

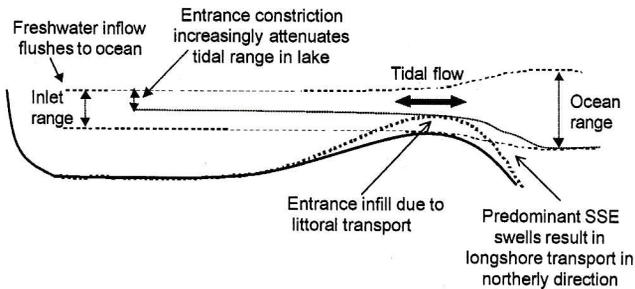
Lake Conjola Entrance Management Plan

Newsletter No. 1
November 2001

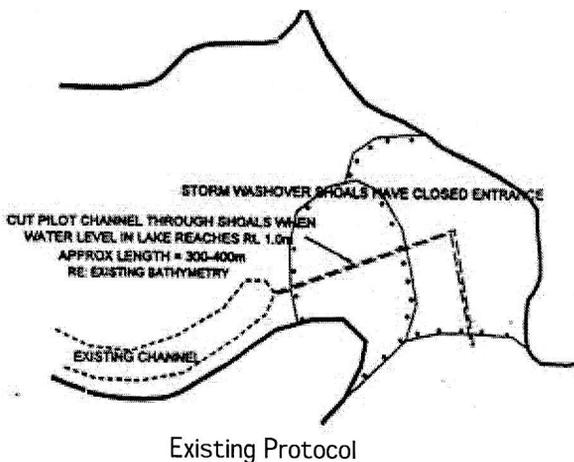
Shoalhaven City Council has commissioned Manly Hydraulics Laboratory (MHL) to develop an Entrance Management Plan for Lake Conjola.

Background

The entrance of Lake Conjola is generally open, although the entrance channel shifts in response to ocean conditions and floods. However, since 1937 the entrance has closed off completely eight times, and these closures have often lasted for several years. Over the last 62 years, the entrance has been closed for 9½ years, open for 38½ years and heavily shoaled for 14 years (cumulative durations). Typical estuarine processes are depicted in the following diagram.

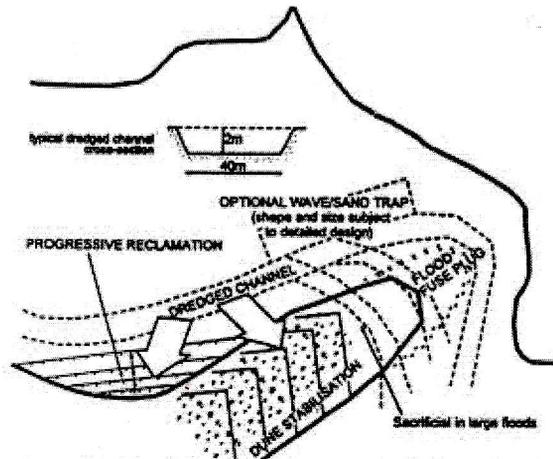


Shoalhaven City Council has a policy of reopening the closed lake to relieve flooding and water quality concerns by excavating a short pilot channel across the closure spit when water levels reach RL 1.0m AHD.



Existing Protocol

The Lake Conjola Entrance Study, undertaken in 1999, defined six options to maintain a sustainable open entrance. A *preferred option* of a 'Managed Entrance' was subsequently adopted by Council.



- Stabilise entrance spit to reduce storm washover
- Monitor entrance conditions
- Maintain fuse plug at northern tip of spit to suit flood flows (1.0-1.5 m AHD)
- When close to closure according to a new Entrance Management Policy, dredge new channel along path of historic flood cuts to substantial dimensions, i.e. 40m x 2m deep

Managed Entrance

A formal Entrance Management Plan is now required to enable effective implementation and ongoing operation of the new strategy. The Managed Entrance will include implementation, at the appropriate time, of works to maintain a viable lake entrance. The works are:

- Excavating a substantial channel approximately south to north across the inner sand flats, leading to the northern entrance throat.
- Building up of the entrance spit to a level (approx RL 7.0 m AHD) above wave run up in order to limit coastal storm washover effects.

