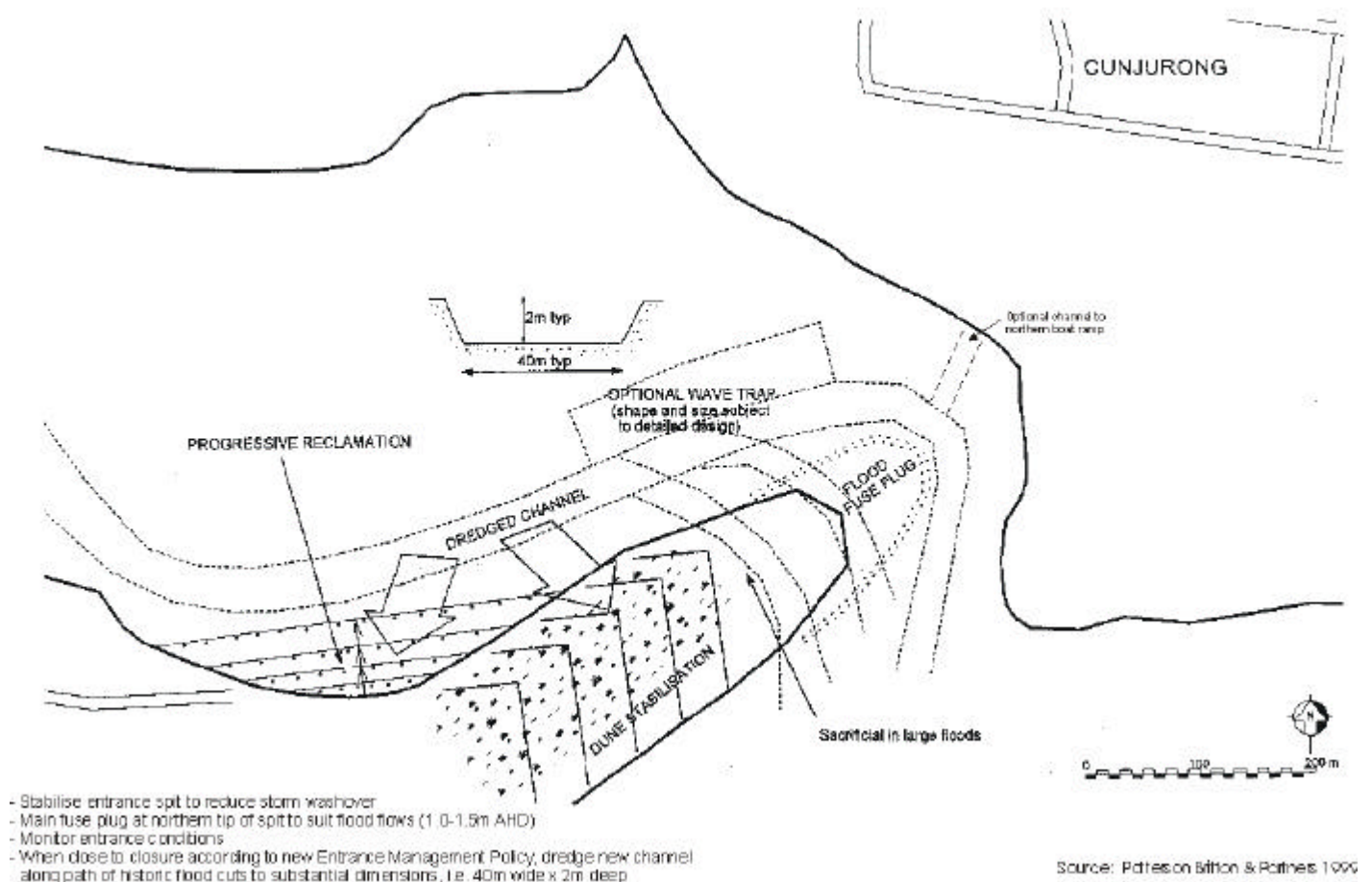


## Introduction

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.



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.

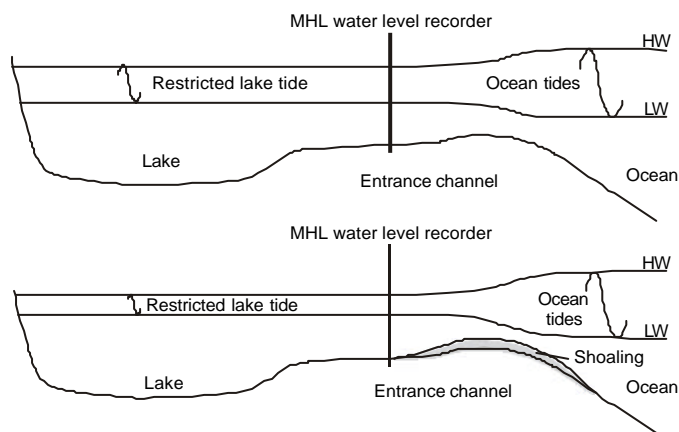


Figure 2, showing restricted tide in lake and position of recorder

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.

