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# Shoalhaven City Council

## Lake Conjola

## Estuary Management Plan Review

June 2015

INFRASTRUCTURE | MINING & INDUSTRY | DEFENCE | PROPERTY & BUILDINGS | ENVIRONMENT

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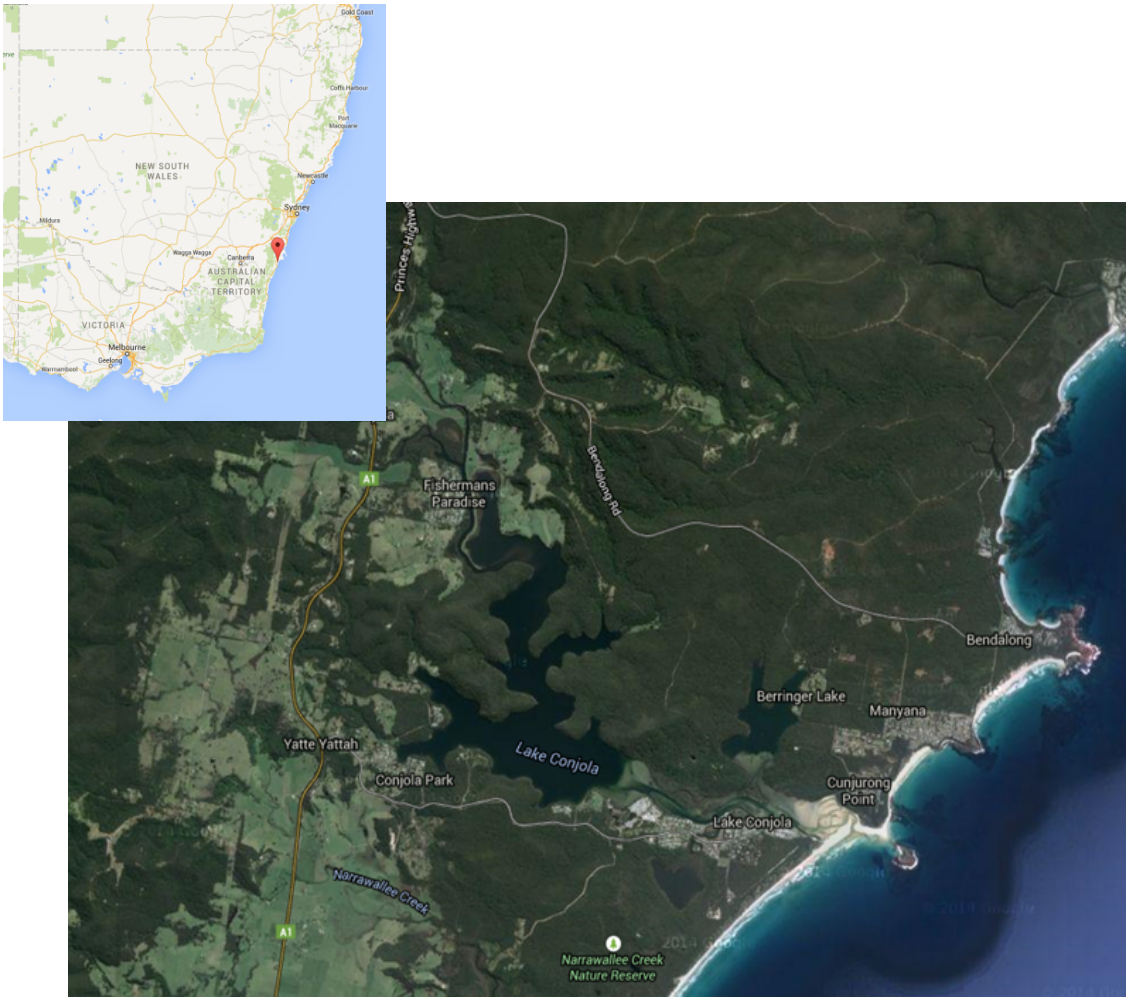
# 1. Introduction

## 1.1 Background

Lake Conjola (the Lake) is a coastal lake located approximately 50 km south of Nowra on the NSW south coast in the Shoalhaven City Council (SCC) local government area as shown in Figure 1. The Lake has a surface area of approximately 4.3 km$^2$ and a catchment area of 145 km$^2$. Lake Conjola is classified as an Intermittently Closed and Open Lake and Lagoon (ICOLL) and historically has remained generally open.

The main Lake is separated from the ocean by a shallow sandy inlet some 3 km long. The entrance to the Lake comprises a tidal delta of clean marine sand, with pronounced sand lobes, which are elevated up to 1 m above sea level. The inlet itself is shallow with extensive intertidal muddy sand flats and an average channel depth in the order of 1 m compared with the Lake itself which has water depths up to 10 m.

**Figure 1 Lake Conjola Locality**




Urban development is relatively minor at approximately 5% of the total catchment area and consists of three urban clusters; Lake Conjola, Conjola Park and Fisherman's Paradise

In the 2011 census, the combined population of the three centres was recorded at 1155.

Lake Conjola is a popular tourist destination and during peak holiday periods the population may, at least, triple. There are four tourist parks in Lake Conjola which can, in total, accommodate around 3000 people.

## 1.2 The 1998 Estuary Management Plan

Preparation of the Lake Conjola Estuary Management Plan (EMP) commenced in 1996, initiated by Shoalhaven City Council (SCC) in accordance with the NSW Government's Estuary Management Policy. The plan was developed to provide a comprehensive and integrated set of strategies to restore, protect and conserve the natural resources of the Lake. The plan was developed cooperatively with members of the Shoalhaven Lakes and Estuary Management Committee, the Lake Conjola Task Force (LCTF), the local community, SCC Councillors/Officers and State Government Departments. The plan also incorporates comments raised during the 1996 public exhibition. The plan was finalised and adopted by Council in 1998.

The 1998 Plan has now been in place for over 16 years and has played an important role in the management of the waterway and surrounding environment. During the implementation phase of the 1998 plan there has been extensive achievement in the strategies and actions adopted. There has also been additional information collected, revised strategic planning for the region and new issues raised which require review and incorporation. To ensure the new information, planning requirements and issues are incorporated into the EMP, it is necessary to undertake regular reviews of the strategies and actions adopted.

This review is the first formal review of the Lake Conjola Estuary Management Plan and is being undertaken in accordance with the NSW Coastal Protection Act 1979 and NSW Guidelines for Preparing Coastal Zone Management Plans.

### 1.2.1 1998 Management Areas

At the time of the development of the 1998 Plan, six management areas were identified as being of significance to Lake Conjola:

- Water Quality;
- Erosion and Sedimentation;
- Flooding;
- Lake Ecology;
- Recreation and Tourism; and,
- Lake Entrance Conditions.

The 1998 Estuary Management Plan included 23 strategies and 72 actions that were developed around each of the identified management areas. Of the 72 actions outlined within the EMP approximately 86% have been completed or implemented as ongoing action items. A visual summary of those actions completed is provided in Appendix A with commentary provided throughout this review document.

### 1.2.2 Revised Management Areas

Along with additional strategies and actions it is also recommended to group the strategies and actions into new management areas that are better aligned with NSW Government Guidelines and SCC's existing documentation. The new management areas are;

**Catchment Inputs and their Impacts**

This combines two previous management areas; Water Quality & Erosion & Sedimentation.

- Water Quality and Sedimentation
- Urban Stormwater
- Onsite Effluent Management
- Sewerage Scheme
- Acid Sulfate Soils

- **Biodiversity and Ecosystem Protection and Rehabilitation**

This includes the previous management area of Lake Ecology.

  - Terrestrial Habitat
  - Riparian Habitat
  - Aquatic Habitat
  - Fish

- **Access, Recreation and Tourism**
  - Foreshore Access
  - Aquatic Recreation
  - Boating Navigability
- **Entrance Management**
- **Flooding**
- **Adapting to Climate Change**

This is a new management area.

  - Lake Level
  - Sea Level Rise

- **Cultural Heritage**

This is a new management area.

## 1.3 EMP Review Process

Review of the existing Estuary Management Plan for Lake Conjola has been equally funded by SCC and the NSW Government.

Activities undertaken as part of this review process include:

- Identification of the values and issues currently and potentially affecting the health and use of the estuary;
- Assessment and implementation of new studies and information;
- Assessment of current NSW Government policy and legislations in relation to management of estuaries;
- Review of the actions within the 1998 EMP; and,
- Development of new management areas, strategies and actions to be implemented to ensure ongoing, up to date management of the estuary.

This review process has followed the NSW Government Guidelines for Preparing Coastal Zone Management Plans (DECCW December 2010) as well as the requirements of the amended NSW Coastal Protection Act 1979 (amended 2010).

### 1.3.1 Consultation

The methodology used to conduct this review essentially involved contacting each of the stakeholders and agencies responsible for implementing the plan, followed by a meeting with Council to determine the status of each of the strategies and actions outlined in the EMP. In addition, the Lake Conjola Community Consultative Body (CCB) was also given a 2 month period to comment on this review document which ended June 2012 with comments incorporated into the final document.

The agencies contacted during the review process included National Parks & Wildlife Service (NPWS), Department of Primary Industries Fisheries (DPI Fisheries), NSW Maritime, NSW Office of Environment & Heritage, South East Local Land Services and Shoalhaven City Council staff (SCC).