Prior to implementation of the Management Plan interim works have been undertaken to avoid entrance closure, by dredging a small channel and raising the spit to a height of approximately 3.5 m AHD.

Who is preparing the Plan?

The Entrance Management Plan is being prepared by the NSW Department of Public Works and Services' **Manly Hydraulics Laboratory** (MHL). MHL has been a specialist problem solver in the area of water, coastal and environmental engineering for over 40 years, making use of physical models, mathematical models and field data collection. MHL has completed numerous estuary investigations, estuary management studies and management plans and has conducted sediment, hydrodynamic and water quality monitoring and modelling programmes on most of the major estuaries in NSW. MHL operates water level recorders at a large number of estuaries and Waverider buoys at seven sites along the NSW coast. MHL operates the rainfall and water level recorder at Lake Conjola which assists SES, Council and DLWC personnel to make management decisions related to reduction of flood hazard and water quality.

Sections dealing with biological issues, particularly aquatic ecology, will be prepared by The Ecology Lab (TEL). TEL is an Australian-owned and operated environmental consulting firm specialising in aquatic habitats and biota since 1985. In the last five years TEL has completed over 25 studies involving assessments of aquatic habitats and biota in relation to proposed engineering works.

What will be in the Plan?

The Plan will include:

- a comprehensive description of the physical processes determining the state of the entrance, particularly the influence of storm events
- the actions required and their timing to maintain a sustainable entrance
- definition of the flow criteria signalling imminent closure which will trigger initiation of the works
- specification of the monitoring data to be used to describe the processes affecting entrance behaviour
- a Review of Environmental Factors (REF) to allow the works to be approved and initiated without delay
- a decision support system which will evaluate the state of the entrance and trigger initiation of the works

- a commitment document to ensure sustained commitment to maintenance of an open entrance
- identification of the appropriate source of funding and documentation of the procedure for accessing funding for the works at the appropriate time and for funding the ongoing decision support system
- the conceptual configuration of the substantial channel from south to north across the inner sand flats and the configuration to build the entrance spit up to approximately RL 7.0m AHD
- the most effective methodology for dredging the channel and transportation and placement of sand to the spit taking into account the cost, environmental impacts and plant availability and mobilisation requirements of various methods
- a cost estimate for the works
- definition of the required contract documentation and the procedure for calling and assessing tenders - preparation of such documentation is not part of this project.

The Plan will take into account:

- environmental constraints, particularly migratory bird nestings
- beach access, recreational amenity and aesthetics
- future maintenance
- the *Caulerpa taxifolia* infestation
- the active erosion of vegetated high dunes in the south-east corner of the lake
- boating access to the launching ramp at Cunjurong Point.

The Review of Environmental Factors

The REF will define any environmental constraints to be accommodated in the Plan and expedite the environmental approval process. The REF will be designed to satisfy the requirements of the *Environmental Planning and Assessment Act 1997* and avoid the need for a full rigorous assessment each time it is proposed to carry out works. All relevant bodies will be identified and consulted with the aim of streamlining the process required at the time of initiating entrance works. This will include identifying bodies from which approvals or licences will be required and proposing standard conditions of approval where appropriate.

While some parts of the REF will remain applicable over a long period of time it is likely that some parts will require updating at the time dredging and related activities are undertaken to address the environmental conditions at the time. These parts will be flagged and a brief description of the work likely to be required will be included.

The decision support system

An important component of managing the entrance is a decision support system to analyse the information showing the degree of constriction of the entrance and to signal the onset of triggering conditions for initiation of the planned maintenance procedures.

The decision support system will take two forms:

- a written work plan document
- an information management system.

The work plan will outline the actions to be undertaken, under what conditions, and by whom. The information management system will comprise:

- monitoring of the condition of the entrance and environmental data required to identify the trigger conditions
- the input of the information to a 'predictive model' which will signal the onset, or otherwise, of triggering conditions and lead to initiation of entrance maintenance procedures.

