CONJOLA COMMUNITY ASSOCIATION

Proposal to include Channel Optimisation and Entrance Clearance Works in the
Lake Conjola Interim Entrance Management Policy 2013

June 2018
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Executive Summary

The Lake Conjola Interim Entrance Management Policy is effectively a continuation of a reactive entrance management approach which has been used for the past twenty years. Over that period it has been responsible for:

- Extended periods of high lake water level, leading to foreshore erosion;
- Frequent low level flooding;
- Loss of water clarity and amenity, and
- Loss of seagrass beds.

Given the shortcomings of the current Interim Entrance Management Policy it is proposed that proactive channel optimisation and entrance clearance works as outlined in the Entrance Management Plan developed by Manly Hydraulics Laboratory in 2003 (MHL1159) be incorporated into the current Policy. Such a step would:

- Dramatically reduce mean lake water level and subsequent foreshore erosion;
- Dramatically reduce frequency and duration of low level flooding;
- Mitigate catchment flooding;
- Increase biodiversity due to increased access through the entrance, and
- Increase water clarity and amenity through increased tidal flushing.

The following report consists of:

- Comments on excerpts from the current Interim Entrance Management Policy (GHD2013);
- Scientific evidence of failure of Lake Conjola Interim Entrance Management Policy;
- Excerpts from reports relevant to the proper management of Lake Conjola Entrance;
- Present day entrance management practices for another ICOLL - Narrabeen Lagoon, and
- Proposed changes to Lake Conjola Interim Entrance Management Policy.

Not acting on advice from this proposal will lead to high risk of:

- Low level flooding;
- Greater infrastructure damage, and
- Significant costs to Council and Residents.

\[
\text{Rainfall} + \text{Blocked Entrance} = \text{High Risk of Low Level Flooding}
\]

*Council can’t do anything about rainfall but it can do something about a blocked entrance. It is too late to wait until the entrance is closed.*
1. Comments on current Lake Conjola Interim Entrance Management Policy (GHD Aug 2013)

1.1 Planned Opening @ 1.0m AHD

“At a level of 0.8 m AHD plant and equipment are to be placed on standby. If moderate or heavy rainfall is ongoing or predicated and water reaches a level of 0.9 m AHD (measured from the MHL gauge at Conjola Holiday Haven Caravan Park) preparatory works should be undertaken to prepare the pilot channel for opening. Opening to commence when the Lake water level (measured from the MHL gauge at Conjola Holiday Haven Caravan Park) is at or exceeding 1.0 m AHD.” (Page 4).

Comment:
This approach needs to be considered in the light of the PBP 1999 Entrance Study - Technical Appendix 18 - Entrance Options Assessment:

... “Maintain Existing Protocol: The last option is simply to continue doing what has been adopted in the past, refer Figure 6. That is, allow storms to close the entrance, wait until water levels in the lake increase to RL1.0 metres AHD, then excavate a small pilot channel across the entrance spit to initiate a breakout. During the last closure, the length of the pilot channel in respect of a channel located in the north of the entrance has been too long to achieve an effective breakout, and hence the existing protocol has had little effectiveness. This illustrates the need to have a channel dimension of sufficient size as discussed in the Managed Entrance Option.”

1.2 Emergency Opening @ 1.2m AHD

“An emergency situation where the Lake water levels are rising rapidly and a flood event is occurring or predicted. At a level above 1.2 m AHD works should be undertaken, if situation permits, to open the entrance in the shortest and quickest way possible.” (Page 4).

Comment:
It seems counter-intuitive to have an emergency level higher than a planned opening level simply because, in emergencies, there is less time to react and so a more proactive approach is required. In fact on 17th, 18th and 19th August 2014, when the lake could have been opened at 1.0m AHD, the situation was deemed to be an ‘emergency’ and the lake was allowed to rise to 1.2m AHD. It was then decided that conditions were too dangerous for equipment to open the lake and consequently flooding was exacerbated. Eventual flood height was 1.39m AHD.