The draft Plan also integrated previous comments provided by the Natural Resources & Floodplain Management Committee (NRFMC) members.

The discussions and comments received during the development of this review document have assisted in guiding the development of revised management options and actions for the future management of Lake Conjola.

The draft Lake Conjola Estuary Management Plan Review 2012 was placed on formal public exhibition from 10 October 2012 to 9 November 2012.

During this period, Council staff also attended a meeting of the Lake Conjola CCB (22 October 2012) to discuss the document and answer any queries relating to the EMP review.

In May 2013, at the southern NRFMC meeting it was resolved that;

'The draft Conjola Lake Estuary Management Plan not be adopted without further community consultation and consideration of issues regarding lake management as follows, but not exclusive to:

I. Entrance Management Strategies

II. Internal channel development and management

III. Management of minor flooding

IV. Current Sea grass areas and strategies, and that

Information re Oyster Leases, excluding management actions, be re-introduced to the Lake Conjola Estuary Management Plan Review 2012.'

In September 2013, at the southern NRFMC meeting it was resolved to;

'Recognise that the Lake Conjola Community are working on a response to Council on the Draft Estuary Management Plan with an express desire to have dredging considered as an ongoing maintenance option for Lake Conjola.'

From October 2012 until April 2015, further discussions were held between Council staff and the CCB regarding these resolutions and the actions identified in the EMP.

The revised action table from the EMP review document went back to the Southern NRFMC on 28.4.2015.

The committee recommend that a sentence in paragraph 1.1 of the draft plan should be amended to read 'Lake Conjola is classified as an Intermittently Closed and Open Lake and Lagoon (ICOLL) and historically has remained generally open', and to place the Lake Conjola Estuary Management Plan Review on public exhibition.

Due to the time lapse from November 2012 to April 2015, whilst agreement was reached on the actions in the EMP, other things changed as well. The body of the document then needed to be adjusted to, not only reflect the revised actions in Section 10, but to also include the various broader changes that occurred over the 29 months.

Due to the delay it was also necessary to, once again, place the Estuary Management Plan Review (2015) on public exhibition.

# 2. Review of Water Quality Objectives, Strategies and Actions

## 2.1 Background

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

The water quality in an estuary is affected by a wide range of factors. The estuary can generally be considered to function as a 'mixing bowl', in which quantities of dissolved and particulate matter flow in, mix, decay or settle and flow out to varying degrees. The rates of mixing, decay etc. vary considerably among different estuaries. Key factors determining estuary water quality can be categorised as:

- Catchment inflows;
- Point source pollutants;
- Physical water exchange; and,
- Internal Lake processes.

During the preparation of the EMP the following issues were raised by the local community in regards to water quality:

- Elevated levels of faecal coliforms, particularly in Conjola Creek and Pattimores Lagoon;
- Turbidity related to increases in sedimentation;
- Decrease of dissolved oxygen levels; and
- The change of salinity regime in Lake Conjola and Pattimores Lagoon.

Through a review of available data at the time of the preparation of the EMP the following objective was developed in relation to the water quality of Lake Conjola.

**Management Objective**

**Ensure that the water quality in Lake Conjola, Berringa Lake and Pattimores Lagoon is maintained to a standard that protects and maintains the ecological, recreational and aesthetic values of these water bodies.**

## 2.2 Strategies/Actions – 1998 EMP

The factors affecting the water quality in Lake Conjola were assessed in order to develop strategies and actions to achieve the management objective. Table 1 contains the strategies and actions developed for managing and improving water quality in the Lake along with details of the current status of each action.

**Table 1 Water Quality Strategies and Actions**

| ID | Strategy | Action | Action Completed | Comments |
|---|---|---|---|---|
| WQ1 | Upgrade Sewerage Scheme | Encourage septic tank pump out rather than disposal into absorption trenches (short term) | N/A | Conjola Regional Sewerage Scheme (CRSS) completed in 2008. |
| | | Reticulated sewerage scheme (long term) | Yes | |
| WQ2 | Monitor bacterial levels in Lake | Monitor faecal coliforms at swimming areas | Yes, ongoing | During periods of Lake closure, weekly sampling is undertaken at 3 swimming sites. Biannual water quality monitoring is undertaken at 13 sites. |
| | | Monitor faecal coliforms during a storm event at selected sites within the Lake | incomplete | Not funded |
| WQ3 | Prohibit on-site disposal system for new developments | Insert provision into DCP to make pump outs or alternative systems in accordance with Draft Guidelines for Onsite Wastewater Management Systems for Domestic Households (EPA, NSW Health, DLWC, Local Govt. 1996) compulsory for all new development on flood liable land until sewer is available | N/A | The CRSS applies only to urban areas. On-site sewage management systems in non-urban areas will continue to be inspected by Environmental Services staff. |
| WQ4 | Amend LEP to incorporate erosion and sediment control requirements | Provision of minimum buffer zone widths | Yes | The Shoalhaven LEP 2014, Section 7.6 describes the protection of Riparian Land.<br>Shoalhaven DCP G2, Sustainable Stormwater Management and Erosion/Sediment Control, sets out more detailed criteria to protect riparian zones and waterways. |
| | | Control clearing and vegetation disturbance | Yes, ongoing | Community notifications of illegal clearing are investigated by Council Rangers. |
| WQ5 | Undertake works to minimise sediment loads | Implement erosion control during construction and maintenance of roads | Shoalhaven Stormwater Management Plan | Shoalhaven DCP G2 Sustainable Stormwater Management and Erosion Sediment Control and the Stormwater Management Plan (2000) ensures |

| ID | Strategy | Action | Action Completed | Comments |
|---|---|---|---|---|
| | | | | procedures are followed to minimise sediment loads during construction and maintenance of roads |
| | | Sediment control structures near unsealed catchment roads | Yes<br>ongoing | Control structures Installed at West Lake Conjola. |
| | | Structural and vegetative creek bank stabilisation adjacent to Fishermans Paradise boat ramp | Yes | Bank stabilisation works have been undertaken at several locations, including Fishermans Paradise boat ramp. |
| | | Assess the feasibility of installing sediment traps in areas of high sediment loads | Not done | To be investigated when funding is available |
| WQ6 | Ensure dissolved oxygen is at appropriate levels to maintain the aquatic ecosystem | Investigate feasibility and cost of septic tank pump out rather than disposal into absorption trenches (short term) | N/A | Conjola Regional Sewerage Scheme 2008 |
| | | Provide incentives to residents for conversion to alternative systems | N/A | |
| | | Reticulated sewerage scheme (long term) | Yes | |
| | | Detect illegal septic discharges | Yes<br>ongoing | Environmental Services staff inspects on-site sewage management facilities on properties outside urban areas. |
| | | Public education in dissolved oxygen pollution | Yes<br>ongoing | Water quality data, including dissolved oxygen monitoring results, are available online for public information. (Aqua Data portal) |
| | | Implement erosion and sediment control during construction activities | Yes<br>ongoing | Council requires compliance with the controls set out in the Shoalhaven DCP G2 Sustainable Stormwater Management and Erosion Sediment Control for any construction activities within the catchment. |
| WQ7 | Restore Pattimores lagoon salinity to appropriate regime | Assess the influence of Pattimores Lagoon weir on salinity | Yes | Investigated by a UoW thesis student in 2012. See page 12. |
| | | Determine previous salinity regime and methods of restoration | Yes | |

## 2.3 Review of Complete and Incomplete Actions

Since the implementation of the EMP in 1998, the majority of the strategies/actions outlined above have been implemented or are ongoing action items. The major change was the implementation of the Conjola Regional Sewerage Scheme in 2008.

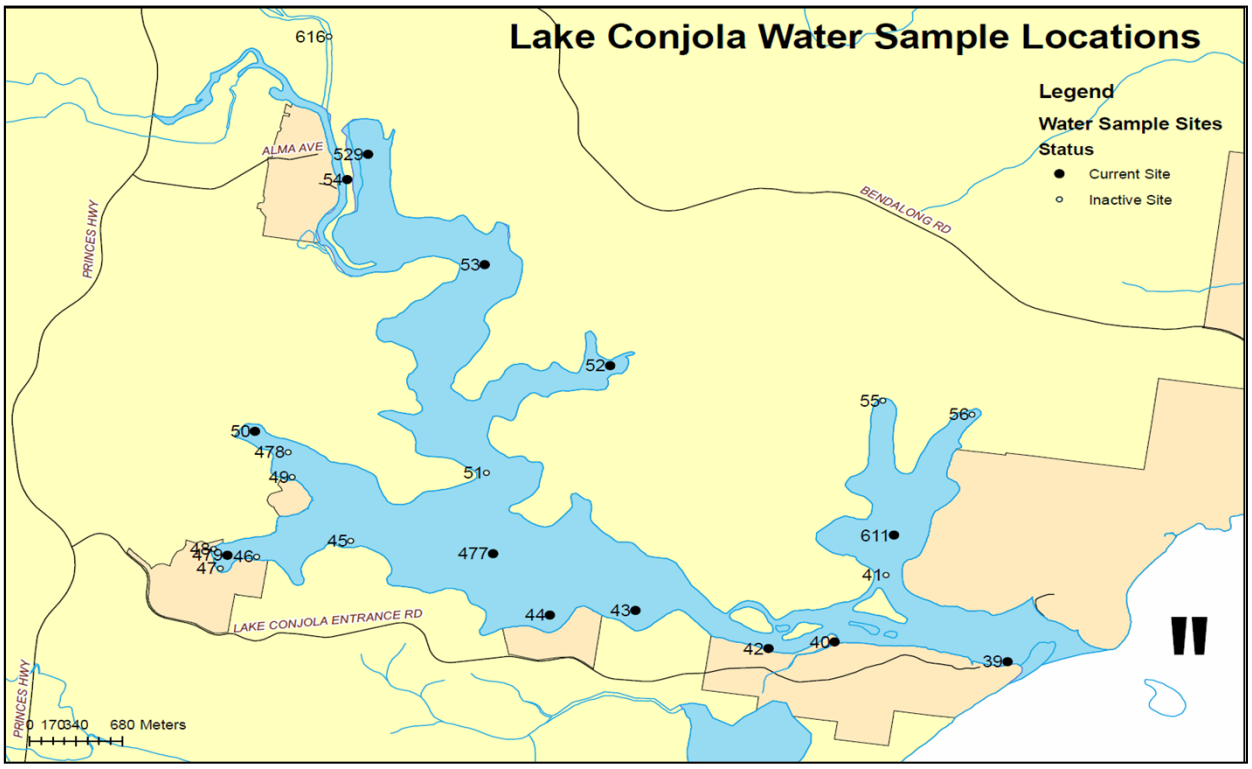
The 2014 Aqua Data portal is also a significant addition to Council's website.