The system will rely on environmental data from the MHL water level recorders in the Lake Conjola entrance and in Jervis Bay, data from the MHL Waverider buoys located off the NSW coast at Batemans Bay, Port Kembla and Sydney, the MHL rain gauge at Lake Conjola and analysis of the occurrence pattern of significant coastal storm events.

The system will carry out a running analysis over a suitable period of the Lake Conjola tidal range compared to the Jervis Bay tidal range (representing the ocean tidal range) to provide an estimate of entrance constriction. When the entrance has reached a condition where closure is becoming likely the probability of a critical ocean storm will be combined with the indicators of entrance state to determine when the threshold conditions to trigger actions in the management plan have been reached.

The commitment document

In contrast to most entrances, which are predominantly closed and require opening soon after heavy rainfall or a decline in water quality, the entrance to Lake Conjola is predominantly open. Closure can be anticipated well in advance with appropriate monitoring of key indicators.

An agreed set of procedures between Council, government agencies and the community will be prepared to ensure sustained commitment to the maintenance of an open entrance. A document will be prepared that summarises, in point form:

- the main benefits of maintaining an open entrance
- the main physical processes involved
- the implications for water quality and ecological processes
- the actions/strategy required, and by whom, to maintain the open entrance
- the areas of responsibility of Council and government agencies relevant to the Entrance Management Plan
- the required funding and funding sources to implement the Plan
- implication for the operation of the plan if various elements of the strategy are not implemented.

This document will be submitted to Council and relevant government agencies for their comment, revision and ultimate endorsement.

The document will be held by Council and will be made available to the general public and relevant government agencies. To ensure the Plan operation remains in the minds of stakeholders, Council will produce an annual report on the operation of the Plan, using a template provided with the document. This annual report would be submitted to stakeholders with a response form to be returned by stakeholders covering, inter alia, any non-conformance with the endorsed actions/strategy set out in the document.

Community Education

The proposed change in approach to entrance management is quite significant and community education will be an important part of the entrance plan.

Elements of the education package are:

- two newsletters
- presentation of the draft report at a public meeting
- a public 'Lake Conjola Entrance' website.

The second newsletter will outline the main findings of the study, listing the broad actions to be taken to maintain the entrance.

A public access web page containing general material for educational purposes is being set up. It will be updated after each meeting with the technical sub-committee.

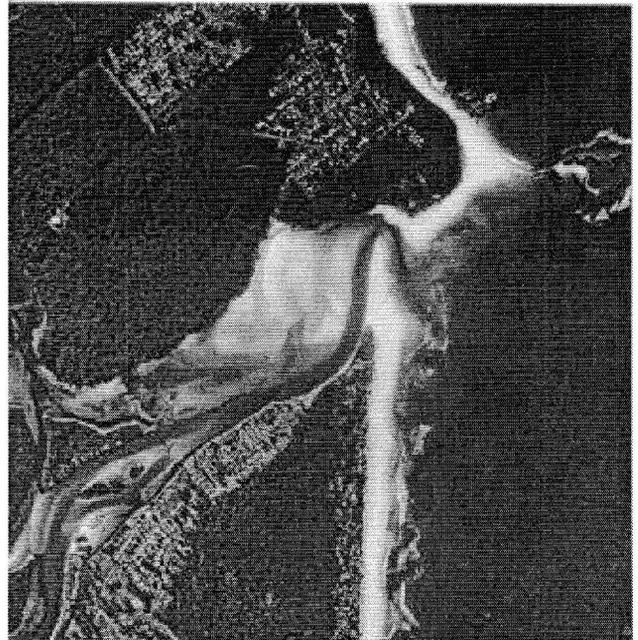
Where are we at?