The apparent rationale behind the 1.2m AHD emergency opening height is that by allowing the lake to rise to 1.2m, entrance scouring would be enhanced. However during floods, lake levels as high as 2m have failed to produce scouring sufficient to keep the entrance channel open for any duration – such is the extent of entrance shoaling. (See Figure 2 at Page 5 of this Report).
1.3 Table 1 Ongoing Management Actions

<table>
<thead>
<tr>
<th>Process/Dev</th>
<th>Issue</th>
<th>Management</th>
<th>Action &amp; Timeframe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storm Washover</td>
<td>Susceptibility of the entrance channel to close as a result of storm washover</td>
<td>Increase height of the dune on the southern side of the entrance and provide dense vegetation cover to prevent sand being remobilised. NB: dune to be of sufficient height to prevent wave overtopping otherwise has the potential to act as a sand source to infill the entrance channel</td>
<td>Dune Nourishment and Vegetation – Ongoing</td>
</tr>
</tbody>
</table>

Comment:
The question must be asked “Where will the sand come from to build the protective dunes?” In the MHL Report 1159, dune height was to be raised using dredged sand. Moreover the current Interim Entrance Management Policy takes no account of the erosion of the southern sand dune due to growth of the flood tide shoal. This erosion was noted in the PBP 1999 Study and was the subject of an urgent dredging operation to realign the ebb tide channel away from the southern sand dune.

1.4 5.2 Ongoing Management

This policy seeks to manage against the risks associated with low level flooding and impacts associated with poor water quality; it does not seek a permanently open entrance. Policy process:

- Monitor lake water levels, water quality and rainfall forecasts;
- Open entrance when lake trigger levels are reached (refer 4.1.1);
- Undertake ongoing management (Table 1) with intent of allowing an increase in the adopted trigger levels with time;
- Revise trigger levels (approximately 5 years) based on implemented management objectives and monitoring of past opening events.

The long term entrance management policy is to reflect strategies intended to improve entrance stability using the natural processes of the Lake. Specifically, the entrance processes outlined in Table 1 can be managed effectively by ongoing involvement by SCC and the community through an overall entrance management strategy. A holistic approach needs to be adopted in terms of both development approvals and management of the entrance to ensure that the Lake can be restored to as natural a regime as is possible.

It needs to be outlined that opening at such low water levels means the entrance has the potential to shoal and close relatively soon after an opening event.

Comment:
At the “Emergency Opening Level” of 1.2m AHD the water depth is 100mm in parts of Lake Conjola Deepwater and affects an even greater number of properties and infrastructure with each additional 100mm increase in water level as has been the case in June 2007 (1.4m AHD); March 2012 (1.27m AHD); June 2012 (1.43m AHD); April 2013 (1.22m AHD); June 2013 (1.41m AHD); August 2014 (1.39m AHD) and August 2015 (2.4m AHD).
2. **Scientific Evidence of Failure of Lake Conjola Interim Entrance Management Policy**

The M2 is a management tool designed to measure the state of the Lake Conjola entrance and there is a wealth of data over 20 years. See Figure 1 below.

![Figure 1 Lake Conjola M2 Tidal Constituent 1992-2013](image1)

**Figure 1 Notes:**
- The M2 Graph is from the Manly Hydraulics Laboratory (MHL) M2 website
- “Stage 1 Interim (dredging) Works were undertaken in 1999 as an urgent corrective measure to realign the main ebb channel and arrest the ongoing erosion of the ancient high dunes on the southern shore.” (MHL Report 1161)

![Figure 2 Lake Conjola: Analysis of Lake Water Level + Rainfall + M2 - January 2007 to April 2018](image2)

**Figure 2 Notes:**
- Rainfall data is extracted from BOM (Ulladulla) website
- Lake Water Level data is the monthly maximum and minimum values from the MHL website (BOM river height data)
- The raw data and spreadsheets are available from Bill Hackett, Conjola Community Association
While not shown on the above graph, it should be noted that between 1999 and May 2008 the Lake water level exceeded 1.2m only twice – in July 2000 (1.32m) and July 2001 (1.2m). As such, the following conclusions can be drawn from the above plots in Figure 2:

1. An open lake with a high value for M2 dramatically reduces the incidence of low level flooding.

2. The flooding event in August 2015, while removing in excess of 100,000 m$^3$ of sand did not achieve the same level of channel scouring as produced by the May 2016 navigation channel dredging which removed around 16,000 m$^3$ of sand.