### 2.3.1 Water Quality Monitoring in Lake Conjola

Water quality is important for human enjoyment of the estuary, including amenity, recreation and overall ecology of the aquatic system. In order ensure the water quality objective is being achieved, Shoalhaven City Council has a biannual water sampling program. This has been augmented with the Estuary Health Report Card, weekly sampling when the Lake is closed and the Aqua Data portal.

The biannual sampling is undertaken at 13 sites as outlined in Figure 2.

**Figure 2 Water Quality Sampling Locations *(SCC)***

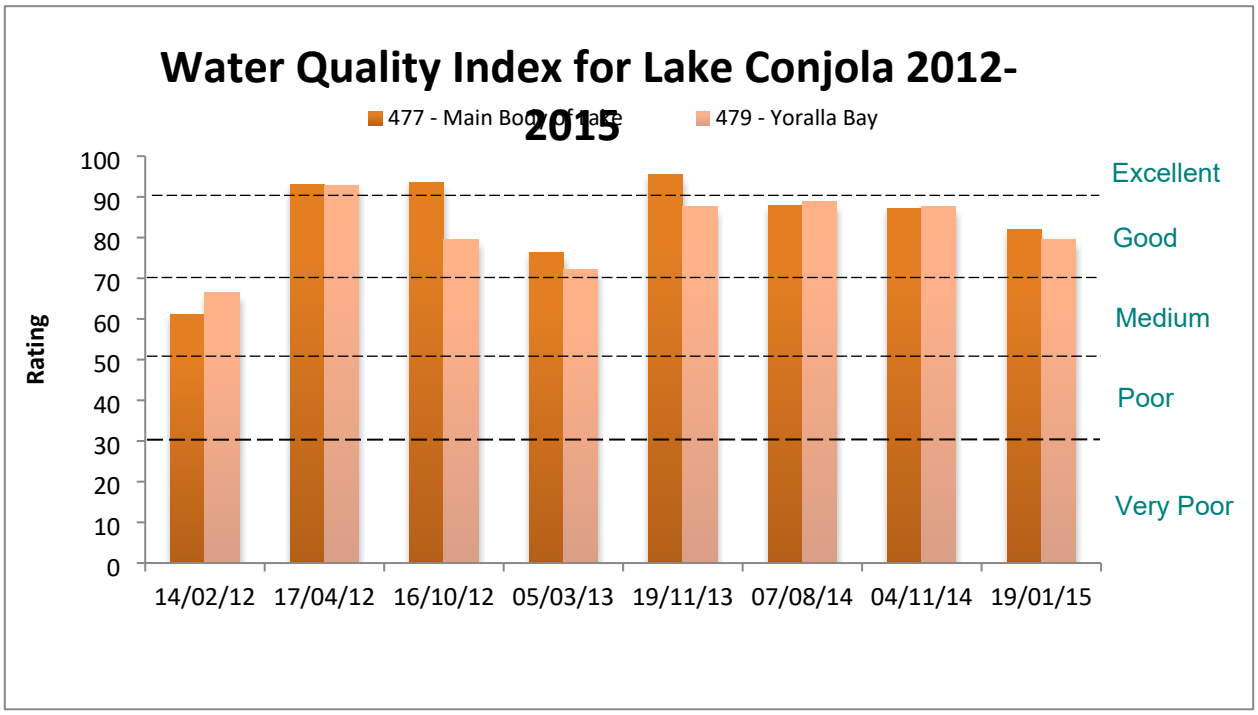



Nina indicators are monitored to measure water quality in Lake Conjola;

- Concentration of forms of nitrogen (µg/L);
- Concentration of forms of phosphorus (µg/L);
- Dissolved oxygen (mg/L)
- Faecal coliform counts (cfu/100mL)
- Water acidity/alkalinity (pH)
- Water temperature (ºC);
- Salinity (ppt);
- Turbidity (NTUs)l; and,
- Chlorophyll a (µg/L).

Council has adopted a Water Quality Index (WQI) which determines a value from the water quality results and then multiplies them by a weighting. All the results are then added to give an overall Water Quality Index. This method provides a snapshot view of catchment water quality. The sites in Lake Conjola have been assessed against WQI for the period 2009-2011, and were reported as having 'good' to 'excellent' water quality for this period as shown in Figure 3.

**Figure 3 Water Quality Index *(SCC)***




Water quality in Lake Conjola is considered to be good and improving.

With the loss of tidal flushing when the entrance is closed, water colour changes, leading to understandable perceptions that water quality is compromised. In response to these concerns, and while the Lake was closed from January 2012 to January 2013, weekly water quality monitoring was undertaken at three swimming sites; Entrance boat ramp, Killarney and Conjola Park.

For this period results were consistently 'Good' or 'Fair'. These results indicated that all sites were suitable for swimming.

Weekly monitoring can be reinstated when the Lake is fully closed again with results added to the Aqua Data portal.

**Estuary Health Report Cards**

In 2010-11 SCC developed an Estuary Ecosystem Health Monitoring Program for eight estuaries in Shoalhaven, including Lake Conjola. The Program was implemented with funds received from the NSW Estuary Management Program.

As an outcome of the program, Estuary Health Report Cards were developed for each of the eight estuaries. The aim of the report cards was to assess the overall health of the estuaries and to provide baseline information in order to track how well each estuary is managed over time and whether estuary management plans are contributing to improved estuary health.

The report cards are based on an assessment of chlorophyll a and turbidity data collected by Council, combined with information on estuary vegetation distribution change collected by DPI Fisheries.

The Estuary Health Report Card 2010-11 rated the ecosystem health of Lake Conjola as Good. Algae levels were consistently low, with water clarity always high.

Estuary Health Report Cards will be updated if funding becomes available from the NSW Government.

The Lake Conjola Estuary Health Report Card 2010-11 is at Appendix B.

**Aqua Data**

To improve communication of water quality data to the community, Council developed an online website called Aqua Data. This went live in late 2014. It provides up to date water quality information for all waterways included in Council's water sampling program.

Aqua Data displays water quality test results within a couple of days of the completed laboratory analysis. Users can navigate to any site using an interactive map, view result tables and graphs on-screen and download or print reports showing results from the present to several years ago.


http://webreports.esdat.net/SCC/Search/Locations#results-map

### 2.3.2 Conjola Regional Sewerage Scheme groundwater monitoring

Shoalhaven Water commenced discharge of treated effluent into the dune exfiltration system in 2008 and conducts quarterly groundwater monitoring to assess water quality trends in proximity to the exfiltration trench and surrounding areas.