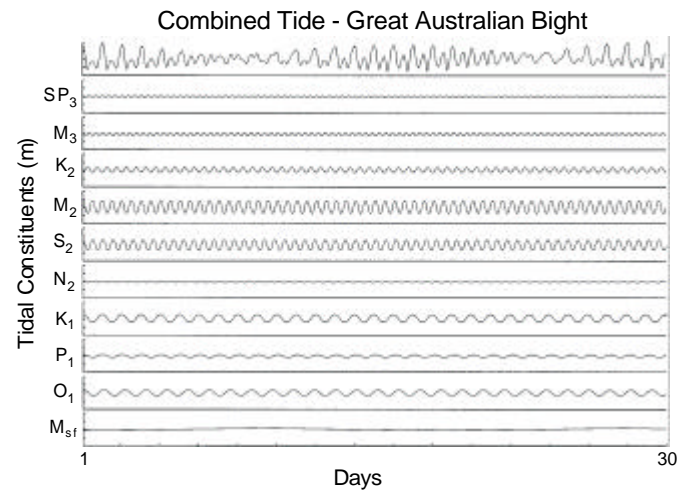


Figure 3, showing some of the main tidal constituents

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 m<sup>3</sup>.

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.

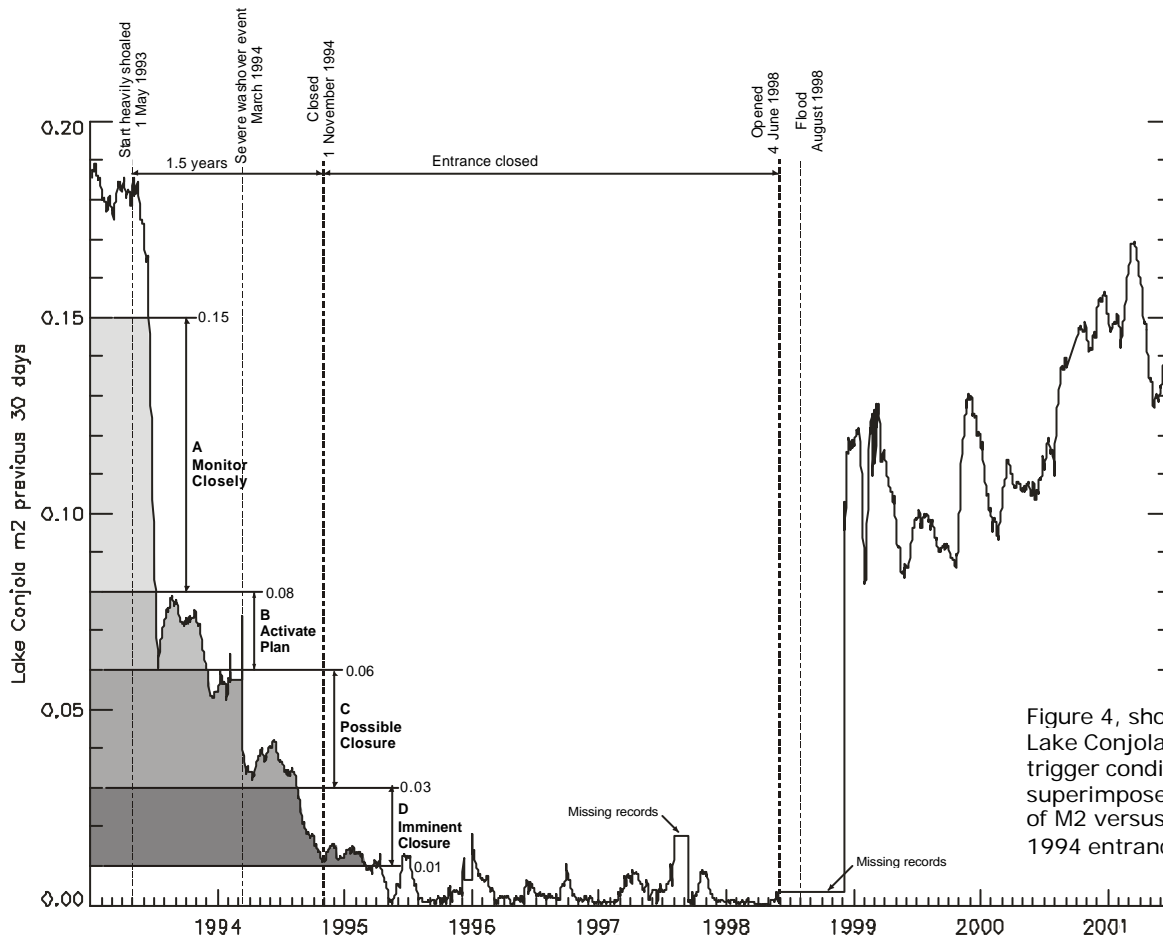


Figure 4, showing Lake Conjola entrance trigger conditions superimposed on plot of M2 versus time for 1994 entrance closure

## ***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](mailto:rcook@mhl.nsw.gov.au) or have a look at the website.