3. After the 2016 completion of the Navigation Channel dredging Works (2016), a major rainfall event occurred (over 400mm in Feb/Mar 2017) which resulted in no low level flooding. This is in stark contrast to lesser rainfall events that have resulted in flooding.

### 3. Excerpts from Reports Relevant to the Proper Management of Lake Conjola Entrance

#### 3.1 Lake Conjola Entrance Study Issue 2, Patterson Britton and Partners Pty Ltd May 1999

This PBP Report remains the most comprehensive and authoritative investigation of the processes that control the Conjola Entrance.

It was initiated in response to community concerns that the then Entrance Management Plan (open lake when water level reached 1.0m AHD) did not produce a stable entrance and there was consequent loss of water quality and susceptibility to flooding. While loss of water quality in the closed lake was primarily linked to faecal coliform build-up from septic systems, in its analysis of the cost benefits of entrance management, the report did take into account the introduction of a sewage system.

The Report concluded that the most cost effective entrance management plan was to dredge the entrance channel to maintain an open entrance.

Other findings of note:

- **Causes of lake closure:** “Entrance closures are caused by severe storms; periods of entrance stability correspond with periods of little storm activity; and the key to improving entrance stability is reducing the destabilizing impact of severe storms i.e. preventing storm washover deposits.” (Page 13)

- The study identified four entrance states: **Regime, Flood Scoured, Intermediate and Storm Wash-over.** It noted that the Regime state is “... the steady state that the entrance naturally and gradually establishes in the absence of any sudden changes caused by major floods and storms. This is a state of near equilibrium and should be the aim of any sustainable management plan.” (Page 6).

- “Secondary flood tide channels convey sand towards the southern edge of the tidal delta, in the vicinity of the boat-ramp. (TA8) Southerly progradation of the delta in this area deflects ebb tide and flood flows against the high dune causing bank erosion.” (Page 13).

#### 3.2 Lake Conjola Entrance Management Plan MHL1159 January 2003

“Six basic options for the long-term management of the entrance to Lake Conjola were identified in Patterson Britton and Partners (1999).”
The Managed Entrance which has the lowest cost and a positive flood mitigation benefit, was the only option returning a positive nett benefit in the PBP1999 Study, “... i.e. the Managed Entrance option was the only option which had a benefit:cost ratio greater than 1.” (Page 9).

“After evaluating the options the Managed Entrance was selected as the preferred option by the Lake Conjola Estuary Management Task Force. The majority of the Task Force are community members representing all major interest groups from the various communities around the lake. A public meeting held on 25 August 1999 to consider findings of the entrance study unanimously endorsed the preferred option, provided urgent Stage1 interim entrance works were carried out.” (Page 9).

Key Strategies to Maintain an Open Entrance:

Based on the entrance process studies and investigation of the causes of past entrance closures, any options for improving entrance stability must utilise as many of the following strategies as possible:

- **Reduce susceptibility to storm washover** - this is the dominant factor in all previous entrance closures.
- **Manage and contain wind-blown sand** - wind-blown sand can contribute half of the sand supply to the entrance shoals unless effectively trapped.
- **Reduce littoral sand infeed** - there is a strong northerly longshore sand supply which enhances flood tide transport into the entrance.
- **Locate entrance to the north** - the northern foreshore has least exposure to wave energy because of the Green Island wave-shadow and the wave energy dissipation caused by the nearshore shoals.
- **Reduce or modify wave penetration of the entrance** - wave stirring enhances the ability of flood tide to transport sand across the delta surface.
- **Don’t let the entrance close** - once the entrance closes, subsequent sand build-up across the delta surface necessitates high lake levels to effectively re-open the entrance.
- **Nullify the effect of storm wash-over** - in the event of a storm wash-over which cripples the entrance, by perching the main channel, immediately cut a new channel through or around the wash-over. Otherwise the entrance will close and subsequent sand build-up will necessitate a substantial rise in lake level to scour a new entrance. The channel cut should be of sufficient size to effectively re-open the entrance. The new channel should be cut as far to the north as practicable.” (Pages 13/14).