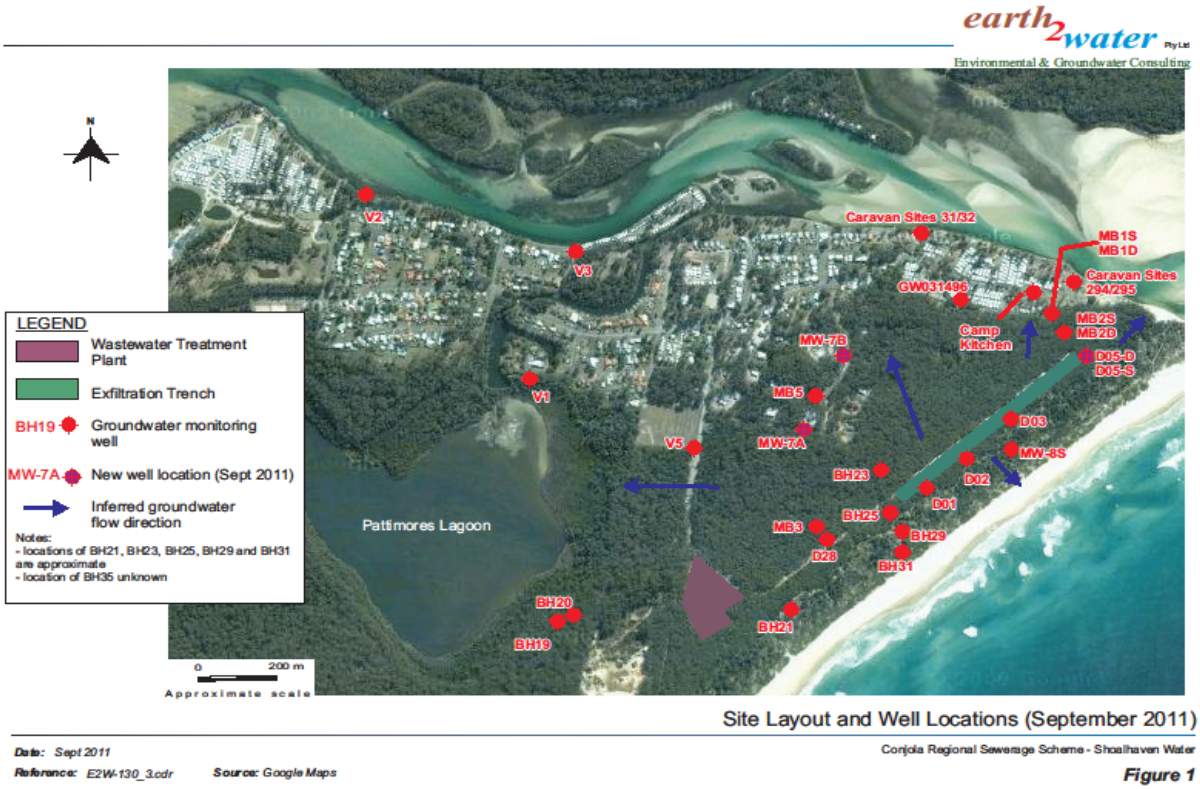
The results of the CRSS effluent monitoring indicate that the final effluent quality between June 2008 and October 2012 has complied with the EPL limits.

Effluent discharged from the CRSS is governed by prescribed limits in Environment Protection Licence (EPL, No. 12357).

Earth2Water Pty Ltd (E2W) has been engaged by Shoalhaven Water to complete annual monitoring reports for the water quality data obtained from approximately 30 monitoring wells around the Conjola Regional Sewerage Scheme. See Figure 4.

More information regarding the CRSS and the license can be found on the Shoalhaven Water website http://www.shoalwater.nsw.gov.au/services/epa-monitoring.html

**Figure 4 Groundwater monitoring locations *(Annual Groundwater Monitoring Report 2011-2012 CRSS, Earth 2 Water Pty Ltd)***




### 2.3.3 Water Quality Actions (WQ1 – WQ7)

In order to improve the water quality, address community concerns and implement the strategies/actions identified in the EMP, Council has undertaken, or will undertake the following:

- WQ1 & WQ3: The Conjola Regional Sewerage Scheme was completed in 2008. This reduced the potential for elevated levels of faecal coliform in the estuary. On-site effluent management systems are still located on properties outside the urban areas, and Council's Environmental Health Officers will continue to inspect these systems for compliance;
- WQ2 & WQ6: As outlined above, SCC undertakes extensive water quality data collection. Biannual monitoring of nine indicators, including bacterial levels and dissolved oxygen, is undertaken to ensure levels are in accordance with *ANZECC guidelines for Fresh and Marine Water Quality.* And, in order to address community concerns during periods of Lake closure, weekly monitoring was also undertaken and will continue when the Lake is fully closed. The Aqua Data site is also an important contribution to water quality management and providing the public with up to date water quality information.
- WQ4: The Shoalhaven LEP 2014 addresses water quality in Part 7, Additional Local Provisions (clause 7.6 Water), 'The objective of this clause is to maintain the hydrological functions of riparian land, waterways and aquifers to protect water quality, natural water flows, stability of the bed and banks of waterways and groundwater systems. This clause applies to land within 50m of the bank of a natural waterbody'. In addition, Shoalhaven DCP 2014, chapter G2 - Sustainable Storm Water Management & Erosion/Sediment Control, contains further detail outlining Specific Controls for Waterfront Land.

- WQ5: Bank stabilisation and foreshore rehabilitation works have been undertaken at seven locations – Fishermans Paradise, the entrance boat ramp, Cunjurong Point, West Lake Conjola, Deepwater Estate, Milham Street shop frontage and the Post Office precinct.
- WQ7: Research for a thesis by University of Wollongong student, Ashlee Rene Clarke, was completed in 2012. Ms Clarke concludes that 'In the context of restoring Pattimore's Lagoon to its natural regime, it was concluded that the lagoon is not behaving entirely unnaturally, and though it is a variable and complex system, it is thought to be behaving relatively similarly to what would have been experienced previously.' So at this stage, no new action is required. However, should further research be conducted and new information become available, it will be considered in further reviews of the EMP.

## 2.4 Recommendations/Actions.

**Now under the heading of Catchment Inputs and their Impacts – Section 9**

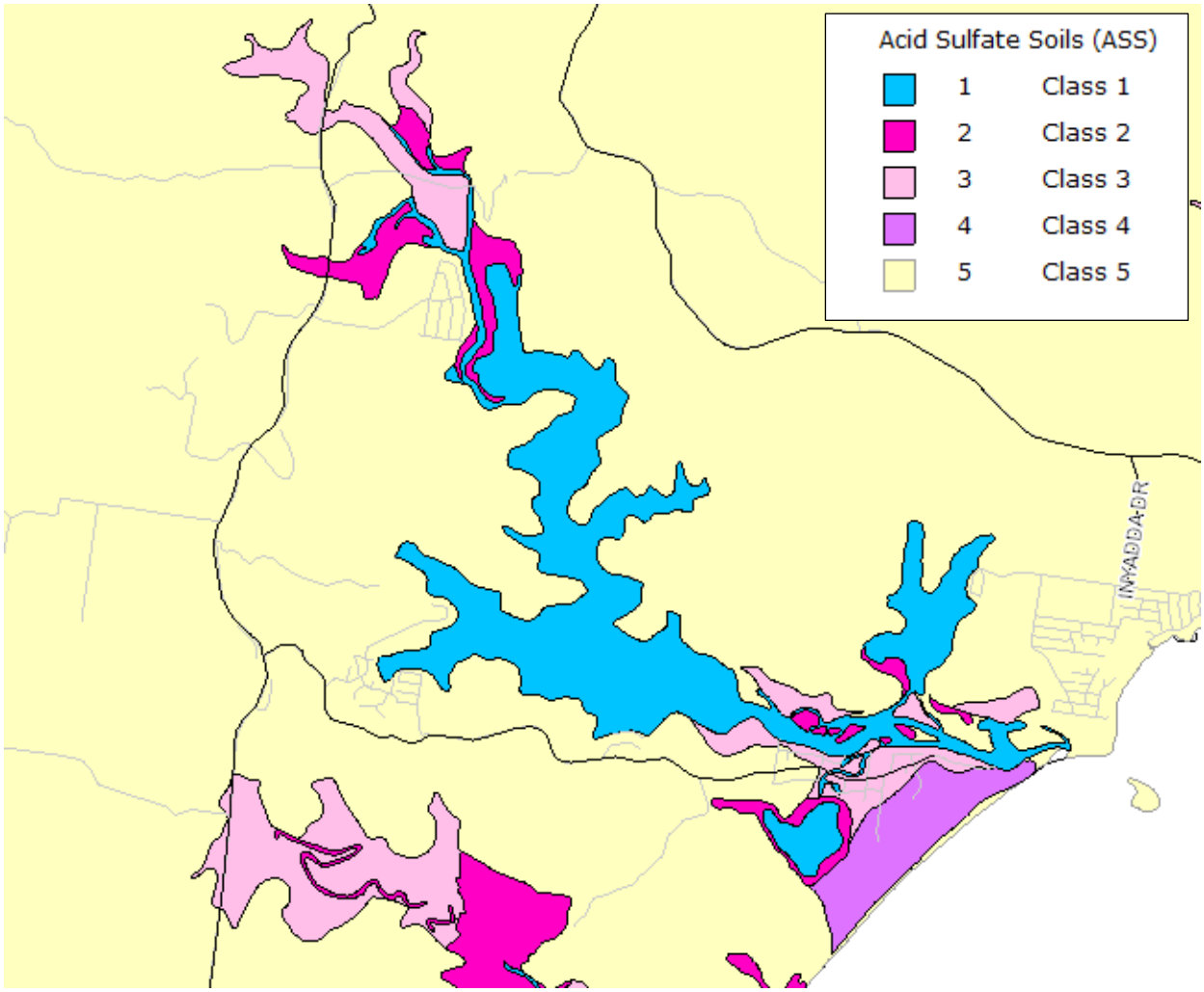
The actions put in place by Shoalhaven City Council have been successful in improving the water quality in Lake Conjola.

