sealed surface;
- runoff from the sealed roads; and
- high pedestrian traffic, particularly in the south-east corner of the lake reserve.

The sealed access road's close proximity to the lake and its impervious nature will convey runoff to the lake faster than other natural surfaces. This flow has erosive potential, as there is no erosion control between the lake and the road, exposing the foreshore to erosion processes.

Aerial photographs of Lake Ainsworth over a period of time suggest that significant foreshore erosion has not occurred, even though the location of the road has remained the same since the late 1940s. The planting of vegetation along the road strip to the west will reduce any further erosion that may occur.

The lake consists of two types of sediments, with the most common being sandy sediments which consist of well sorted medium grained quartz sands. These occur in the shallower depths down to about 4 m below AHD around the perimeter of the lake. The other sediments are gelatinous organic rich muds consisting of mainly decaying plants which occur in the deeper central part of the lake. The thickness of the organic rich muds is uncertain although there is data available that indicates that, at the deepest parts of the lake, it is in the range of 4-6 metres.

Sandy sediments taken from the lake had low carbon content and low total phosphorus. Sediment samples of the rich muds from the centre of the lake have relatively high organic carbon content as

well as relatively high total kjeldahl nitrogen (TKN) and total phosphorus (TP) concentrations. The heavy metal concentrations for the sediments are within the background levels for NSW coastal and estuarine sediments. Based on radiocarbon dating, it has been estimated that the sedimentation rate for organic material is about 0.4 mm per year.

Overall Strategy for Erosion and Sedimentation

Management Objective: To minimise the impact of natural variations in water level of the lake, both high and low, so as to protect terrestrial and aquatic ecosystems, and to reduce foreshore erosion and disruption to access and recreational use.

The foreshore erosion and sedimentation processes are not thought to be significant at the lake. Although an increase in usage of the lake over time, associated with unregulated vehicular and pedestrian movements, could increase the level of erosion and hence the amount of sediment entering the lake.

The strategies needed to be implemented to reduce the erosion potential around the lake include (Illustration 10):

Control and regulate vehicular and pedestrian movements

- Involves restricting vehicular and pedestrian movements to specific areas to minimise damage to riparian vegetation and in so doing minimising erosion.

The continued and enhanced current riparian flora management strategies

- The Lennox Head Dune Care group has successfully undertaken the management of the coastal dunes and the lake margin over the past decade. More recently, the Lennox Head Residents' Association and the staff, especially Mr Phil Buckland, of the Lake Ainsworth Sport and Recreation Centre have undertaken some significant regeneration and management programs. Future activities could be coordinated with vehicular and pedestrian management strategies to further enhance the native riparian vegetation of the lake and aid in minimising further erosion.
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Table H Erosion and Sediment Management Actions

Ref	Issues	Management Action	Reason for Selection	Priority	Agency	Cost
H	Erosion of the foreshore of the lake and accumulation of sediments in the lake.	1. Implement Traffic Management Plan (See section Traffic Management Actions).	This will reduce erosion on the foreshore areas.	High	BSC	Medium-High
		2. Continue and enhance current riparian flora management strategies.	This will establish protection against erosion during times of lake level rises and bind the soil and further prevent erosion.	Medium	Lennox Head Dune Care Group and BSC	Low

Other
Implement Traffic
Management plan

Continue and exchange
riparian management
strategies

Rehabilitate closed road
portions

Relocate road around
caravan park sites



I. Education

Background

As previously discussed, Lake Ainsworth is one of the few freshwater lowland dune lakes in Northern New South Wales and, as such, is an important educational resource for the region. The Sport and Recreation Centre runs Primary Outdoor Education Programmes (POEP) which are conducted over five days in conjunction with the NSW Department of Education. These programmes are for groups of 120 school children accompanied by 7-8 teachers, and are held 41 weeks of the year. Based on a 93 percent occupancy rate, the POEP generates 22,755 camper days per year (NSW PW 1994).