The project has started on several fronts and the first meeting with the Technical Sub-Committee has been held. The Plan, REF and development of the decision support system are underway and letters have been sent to government agencies seeking comments. The information website is accessible at:

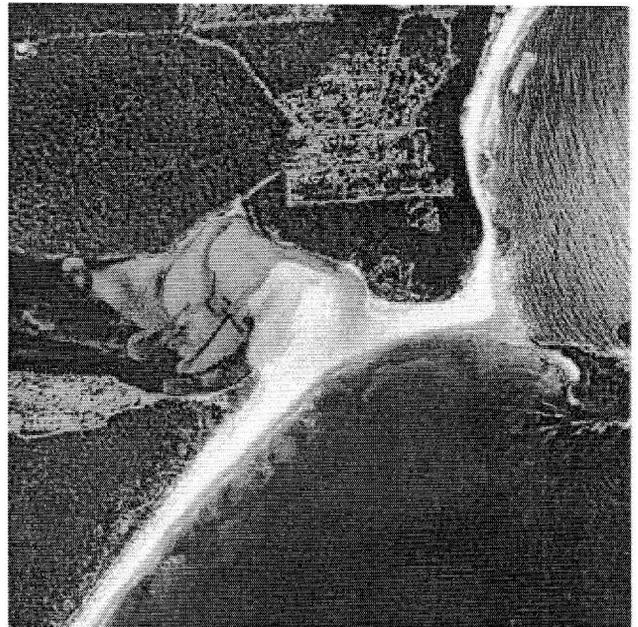
<http://marlin.mhl.nsw.gov.au/www/lconj.html>

For more information

Contact Bob Cook at Manly Hydraulics Laboratory by email at rcook@mhl.nsw.gov.au or have a look at the website.



Lake Conjola entrance area 1993
entrance open



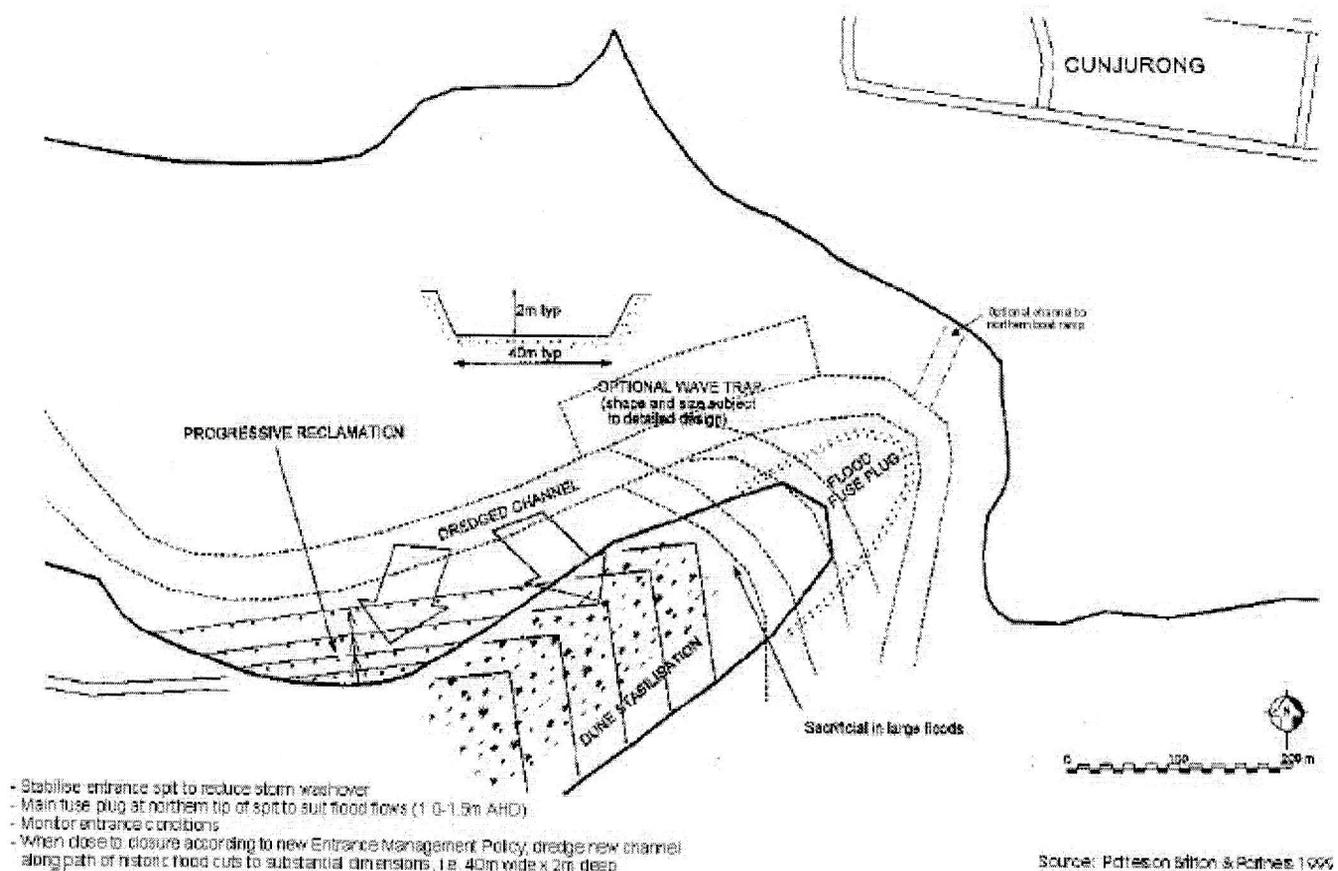
Lake Conjola entrance area 1997
entrance closed