Managing catchment inputs is vital for the protection of water quality and ecosystem health therefore emphasis should remain on minimising pollutant loads at the source by focusing on land use and related management practices. The following recommendations are provided in relation to maintaining and improving water quality in Lake Conjola (and further detailed in Section 9):

- Provide a web portal with accurate and up to date water quality data. Provide information on what the community can do to help improve water quality;
- Update Estuary Health Report Cards when OEH funding becomes available;
- Regularly review test parameters and water sampling locations to ensure they are representative of Lake water quality and that they are in accordance with NSW Government Guidelines;
- Investigate deployment of a permanent water quality probe with results uploaded regularly to the Aqua Data portal;
- Continue to inspect and regulate compliance of remaining on-site sewage systems in the Lake Conjola catchment;
- Continue the monitoring and reporting program of the Conjola Regional Sewerage Scheme in accordance with Environmental Protection License requirements. Implement rectification or upgrade works when/if required to ensure minimal impacts on estuary health.
- Investigate the viability of implementing site appropriate water quality control structures to decrease sediment loading to the Lake and assess effectiveness once implemented.
- The Shoalhaven Growth Management Strategy 2014 states that there is no potential for urban expansion at either West Conjola or Lake Conjola, however, there may be potential for some dual occupancy or infill development. Ensure compliance of erosion & sediment controls at building sites through Shoalhaven DCP 2014, chapter G2 - Sustainable Storm Water Management & Erosion/Sediment Control.;
- Through the CCB, request that the community report potential erosion and sediment control breaches to Council.
- Acid Sulfate Soils are mapped in the Shoalhaven LEP 2014 (SLEP 2014). See below. Any land identified in the maps is subject to controls in Clause 7.1 of SLEP 2014 and Shoalhaven DCP 2014 Chapter G26 - Acid Sulphate Soils and Geotechnical (Site Stability) Guidelines. Clause 7.1 ensures that ASS is a consideration in the assessment of development applications.

**Figure 5 Acid Sulfate Soils *(SLEP 2014)7.3***

In the SLEP 2014 land is categorised into 5 classes with varying development consent requirements set out for each class.




| | |
|---|---|
| Class 1 | Any works |
| Class 2 | Works below the natural ground surface.<br>Works by which the watertable is likely to be lowered. |
| Class 3 | Works more than 1 metre below the natural ground surface.<br>Works by which the watertable is likely to be lowered more than 1 metre below the natural ground surface. |
| Class 4 | Works more than 2 metres below the natural ground surface.<br>Works by which the watertable is likely to be lowered more than 2 metres below the natural ground surface. |
| Class 5 | Works within 500 metres of adjacent Class 1, 2, 3 or 4 land that is below 5 metres Australian Height Datum and by which the watertable is likely to be lowered below 1 metre Australian Height Datum on adjacent Class 1, 2, 3 or 4 land. |

# 3. Review of Erosion and Sedimentation Objectives, Strategies and Actions

## 3.1 Background

Erosion and sedimentation refers to the amount of material moved and deposited by the action of waves, water and wind into the Lake.

Potential sources of sediment capable of infilling the Lake include the catchment, the Lake shore and the ocean. For Lake Conjola possible sediment sources outlined in the EMP include the following:

- Aeolian transport of barrier dune sands;
- Fine catchment soil carried into the Lake during a flood;
- Coarser material from bank erosion in the catchment transported down tributary streams into fluvial deltas;
- Estuary bank erosion from wind and boat waves, human influence, and natural channel processes; and,
- Marine sand carried into the lower inlet channel reach by flood tides when the entrance is open.

During the preparation of the EMP, evidence of significant sedimentation existed, dating back to 1944, in the shoals behind the entrance dune. It was proposed that the majority of the deposited sand had originated from the southern entrance dune however it was recommended that further site investigations would be required to confirm this hypothesis. It was noted that there were few existing erosion problems associated with the main water bodies of Lake Conjola, Berringer Lake and Pattimores Lagoon at the time the EMP was implemented. Minor localised bank erosion had been identified during field observations at various locations around the Lake and generally along the tidal channels which connect the main water bodies to the ocean.

During the development of the EMP possible causes of sedimentation and erosion were determined which included:

- Sediment Generation
  - Road construction and maintenance;
  - Agriculture and forestry land use practices; and,
  - Urban development.
- Bank Erosion
  - Natural channel migration;
  - Wind waves;
  - Freshwater flood flows;
  - Vegetation removal and other human activities on the banks;
  - Trampling by stock; and,
  - Boating activities.
- Other sources
  - Aeolian transport of exposed dune sands.

Based on the available information at the time of the development of the EMP the following objective was developed for the management of erosion and sedimentation in the Lake.

**Management Objective**

**To minimise erosion from the foreshores and catchment of the Lake and maintain and delineate navigable channels within the Lake.**

**Photo 1 Lake Conjola Shoreline Vegetation to Prevent Shoreline Erosion**

## 3.2 Strategies/Actions - 1998 EMP

Historic and current sedimentation rates in the Lake were unknown during the preparation of the 1998 EMP. The strategies developed were to target the obvious causes of erosion through planning controls and protective works where necessary. The strategies and actions are provided in Table 2, together with the current status of each action item.

**Table 2 Erosion and Sedimentation Strategies and Actions**

| ID | Strategy | Action | Action Completed | Comments |
|---|---|---|---|---|
| ES1 | Provide a consistent approach to bank protection and revegetation | Amend LEP to provide foreshore protection through retention of a buffer zone | Yes | The Shoalhaven LEP 2014, Section 7.6 describes the protection of Riparian Land.<br>Shoalhaven DCP G2, Sustainable Stormwater Management and |

| ID | Strategy | Action | Action Completed | Comments |
|---|---|---|---|---|
| | | | | Erosion/Sediment Control, sets out more detailed criteria to protect riparian zones and waterways. |
| | | Amend LEP to incorporate long term strategy of public ownership of foreshore lands and wetlands | Not done | This issue is beyond the capacity of local government. SCC is awaiting action from the Federal and State Government. |
| | | Public education in management of foreshore and riparian vegetation | Yes | Signs installed at multiple locations around Lake foreshore. |
| ES2 | Bank stabilisation | Implement boat speed restrictions in areas sensitive to wave action | Yes | BPOM (2005) |
| | | Identify and fence off sensitive foreshore areas | Yes<br>ongoing | Local Land Services has worked with property owners to fence off sensitive areas along Conjola Creek and northern reaches of the Lake. More needs to be done. |
| | | Bank stabilisation adjacent to Fishermans Paradise boat ramp | Yes | Council has also undertaken bank stabilisation and foreshore rehabilitation works at Cunjurong Pt, the Lake entrance boat ramp, West Lake Conjola, Deepwater Estate, Milham Street shop frontage and the Post Office precinct. |
| | | Provide dinghy racks at foreshore caravan parks | Not done | To be reassessed during site specific rehabilitation works |
| ES3 | Entrance dune stabilisation | Formalise foreshore access (including board and chain paths, dinghy racks and fencing) | ongoing | Foreshore access continues to be formalised |
| | | Investigate appropriateness of vegetation planting on entrance dune | Yes | Interim Entrance Management Policy 2013 states, 'Increase height of the dune on the southern side of the entrance and provide dense vegetation cover to prevent sand being remobilised.' |
| | | Investigate feasibility of realignment of main channel away from current position near southern dune | Yes | Following extensive community consultation, a more central intervention channel was trialled in February 2013. |

## 3.3 Review of Complete and Incomplete Actions

Since the implementation of the EMP in 1998, the majority of the strategies/actions outlined above have been implemented or are ongoing action items. In 2002 a stormwater and road sedimentation audit was completed with mitigation measures being gradually implemented as funding becomes available. The Shoalhaven DCP G2, Sustainable Stormwater Management and Erosion/Sediment Control, sets out more detailed criteria to reduce sedimentation and protect riparian zones and waterways.

### 3.3.1 Bank Protection and Revegetation (ES1)

The Shoalhaven LEP 2014 addresses water quality in Part 7, Additional Local Provisions (clause 7.6 Water), 'The objective of this clause is to maintain the hydrological functions of riparian land, waterways and aquifers to protect water quality, natural water flows, stability of the bed and banks of waterways and groundwater systems. This clause applies to land within 50m of the bank of a natural waterbody'. Mapping linked to clause 7.6 Water, shows three categories of 'sensitivity'. Watercourse Category 1 includes the entire foreshore of Lake Conjola and attracts a 50m 'buffer'. This means that before determining a DA, Council must consider any potential adverse impact in relation to natural flow regime, water quality of receiving waters, waterway's natural flow paths, and stability of the waterway's bed, shore and/or banks. Watercourse Categories 2 and 3 apply to catchment creeks and have narrower buffers applied.

**Public education**: Signage has been installed at various locations around Lake Conjola to educate the community in relation to erosion, sediment control and the importance of foreshore and riparian vegetation.