The ecological importance of Lake Ainsworth makes the area an important natural resource for study of flora, fauna and water quality issues for students in the region.

Overall Strategy for Education

Management Objective: To develop systems and programs to educate and inform the community about the values of the lake and the impacts of human activity, to reduce adverse impacts and enhance the lake's values.

An information display board should be provided near the south-eastern entrance to the Lake Ainsworth reserve. Containing a large map of the lake, the board could be used for a variety of purposes, including but not limited to:

- Advising of the location and type of recreational facilities available (i.e. public amenities, BBQs, sail craft launching areas, parking areas, disabled access facilities, waste disposal areas, walking tracks, etc.)
 - highlighting restricted usage zones (i.e. swimming and sailing areas);
 - advising of the latest contact recreational status of the water (i.e. is it suitable for swimming) and the fire hazard status of the reserve;
 - advising users of the lake on steps that they can take to help maintain and improve the qualities of Lake Ainsworth (e.g. appropriate removal or disposal of dog droppings and litter; avoid using excess sun screen, vegetation conservation);
 - advising on current management strategies aimed at reducing the occurrence of algal blooms (e.g. trial aeration system);
 - providing dates for upcoming events (e.g. surf carnivals, sailing regattas); and
-

- providing contact numbers to report matters of concern or obtain more information (Council, Dune Care, and Ballina Environment Society, etc).
- Sail craft users should also be better informed of the restricted swimming areas to avoid conflict with swimmers.

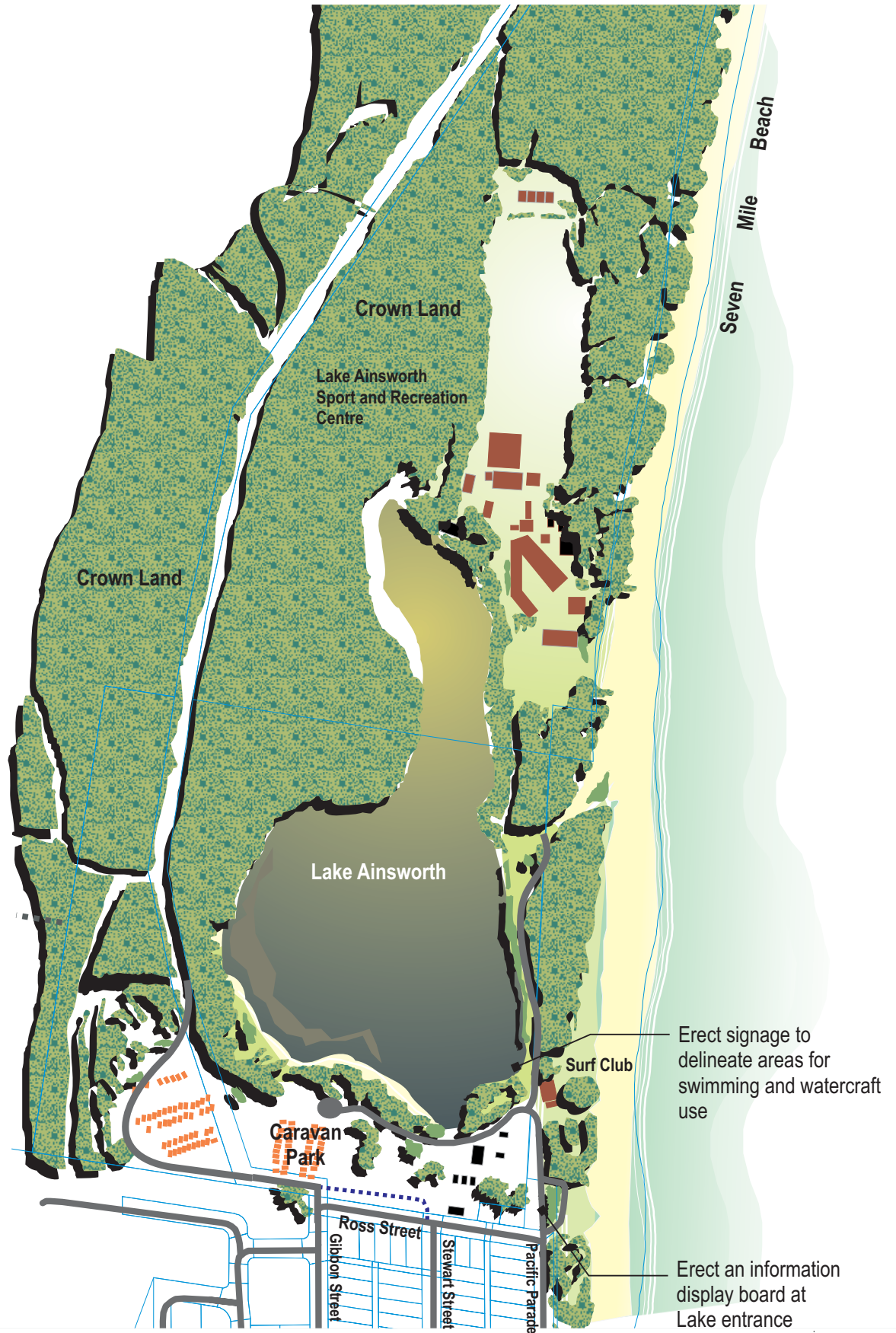
The information display board should be placed in a visible and readily accessible location but not in a location that will detract from the visual amenity of the lake itself. Information provided should be concise and, where possible, in pictorial format. The board should be designed to enable the information on it to be readily updated.