3.3 Lake Conjola Entrance Management Dredging Works Review of Environmental Factors

MHL1161 January 2003

“...Two maintenance dredging works have been previously undertaken within Lake Conjola with the aim of maintaining an open entrance. The most recent, Stage 1 (Interim Works), was undertaken in 1999 as an urgent corrective measure to realign the main ebb channel and arrest the ongoing erosion of the ancient high dunes on the southern shore. Stage 2 (Managed Entrance) is the focus of this REF and will involve larger-scale dredging works in order to prevent entrance closure whenever the lake approaches imminent closure.” (Summary).

“... The main long-term benefit of a permanently open entrance is mitigation of flood impacts on
development along the foreshore area and reduction of the potential for adverse impacts on the water quality and the flow-on effects on recreational amenity and tourism.” (Summary).

“... Secondary flood tide channels convey sand towards the southern edge of the flood tide delta, in the vicinity of the boat ramp. Southerly propagation of the delta in this area deflects ebb tide and flood flows against the high dunes, causing bank erosion.” (4.1.3).

“... Another effect on seagrasses of a permanently open entrance is likely to be the increased opportunity for estuarine-dependant organisms to colonise seagrass beds. Continuous tidal flushing would increase the chances of recruitment of juvenile fish and their invertebrate food, increasing the diversity and potentially the abundance of organisms living in the seagrass beds.” (Page 30).

“... Pollard (1994a) sampled fish communities in April 1984 and May 1985. One hundred species of fish were captured of which 73 were found in Zostera beds, 76 in shallow sandy habitats, and 33 over the deeper part of the lagoon. Almost half the species were of some economic importance to commercial and recreational fisheries. Pollard (1994a) considered the fish community of Lake Conjola to be one typical of an estuary with a permanently open entrance, despite the periods of closure the estuary experiences.” (Page 31).

“... The Environmental Research Institute (1999) sampled fish from seagrass beds in the entrance, middle region and upper regions of Lake Conjola in spring 1998, summer and autumn 1999 using a small seine net. They collected a total of 42 species, including 16 of commercial importance. The found the greatest numbers of fish in the upper region of the estuary, but a greater diversity in the entrance and mid-estuary regions (ERI 1999). The entrance was open during their sampling (spring 1998), but had been preceded by a four-year period of closure.” (Page 32).

“... The relatively shallow water in the vicinity of the entrance provides important feeding habitat for many bird species. The exposed sandflats are used by shorebirds for feeding and nesting. The higher dry sandflats between the sea and the lake are used for nesting by a few species. High water level usually has a negative impact on many wetland birds, because it reduces the abundance and diversity of habitats available. For example, when the water level reaches 1.0m AHD there are virtually no entrance shoals, which are important feeding areas for waders (K Mills 2000)” (Pages 32/33).

3.4 Shoalhaven Entrance Sensitivity Project Stage 2 BMT WBM Pty Ltd June 2011

“During floods, the entrance channel tends to migrate southwards but between floods, the longshore transport tends to grow the spit northwards, pushing the entrance channel against the southern edge of Cunjurong Headland. PBP (1999) found that, although the entrance is quite stable, coastal storms are a typical trigger for the incipient closure of the entrance. PBP proposed four states for the entrance:

- Flood Scoured: the state after a flood has scoured the entrance;
- Intermediate: the state between “Flood Scoured” and “Regime” characterised by gradual infilling as the entrance moves towards a regime state;
- Regime: the state the entrance achieves under tidal action, in the absence of significant flood or coastal storms, the tidal channel is typically located adjacent to Cunjurong Headland; and
• Storm Washover: sudden change caused by the washover of sands into the channel, PBP considered this a precursor to entrance closure.