### 3.3.2 Bank Stabilisation (ES2)

**Boating Plan of Management**: In 2005 NSW Maritime implemented the *Lake Conjola Boating Plan of Management* (BPOM) which is designed to:

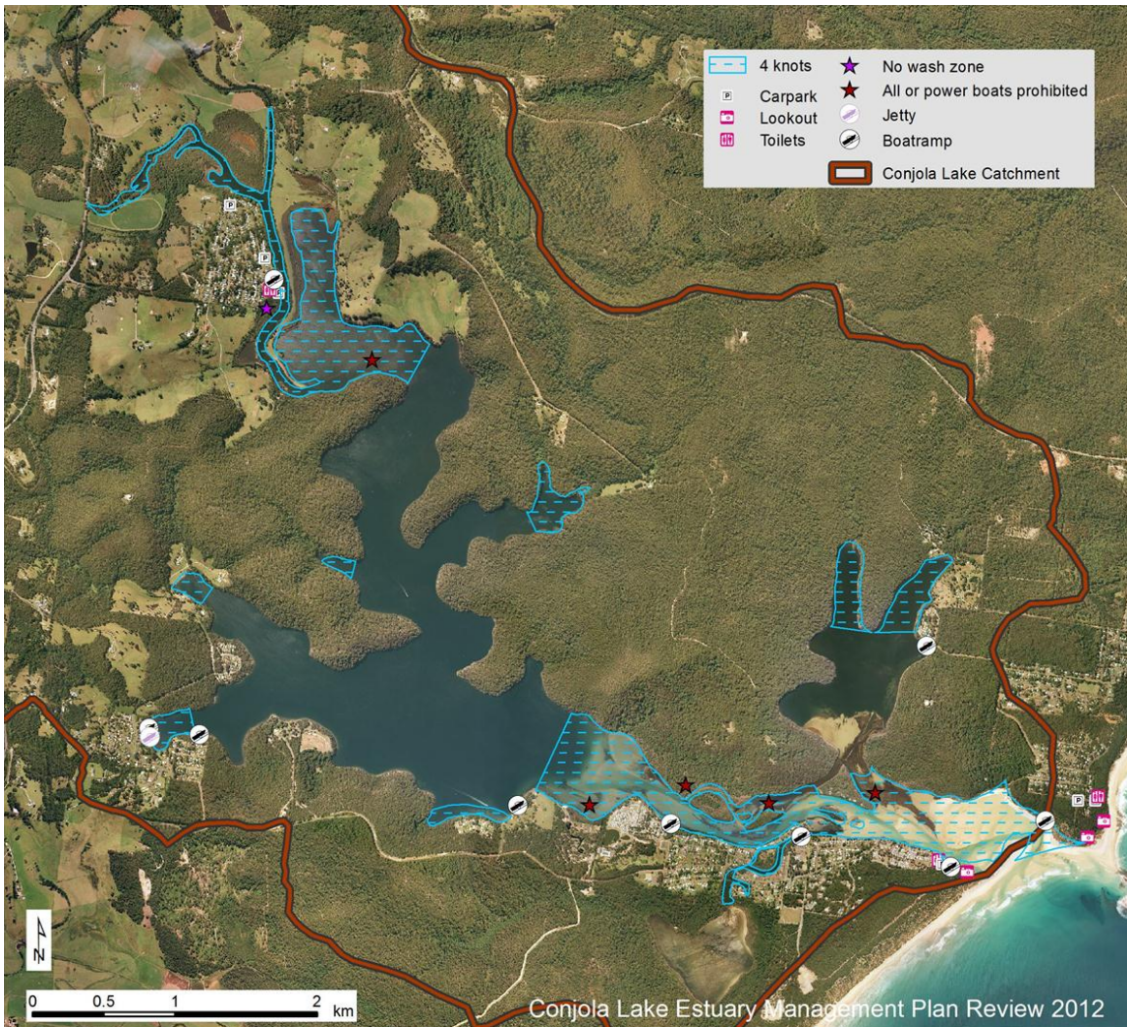
- Protect and sustain the recreational and environmental values of the waterway;
- Ensure the boating practices maximise user safety, enjoyment, public safety and amenity;
- Consider the needs of shore-based estuary users as well as boating-based activities;
- Review shore-based boating-related facilities or infrastructure such as launching ramps; and,
- Provide a framework for consultation.

The Plan contains strategies addressing values and issues relevant to both the entire estuary and location specific areas. The boat speed restrictions outlined in the Plan were implemented to address ES2 and to protect the foreshore from erosion as a result of boat wash. See Figure 6.

**NOTE:** At the time of finalising this document, RMS informed Council that the Regional Boating Plan Shoalhaven – Illawarra (February 2015) is finalised and publicly available http://maritimemanagement.transport.nsw.gov.au/documents/shoalhaven-illlawarra-regional-boating-plan.pdf

SCC and RMS intend to consider its implications for boating management in Lake Conjola as part of a future review of the estuary management plan.

**Figure 6 Boating Plan of Management Zones**




**Fencing sensitive areas on private land**: In order to protect sensitive riparian areas in the northern reaches of the Lake (including 5 SEPP 14 Wetlands, see Figure 10), the Southern Rivers CMA (now South East Local Land Services) has worked with property owners along Conjola Creek and the northern arm of the Lake to erect approximately 7km of fencing. There is still more fencing required to protect the creek banks upstream of Murrays Bridge where stock continue to access Conjola Creek.

**Bank stabilisation on public land**: Council conducts its own assessment of foreshores and also responds to community requests to improve sections of the Lake Conjola foreshore to ensure that the bank stabilisation strategy, ES2, continues to be fulfilled.

In addition, a *Shoreline Protection Condition Assessmen*t of all Council's assets was undertaken in November 2010 to assess and prioritise works for future rehabilitation of shoreline protection assets.

Reference is made to four sites at Lake Conjola;

- Entrance Boat Ramp Reserve (medium priority) – foreshore revegetation and minor rock armour protection completed
- Carol Avenue Reserve (medium priority) – stub groyne and sand nourishment completed in the section in front of the post office. Photo 2 shows a different section of bank in Carol Avenue Reserve in need of rehabilitation.

**Photo 2 Carol Avenue Reserve**

- Edwin Avenue Reserve (low priority) – no work done as yet
- Pattimores Lagoon Inlet (low priority) – no work done as yet.

When bank stabilisation works are implemented, they generally include at least some of the following components - walkways, seating, picnic shelter, interpretive signage, foreshore revegetation, road and /or carpark upgrade, canoe launching ramp, fishing platform.

Bank stabilisation and foreshore rehabilitation works have been undertaken by Council at,

- Cunjurong Point – seating, picnic tables, walkway, interpretive signage & improved road drainage included;

**Photo 3 Cunjurong Point Foreshore Rehabilitation**

- Fisherman's Paradise boat ramp;
- Entrance boat ramp – fishing platform, seating, revegetation included;
- West Lake Conjola – storm water mitigation works included;
- The Post Office precinct – sand beach, stub groyne & revegetation included.
- Milham Street shop frontage – canoe launching ramp & fishing platform included.

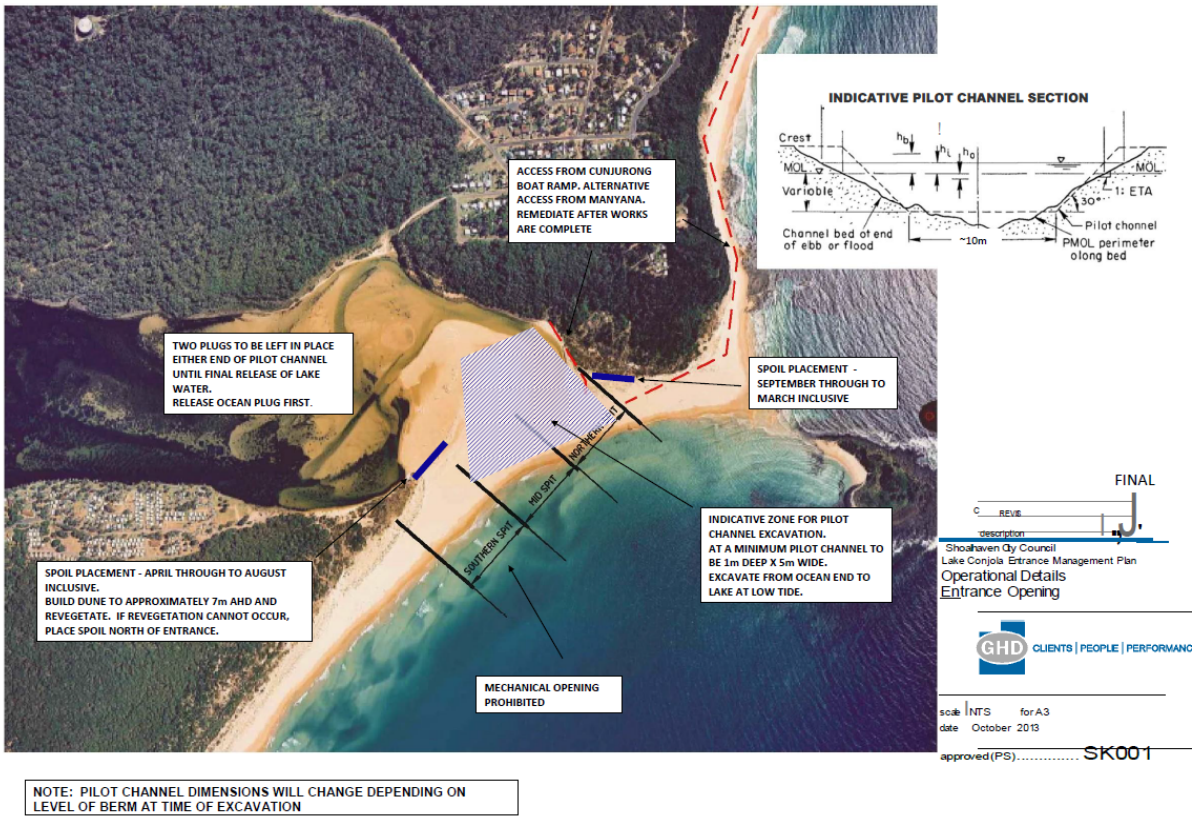
**Photo 4 Milham Street Foreshore Rehabilitation**

### 3.3.3 Entrance Dune Stabilisation (ES3)

The Lake Conjola Interim Entrance Management Policy 2013 prohibits mechanical openings at the southern end of the spit. Mechanical openings are to be limited to the mid and northern sections of the spit. See Figure 7.