Sail craft users should be informed of the restricted swimming areas to avoid conflict with swimmers. As well as advising of these areas on an information display board, hire operators should be required to advise people hiring sail craft of these restricted areas. Hire operators could also be vested with the responsibility of 'policing' these areas by warning sailors who stray into swimming zones.

Illustration 11 outlines the education management actions for Lake Ainsworth.

Table I Education Management Actions

Ref	Issue	Management Action	Reason for Selection	Priority	Agency	Cost
I	Visitor awareness of the effects of their actions.	<p>1. An information display board should be provided in the south-eastern entrance to the Lake Ainsworth reserve. Containing a large map of the lake, the board could be used for a variety of purposes, including but not limited to:</p> <p>Advising of the location and type of recreational facilities available, highlighting restricted usage zones (i.e. swimming and sailing areas);</p> <p>Advising of the latest contact recreational status of the water (i.e. is it suitable for swimming) and the fire hazard status of the reserve.</p>	This will provide information to the community about the management of the lake such as the values of the lake, and the management strategies for the lake.	Medium	BSC	Low
	Conflict between users of the lake in terms of potential collisions between sail craft and swimmers.	2. Erect sign to delineate the areas for swimming and watercraft use.	This will clearly inform the users of the lake to keep to the designated areas and therefore avoid conflicts with the different uses.	Medium	BSC	Low



J. Water Level and Flooding

Background

The lake levels are directly related to the amount of rainfall in the locality. The major processes controlling the lake water budget are rainfall and evaporation. Data has been collated for the lake water levels since late 1994. The water level in the lake exceeded the lowest point on the eastern road about 7.5% of the time between September 1994 and October 1999.

The annual rainfall statistics for Lake Ainsworth show that during this period, 1996 and 1999 were above average rainfall years. 1999 was a particularly high rainfall year, with more than 2,500 mm of rainfall recorded to the end of October, compared with the long-term average annual rainfall of 1,689 mm. The lake water level tends to respond almost immediately to high intensity rainfall events. The lake water level reached the level of the eastern road during six months in this period, from June to October 1999, and in June 1996. In both cases the elevated water levels were triggered by high rainfall, with rainfalls at or above 400 mm for the month. In 1999, the water was maintained at an elevated level by ongoing monthly rainfalls that were considerably higher than the long-term average. Another contributing factor appears to be evaporation, with all recorded high water level events over the period occurring during the months associated with lower evaporative losses.