Introduction

This is the second of two newsletters to inform the community of progress in the Lake Conjola Entrance Management Plan project. This newsletter and the public meeting mark the submission to Shoalhaven City Council of the draft Management Plan.

Newsletter 1, distributed in November 2001, outlined the background and aims of the project. Previous studies have shown that the entrance to Lake Conjola is generally open. However, since 1937 (the period for which records are available) the entrance has closed off completely eight times. During closure water quality in the lake deteriorates and low-lying areas near the lake are at risk of flooding during periods of high rainfall in the lake catchment.

The Lake Conjola Entrance Study undertaken in 1999 showed that closure of the entrance is initially triggered by waves from a severe ocean storm washing sand from the entrance spit into the channel and restricting tidal flow through the entrance. Over a considerable period of time, up to several years, the channel gradually shoals completely until the point of closure. If a large flood occurs in the meantime the entrance may be scoured and the typical tidal regime resumes. On the other hand a series of ocean storms can hasten shoaling. Entrance closure can typically last for several years. Following closure the entrance can be opened either by excavating a channel to initiate scouring or by a flood scouring a channel through the spit. In either event a large flood is required to establish the substantial channel that is required to ensure a viable long-term entrance.



- Stabilise entrance spit to reduce storm washover
- Main tuse plug at northern tip of spit to suit flood flows (1.0-1.5m AHD)
- Monitor entrance conditions
- When close to closure according to new Entrance Management Policy, dredge new channel along path of historic flood cuts to substantial dimensions, i.e. 40m wide x 2m deep

Source: Pedreson Sifton & Rofines 1999

Figure 1 Managed Entrance Option, showing entrance, location of gauge, channel location, spit nourishment site

The Lake Conjola Entrance Study presented six potential options to maintain a sustainable open entrance. Council and the local community adopted the Managed Entrance option (Figure 1) as the most economically and environmentally viable option. The Managed Entrance requires continual long-term monitoring of entrance conditions and implementation of works to achieve a long-term open entrance when shoaling reaches a point where closure is inevitable without a large flood event. The works comprise dredging a substantial channel across the inner sand flats to increase tidal flow and using the dredged sand to build up the entrance spit to a level above wave runup to restrict the amount of sand washed into the entrance by storm waves.

The Entrance Management Plan Project

The project comprised four main components, which are described below:

- Decision Support System
- Entrance Management Plan
- Review of Environmental Factors
- Commitment Document.

Decision Support System

The decision support system will monitor the tides in the lake and alert Council when the entrance channel has shoaled to a point that the plan needs to be initiated so that dredging can be carried out to prevent closure.