To address the issue of storm washover and sand build up in the entrance, The Interim Entrance Management Policy 2013 (Table 1, p 9) states, 'increase height of the dune on the southern side of the entrance and provide dense vegetation cover to prevent sand being remobilised.

**Figure 7 Lake Conjola Interim Entrance Management Policy, Operational Details *(GHD 2013)***




## 3.4 Recommendations/Actions

**Now under the heading of Catchment Inputs and their Impacts – Section 9**

Minimisation of erosion and sedimentation requires ongoing attention. Council has addressed most of the strategies outlined in the EMP and the following additional recommendations are made:

- In order to address the ad hoc construction of retaining walls on private properties promote the use of the *Environmentally Friendly Seawall Guidelines* (DECC and SMCMA, 2008);
- Develop an ongoing foreshore monitoring program to identify sections of bank for remediation and ensure minimisation of sediment loads entering the Lake;
- Ensure that buffer zones are maintained and reassess the inclusion of a buffer zone in the Shoalhaven LEP;
- Undertake a foreshore vulnerability study;
- Further investigate erosion and sediment loads from road and track surfaces. Identify locations where roads/tracks intersect streams (GIS analysis) and implement appropriate mitigation works;
- Ensure greater compliance of erosion and sediment controls at building sites.

# 4. Review of Flooding Objectives, Strategies and Actions

## 4.1 Background

The Lake Conjola Flood Study 2007 (BMT WBM) identified two main causes of flooding at Lake Conjola; flooding as a result of intense rainfall in the catchment (catchment flooding) and flooding resulting from severe ocean conditions (ocean flooding).

The 2013 Flood Risk Management Study and Plan (FRMS&P) defines both flood types and identifies a third cause of flooding,

- Catchment Flooding: Flooding from runoff generated from significant rainfall in the catchment contributing to flows into Lake Conjola
- Ocean Flooding: Flooding from very high ocean water levels, typically as a combination of big tides and storm surge and;
- Low-level Persistent Flooding: Flooding of the lowest parts of the foreshore areas from gradual rises in Lake level during periods of entrance closure or under potentially higher tidal conditions with sea level rise and an open entrance.

The FRMS&P concludes that whilst a closed entrance may increase the likelihood of low level persistent flooding and decreases the likelihood of ocean flooding, it has little impact on major catchment flood events. In these events, flooding is likely to occur whether the entrance is open or closed.

Catchment runoff during heavy rainfall events causes significant rises in water levels in many estuaries on the NSW coast. Flood inflows perform several functions vital to the maintenance of an estuary's character and condition including:

- Introduction of nutrients and organic material from the catchment into the estuary where they may be incorporated in the food chain;
- Inundation of low lying wetlands that are dependent on the cycle of wetting and drying to maintain their viability; and,
- Scouring of entrance channel sand shoals that generally move upstream under tidal influence. Scour is most effective when the difference in water level between the estuary and the ocean is maximised. Sand, scoured from the entrance, is deposited offshore and then moved back onshore by wave and tidal action.

The land on which the majority of the Lake Conjola township is located is low-lying. Therefore, there is potential for flooding of residential properties and caravan parks, primarily those located adjacent to the foreshore.

**Photo 5 Minor Flooding at Lake Conjola**

As a means of managing minor catchment flooding in the township, the *Draft Interim Lake Conjola Entrance Policy* (2012) outlines proposed triggers that would justify mechanical intervention.

The issues raised by the community during the development of the EMP in relation to flooding included the following:

- Flooding of low lying properties;
- Inundation of septic systems; and,
- The effect of the current entrance opening level on the Lake system.

The flooding objective developed for Lake Conjola through the EMP process was:

**Management Objective**

**Minimise the impact of flooding on individuals and existing and future development and to minimise the impact of development on flooding while maintaining a sustainable ecosystem.**

## 4.2 Strategies/Actions – 1998 EMP

The strategies and actions developed are consistent with the NSW Floodplain Development Manual and are outlined in Table 3.

**Table 3 Flooding Strategies and Actions**

| ID | Strategy | Action | Action Completed | Comments |
|---|---|---|---|---|
| FL1 | Prepare and implement a floodplain management plan | Form a Floodplain Risk Management Committee | Yes | The Southern Natural Resources and Floodplain Management Committee was formed in 2003 |

| ID | Strategy | Action | Action Completed | Comments |
|---|---|---|---|---|
| | | Carry out flood study (including influence of entrance characteristics, catchment and ocean conditions etc.) | Yes | Flood Study 2007 |
| | | Carry out floodplain management study (assessment of management options including structural and non-structural measures) | Yes | FRMS&P completed 2013 |
| | | Review flood standard incorporating both flooding and environmental considerations | Yes | |
| | | Develop a floodplain management plan | Yes | |
| FL2 | Assess the ecological/water quality issues in conjunction with the flood study | Identify level of flooding which will inundate septic systems | N/A | No longer relevant as the sewerage scheme has been completed |
| | | Review management study options with consideration of environmental impacts | Yes | FRMS&P has reviewed the management options available to Council |

## 4.3 Review of Complete and Incomplete Actions

Both of the strategies developed in relation to flooding have been addressed.

### 4.3.1 Flood Study and Floodplain Risk Management Study and Plan (FL1 and FL2)

The Southern Natural Resources Floodplain Management was formed in 2003. From this committee emerged the 2007 Flood Study and the 2013 Floodplain Risk Management Study and Plan.

The Lake Conjola Flood Study investigated flooding in the catchment to identify the critical or worst case flood conditions for a range of flood events for both catchment and ocean flooding. It was determined that for different locations within the catchment, and for different size flood events, the dominant flooding mechanism can vary, being either catchment rainfall or ocean flooding. The Flood Study determined that the condition of the entrance has a significant influence on flood behaviour in Conjola Lake. For low level catchment flooding, an effective open entrance provides for lower flood levels in comparison to a shoaled or closed entrance. However, generally for ocean flooding, an open entrance is less favourable as this allows greater penetration of ocean water into the estuary under storm surge (ocean flooding) conditions.

The aim of the FRMS&P is to ensure that existing and future development is exposed to an 'acceptable' level of risk, consistent with other risks that people live with on a day to day basis. Most importantly, the Plan seeks to minimise Risks to Life.

Due to the legacy of approved developments in low lying areas, flood risk will remain significant regardless of the management measures being implemented.

## 4.4 Recommendations/Actions

Flooding continues to be a very important area of management for the Lake Conjola community and should be a main focus area for Council.

As no major flooding has recently been experienced at Lake Conjola, flood risks are not well understood by the community and ongoing education is required.

The following recommendations are made in relation to flooding:

- Continue to engage with and update the community in relation to flooding, the risks associated with flooding and strategies for mitigating against those risks;
- Ensure the controls identified in the NSW Floodplain Development Manual and Shoalhaven DCP 2014 G9, Development in Flood Prone Areas, are applied in determining development applications;
- Ensure that the management strategies developed in the *Flood Risk Management Plan* are appropriately considered in the *Estuary Management Plan* and the *CZMP*;
- Ensure future planning for the area recognises increased flood risk as a consequence of climate change and sea level rise.

# 5. Review of Lake Ecology Objective, Strategies and Actions

## 5.1 Background

Due to the unpredictable nature of rainfall in south-east Australia, the opening behaviour of estuaries can be intermittent and erratic and the salinity regime is comparatively variable (Roy *et al.* 2001). As the opening and closing of estuary entrances is a natural occurrence, the plants and animals residing in and around them have adapted to the variability in environmental conditions. Estuaries provide critical habitat for many species of fish, invertebrates and birds, for all or part of their life cycles and often support important commercial and recreational fisheries. Estuaries represent the boundary between marine and freshwater ecosystems and as such they support a combination of habitats and species from both systems. The sheltered environment created in estuaries and the predominance of a soft sediment substrate has resulted in the creation of habitats not usually found outside estuaries, such as mangroves, saltmarsh and seagrass beds as shown in Figure 8. Estuaries are dynamic environments, constantly changing their patterns of water movement and standard of water quality, resulting in low species diversity compared with freshwater or marine systems.

A diverse array of aquatic habitats exist within Lake Conjola including seagrasses, mangroves, shoals, wetlands, rocky outcrops and walls and timber pilings. Lake Conjola is a dynamic estuary, with each of these habitats being directly affected by an open or closed entrance.