The issue of flooding of the foreshore of the lake was brought to prominence as a result of an extended period of elevated water levels in 1999. During this period the eastern access road to the Sport and Recreation Centre was inundated, blocking access to the centre via this route. The section of road leading to the 4WD beach access track was also cut; however, it was reported that some 4WD users were continuing to use the flooded road to access the beach. High water levels also inundated significant areas of foreshore land, in the process flooding vegetation and reducing the recreational amenity of the area. Increased traffic use of the western road when the eastern road is blocked can cause conflict with users of the southern foreshore area (e.g. the markets).

While flooding was an issue during much of 1999, the available information suggests that it is an infrequent occurrence. In fact, input from stakeholders and community representatives (Value Management Workshop, 29 November 1999), suggested that although flooding may be seen as a major issue at that time, it is generally not as problematic as low water levels.

Overall Strategies for Water Level and Flooding

Management Objective: To minimise the impact of natural variations in water level of the lake, both high and low, so as to protect terrestrial and aquatic ecosystems, and to reduce foreshore erosion and disruption to access and recreational use.

Management strategies should be implemented to mitigate the effects of the natural variation of the lake water level (Illustration 12).

Strategies that could be implemented to mitigate the effects of prolonged high water levels and reduce the fluctuating water levels include:

- ensure that littoral and riparian revegetation schemes incorporate species that are tolerant to infrequent but potentially prolonged periods of inundation;
- placement of new and/or replacement of existing recreation facilities (BBQs, walking paths, etc.) beyond levels likely to be inundated for prolonged periods; and
- implement strategies to mitigate post-flooding impacts (e.g. fencing off foreshore areas and/or mulching of foreshore areas to allow vegetation to recover and minimise erosion).

Strategies to mitigate the effects of the natural variation of the lake's water level are preferred to the implementation of a system to control and regulate the water level in the lake. However, if over time, enhanced flushing of the lake's water with groundwater becomes the preferred long-term strategy for controlling algal blooms, the idea of controlling and regulating the lake's water level should be revisited.

Table J Lake Water Level and Flooding Management Actions

Ref	Issue	Management Action	Reason for Selection	Priority	Agency	Cost
J	The need to mitigate the effects of the natural variation of the lake's water level rather than implement a system to control and regulate the water level in the lake.	1. Ensure that littoral and riparian revegetation schemes incorporate species that are tolerant to infrequent but potentially prolonged periods of inundation.	It addresses the flooding issue while allowing the natural processes not to be interfered with.	Low	BSC	Low
		2. Placement of new and/or replacement of existing recreational facilities (BBQs, walking paths, etc) beyond levels likely to be inundated for prolonged periods.	It addresses the flooding issue while not interfering with the natural processes.	Low	BSC	Low

Ensure littoral riparian
revegetation schemes
incorporate species tolerant
to infrequent, but potentially
prolonged inundation

Placement of new and/or
replacement of existing
recreational facilities
beyond levels likely to be
inundated for
prolonged periods



K. Aboriginal Heritage

Background

Aboriginal sites that have been identified within the Local Government area include middens, burial sites, camp sites, ceremonial grounds, massacre sites and fish traps. Campsites have been recorded to the north of Lake Ainsworth, around Newrybar Swamp. Burial grounds have been recorded to the south of Lake Ainsworth, and the Lennox Head Bora Ring is a short distance to the south west of the lake (Ballina Shire Council 1982). Six middens have also been recorded at Lennox Head (Collins 1992). We are not aware of any archaeological studies undertaken for Lake Ainsworth itself, however a survey has been carried out by Collins (1992) for a subdivision to the south of the lake. Four open camp sites containing stone artefacts were identified in the subdivision area and a few artefacts were found outside the site, two on a shell midden.