Since 1937, the entrance was found to have closed 8 times. Typically, the entrance stays open for four years, but has remained open for a continuous 15.5 year period on one occasion.” (Page 46).

**Water Levels (m AHD)**

<table>
<thead>
<tr>
<th>Condition</th>
<th>Present</th>
<th>2050</th>
<th>2100</th>
</tr>
</thead>
<tbody>
<tr>
<td>When Closed: 50% Exceedance</td>
<td>0.95</td>
<td>1.43</td>
<td>1.65</td>
</tr>
<tr>
<td>When Closed: 10% Exceedance</td>
<td>1.74</td>
<td>2.17</td>
<td>2.50</td>
</tr>
<tr>
<td>When Closed: 1% Exceedance</td>
<td>1.98</td>
<td>2.39</td>
<td>2.72</td>
</tr>
<tr>
<td>When open: Typical level</td>
<td>0.29</td>
<td>0.69</td>
<td>1.19</td>
</tr>
<tr>
<td>When Open: 10% Exceedance</td>
<td>0.66</td>
<td>1.06</td>
<td>1.56</td>
</tr>
<tr>
<td>When open: 1% Exceedance</td>
<td>0.96</td>
<td>1.36</td>
<td>1.86</td>
</tr>
</tbody>
</table>

(Page 52)

**Comment:**

It is most apparent from the above scientific data that when Conjola entrance is closed, in any given year there is a 50% chance that lake level will rise above 0.95m while when the entrance is open, typical lake level is 0.29m. This means that when the lake is closed there is a considerably higher probability of low level flooding and foreshore erosion.


The entrance to Narrabeen Lagoon becomes periodically filled with marine sediment when the amount of sand moving into the lagoon entrance exceeds the amount of sand being removed by the outgoing tide. This is a natural process and is expected for a lagoon such as Narrabeen.
Without intervention at the lagoon entrance, prolonged closure could have the following effects:

- The flooding of low lying residential/commercial areas surrounding the lagoon, as well as creek.
- Reduction in lagoon water quality due to impaired tidal flushing from the entrance.
- Decreases in biodiversity due to reduced access through the entrance.
- There have been nine major clearance operations at the lagoon entrance since 1975, with the most recent in 2011, during which approximately 36,000 m$^3$ of sediment was removed and transported to selected locations along Collaroy, Narrabeen beach and the Lakeside Caravan Park.
- The 2016 clearance works will take place within the entrance area of Narrabeen Lagoon to the east and west of the Ocean Street Bridge. The work compound will be located within the Birdwood Park carpark, near the North Narrabeen Surf Lifesaving Club.

**Lagoon Clearance Overview**

Northern Beaches Council, with the assistance of the New South Wales Office of Environment and Heritage, will remove approximately 45,000 cubic metres of marine sand from the entrance of Narrabeen Lagoon. The sand will be spread over selected locations along Collaroy-Narrabeen Beach and the shoreline near Lakeside Caravan Park. The clearance will be similar to operations conducted in 2011. An explanation of the processes involved and examples of previous operations are described in further detail in this guide.

**Why is the clearance operation necessary?**

The clearance operation removes excess sand deposited in the lagoon entrance and helps to maintain it in an open state. This is a maintenance activity undertaken every few years when the lagoon entrance becomes clogged. The project is part of the management actions in the adopted Floodplain Risk Management Plan for Narrabeen Lagoon and the adopted Coastal Zone Management Plan for Collaroy-Narrabeen and Fishermans Beach and links with the Narrabeen Lagoon Estuary Management Plan.

### 5. Proposed Changes to Lake Conjola Interim Entrance Management Policy

Given the short comings of the current Interim Entrance Management Policy, it is proposed that the use of channel optimisation and entrance clearance works be incorporated into the Lake Conjola Entrance Management Policy.

It would seem most logical for the channel optimisation and entrance clearance works to be based upon the scientific findings and actions prescribed in the PBP1999 Entrance Study, and detailed in MHL1159 (2003) and MHL1161 (2003). Furthermore, any updated actions/practices can be referenced from present day experiences of Narrabeen Lagoon Entrance Management Plan.