Like most coastal lakes with long, shallow entrance channels, the normal tidal range in Lake Conjola is reduced compared to the range in the ocean. This is due to the frictional effect of the channel on tidal flow. As the channel becomes more shoaled the tidal range in the lake further reduces.

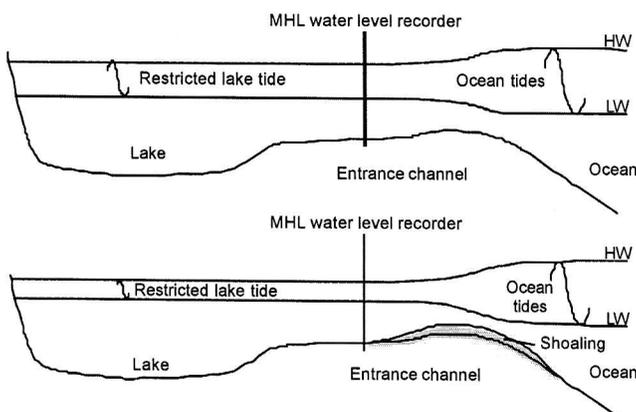


Figure 2, showing restricted tide in lake and position of recorder

This increasing reduction of tidal range presents a means of easily monitoring the shoaling of the entrance by monitoring the tidal range recorded by the water level recorder in the entrance channel operated by Manly Hydraulics Laboratory. This, however, is not completely straightforward as tides do not have a constant range but vary from tide to tide, making it difficult to observe a slow steady decline in range due to shoaling. This has been overcome by looking at the constituents of tides. Tides are the result of regular, predictable influences from many astronomical bodies but are primarily the result of gravitational and centrifugal forces from the earth-moon-sun system. Water level can also be affected by low barometric pressure, wind stress, wave setup, coastal currents, tsunamis and flooding.

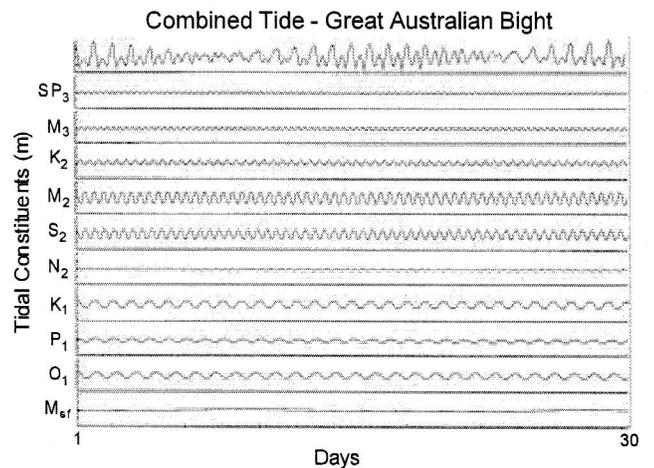


Figure 3, showing some of the main tidal constituents

The identification of entrance constriction is based on work carried out and published by John Hinwood and Errol McLean. The decision support system will undertake a running harmonic analysis over a 30-day period of the Lake Conjola tidal data. The analysis will yield the tidal constituent M2, which is the tidal effect of the moon and is the dominant tidal influence.

The decision support system is the key to maintaining a permanently open entrance. It provides advance warning of entrance closure so that the essential activities that have to be carried out prior to dredging can be set in train to enable dredging to commence before closure is imminent.

The system developed for the Lake Conjola Entrance Management Plan was tested for the closure at the beginning of November 1994. The M2 constituent showed a good correlation to the constriction of the entrance based on observations and records of rainfall and storm events. During the period preceding the closure, the reduction in M2 corresponded to increasing constriction of the entrance. Entrance closure is a long-term process

which can be delayed by a flood scouring out the entrance or hastened by an ocean storm adding sand to the entrance channel. It is therefore important to initiate the entrance works at the appropriate time – in time to finish the works before closure but not prematurely because a flood may scour the channel naturally.

Four trigger levels have been set:

Trigger Level A – Monitor Closely. Early signs of entrance constriction.