Based on the sites identified in the survey, Collins (1992) concluded that it was likely that aboriginal groups were involved in initiations and other bora-related activities camped in discrete localities around the margins of the swamp and along the coastal fore dunes. Collins also noted that most sites in Lennox Head had either been completely destroyed or badly disturbed by urban development, such as sites to the north and east of Lake Ainsworth that have been destroyed or disturbed by mining for mineral sands.

Lake Ainsworth has a significant cultural history as it is the subject of a dreaming story relating to the three Bundjalung brothers (Jolander Nayutah, pers.comm from the Gungil Jindabah Centre at Southern Cross University). The Jali people are the traditional owners of Lake Ainsworth. The area has significance to the Jali people because of the existence of a bora ring (NPWS site register) and the large open campsite adjoining the swamp land which contains an in situ burial site (Collins, 1992).

Overall Management for Aboriginal Heritage

Management Objective: To understand, protect and respect the aboriginal heritage value of the lake.

It is recommended that liaison occurs between Ballina Shire Council and local aboriginal groups to gain a higher level of understanding in relation to Aboriginal cultural history associated with the lake.

Areas of Aboriginal cultural significance should be protected and the community educated with respect to any significant Aboriginal sites around the lake and associated heritage, where it is thought appropriate by the local aboriginal community.

Illustration 13 provides an overview of the Aboriginal heritage management actions for Lake Ainsworth.

Table K Aboriginal Heritage Management Actions

Ref	Issue	Management Action	Reason for Selection	Priority	Agency	Cost
K	Protection of areas of Aboriginal cultural significance.	1. Ensure areas of Aboriginal cultural significance remain relatively undisturbed through measures acceptable to the Local Aboriginal Land Council.	This will provide a means of ensuring that sites of Aboriginal cultural significance remain in their natural state.	High	BSC and the Local Aboriginal Land Council	Low
		2. Liaison between Ballina Shire Council and the Local Aboriginal Land Council.	This will develop a greater understanding about cultural heritage sites to assist in their protection.	High	BSC and the Local Aboriginal Land Council	Low
		3. Erection of signage to educate the community about the presence and significance of Aboriginal cultural sites, where deemed appropriate by the Local Aboriginal Land Council.	This will provide the community with information about the historical Aboriginal uses of Lake Ainsworth and about the significance of sites of cultural importance to the Aboriginal community.	Medium	BSC and the Local Aboriginal Land Council	Low

References

AWACS 1996, *Lake Ainsworth Lake Processes Study*, Report 96/07 August 1996.

Bayly, I. A. 1964, 'Chemical and Biological Studies on Some Acidic Lakes of East Australian Sandy Coastal Lowlands', *Australian Journal of Marine & Freshwater Research*, 15, 56-72.

Ballina Shire Council, 1999, *Lake Ainsworth Lake Processes Study*, Report 96/07 August 1996

International Panel on Climate Change 1995, *Climate Change 1995-The Science of Climate Change*, contribution of WG1 to the second assessment report of the IPCC, Cambridge University Press.

Jones, A. 1988, 'Carrying Capacity of Lake Ainsworth', Student Project, B. Applied Science, Northern Rivers College of Advanced Education.

NSW Government 1990, *Coastline Management Manual*, prepared under the guidance of a Steering Committee comprising government authorities and interested community groups, ISBN 0730575063.

NSW Government 1992, *Estuary Management Manual*, draft, October, ISBN 0731009339

Saenger, P. 1988, letter to Ballina Shire Council.

Seabrook W. 1991, 'Range expansion of the introduced cane toad *Bufo marinus* in New South Wales', *Aust. Zoo* 27: (3&4) 58-63.

Timms B.V. 1982, 'Coastal dune waterbodies of north-eastern New South Wales', *Aust. J. Mar. Freshwater Res.*, 1982 33: 203-222.