Trigger Level B – Activate Plan. Increasing risk of closure if major ocean storms occur but entrance may scour if there is a major flood. If a flood scours entrance and M2 exceeds 0.15 put dredging on hold.

Trigger Level C – Possible Closure. Complete pre-dredging activities and commence dredging.

Trigger Level D – Imminent Closure. Imperative that dredging commences.

The system will be hosted on Shoalhaven City Council's web page on the MHL web site, and will display a rolling assessment of M2 tidal constituent against time; offshore wave height, period and direction; and rainfall. Relevant Council officers will be notified via e-mail, fax or SMS when M2 reaches key trigger levels. Regularly updated results will be available on the public web page.

An annual summary report will be produced which will include a summary of the entrance performance over the year and a summary of the above data.

Entrance Management Plan

A new channel will be dredged along the path of the historic flood cuts from approximately 200 m upstream of the southern boat launching ramp to approximately the alignment of the low water mark along the ocean beach. The volume of sand to be dredged is estimated to be up to 100,000 m³.

The southern part of the entrance spit will be built up to a level of about 7.0m above mean tide level and stabilised so that it is not susceptible to storm washover. The northern part (approximately 200m) of the spit will not be raised above 1.0–1.5m so that the entrance will be free to scour to its full width during major floods. The area on the southern bank scoured following the 1998 opening would be reclaimed during dredging.

Dredged sand will be discharged to the entrance spit directly from the delivery line in the area where the dune is to be constructed. The dune will be subsequently shaped to the natural dune shapes of the area by a bulldozer. Sand fencing will be installed and natural vegetation planted according to guidelines from the Department of Land and Water Conservation.

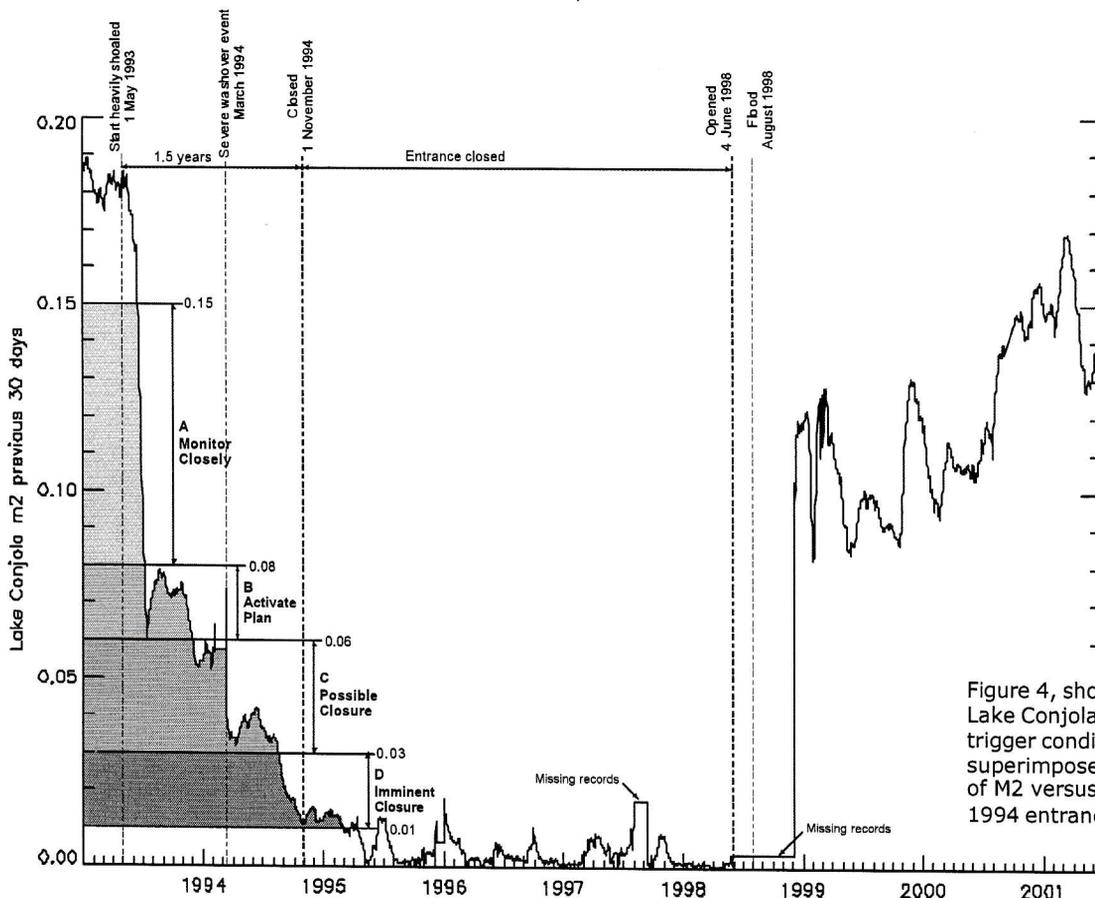


Figure 4, showing Lake Conjola entrance trigger conditions superimposed on plot of M2 versus time for 1994 entrance closure

The Review of Environmental Factors

When it becomes necessary to implement the entrance works required under the plan (Trigger Level C) it will be necessary to gain approvals from a number of bodies and document how the environment will be protected during and following the works. This will require an environmental impact assessment. The appropriate form of assessment for the dredging works, which will be carried out under SEPP 35, State Environmental Planning Policy 35, Maintenance Dredging of Tidal Waterways, is a Review of Environmental Factors (REF). Depositing of the dredged sand on the spit will require a development application accompanied by a similar form of assessment, a Statement of Environmental Effects (SEE). An REF has been prepared for the proposed works to minimise the time required to gain approvals. This may need to be updated at the time to accommodate any legislative or environmental changes. The REF covers both the dredging and the spit works and it should be a minor process to generate an SEE from the document at that time.

The REF:

- describes the site, entrance processes, project background, proposed activities, objectives and alternatives
- identifies stakeholder issues and permissibility, planning and statutory matters
- considers the physical, pollution, biological, resource use and community issues during construction and operation
- evaluates the significance of impacts.

The works will improve water quality due to increased tidal flushing and reduce flooding effects. There should not be any increase in turbidity of the lake waters during the proposed dredging activities.

Following consideration of ecological processes, The Ecology Lab reported the following:

- Under a permanently open entrance, the extent of seagrasses may decrease. The health of existing seagrasses may improve.
- Dredging will result in an initial decrease of benthic invertebrates. The communities should recover through colonisation from surrounding areas.
- Fish species diversity may increase under a more permanently opened entrance

- Finfish and oyster productivity may increase, however prawn fishery will probably not.
- To minimise any impacts on migratory shorebirds, a number of mitigation measures such as avoiding undertaking dredging works from September to March, minimising the area disturbed by people and heavy machinery and spreading debris such as seaweed and shells over deposited sand, should be undertaken.
- If *Caulerpa taxifolia* is found near the dredging area, dredging should cease and alternative dredging methods considered.

Commitment Document

A continued commitment document has been prepared and is being submitted to Council and Government agencies for endorsement. The document is an agreement in principle to the management plan by all parties and a clear description of the actions and funding required. The document summarises:

- the main physical processes involved
- the implications for water quality and ecological processes
- the actions/strategy required, and by whom, to maintain the open entrance
- the areas of responsibility of Council and government agencies relevant to the Entrance Management Plan
- the required funding and funding sources to implement the plan
- implication for the operation of the plan if various elements of the strategy are not implemented.

The document will be held by Council and will be made available to the Task Force and general public, as well as Council and relevant government agencies. To ensure the plan remains in the minds of stakeholders an annual report on the operation of the plan will be produced by Manly Hydraulics Laboratory. This annual report would be submitted to stakeholders by Council with a response form to be returned by stakeholders covering any non-conformance with the endorsed actions/strategy set out in the document.

For more information

Contact Bob Cook at Manly Hydraulics Laboratory by email at rcook@mhl.nsw.gov.au or have a look at the website.