**Figure 8 Estuary Health Report Card 2010-2011** ***(NSW Office Environment and Heritage)***

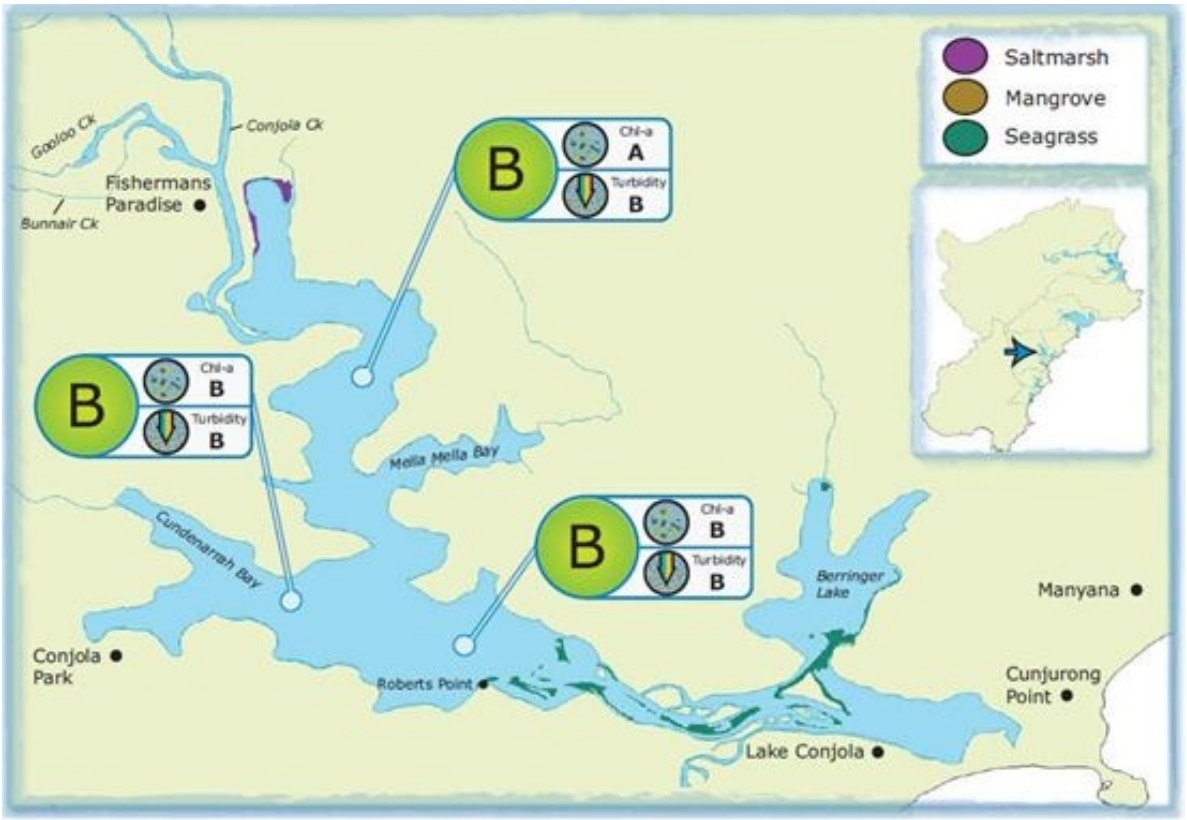
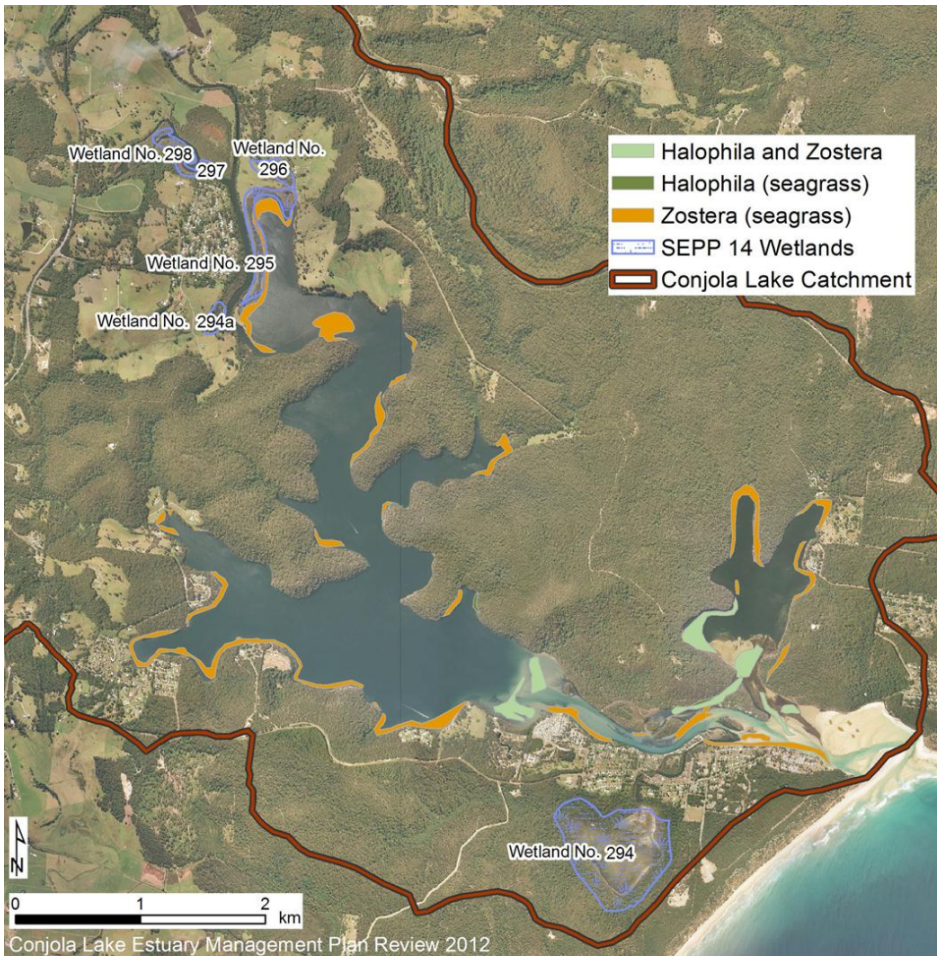


**Figure 9 Wetland Vegetation *(N. Saintlin 2004)***




Ecological values identified specifically for Lake Conjola during the development of the EMP were:

- A diverse assemblage of fish;
- Presence of seagrasses; and,
- State Environmental Planning Policy (SEPP) 14 wetlands.

Because estuaries are popular sites for development, urbanisation, recreation and harvesting, the habitats and species associated with estuaries are possibly the most vulnerable and heavily impacted sites of the coast. Many estuarine habitats and communities have been altered or lost due to direct physical disturbance or as a result of decline in water quality.

Those issues identified during the development of the EMP for Lake Conjola included:

- Reduction of areas of seagrass beds; and
- Perception of a decline in fish populations.

The ecological objective developed for Lake Conjola through the EMP process is provided below.

**Management Objective**

**To maintain or enhance aquatic flora and fauna values of the Lake.**

## 5.2 Strategies/Actions – 1998 EMP

The strategies and actions developed for the Lake Conjola Ecology through the EMP process are outlined in Table 4 with further details of how Council has achieved each action in Section 5.3.

**Table 4 Ecology Strategies and Actions**

| ID | Strategy | Action | Action Completed | Comments |
|---|---|---|---|---|
| AE1 | Maintain and protect seagrass beds | Further delineate areas of seagrass by channel markers and buoys | Yes | BPOM incorporated 4 knot zones, buoys and markers to delineate areas of seagrass |
| | | Stabilise eroding banks that are determined to be increasing sedimentation and/or turbidity levels in the Lake | Yes<br>ongoing | 4 knot zones reduce the potential for bank erosion along with Council's shoreline assessment and revegetation program |
| | | Manage stormwater to reduce sedimentation and nutrient loads entering the Lake | Yes<br>ongoing | Shoalhaven DCP G2, Sustainable Stormwater Management and Erosion/Sediment Control, sets out criteria to sedimentation entering waterways.<br>Stormwater Management Plan 2000 – implement and review |
| AE2 | Sustainably manage fish communities | Undertake a recreational fish catch survey to determine the nature and magnitude of the current recreational fishery including fishing effort, species catch, total catch, catch per unit effort etc. | No | This action was not necessary once commercial fishing was banned due to the Caulerpa infestation. The action emerged from community concern that commercial fishing was taking more than its 'fair share' and, as a result, impacting on recreational fishing. |
| | | Continue to monitor and assess the commercial fish catch, effort and catch per unit effort trends for individual species and all species | N/A | Commercial fishing prohibited in the Lake |
| | | Compare the commercial and recreational catches to determine if the resource is being shared appropriately and is not declining | N/A | |
| | | Continue to enforce the existing commercial and recreational fisheries regulations and closures | Ongoing | Recreational fishing laws are enforced, commercial fishing is prohibited |
| | | Educate fishing community of current rules to ensure conservation of the fish | Yes | Signs & brochures |

| ID | Strategy | Action | Action Completed | Comments |
|---|---|---|---|---|
| | | resource and its habitat | | |
| AE3 | Public education on importance and value of aquatic ecology of Lake Conjola | Develop and implement public awareness and education and programs (brochures, signs, personal contact) to describe ecological value of the Lake, identifying vulnerable habitats and management plan | Yes | Council has erected signs throughout Conjola with information on the habitats in and around the Lake |
| AE4 | Maintain and protect SEPP14 wetlands | Amend LEP to provide Environment protection zonings for SEPP 14 wetlands | Yes | SEPP14 wetlands are consistently zoned E2 in the LEP 2014. |

## 5.3 Review of Complete and Incomplete Actions

The number, type and location of species in an estuary are determined by water quality (salinity, light availability, nutrient levels and turbidity), substrate type and availability and patterns of water movement. Because all these factors can alter significantly under natural conditions, estuaries are often colonised by species (both marine and freshwater) which can tolerate extreme changes in these characteristics. In addition to the variation resulting from natural events, impacts from human activities can also significantly alter these factors.

### 5.3.1 Seagrass (AE1)

Three species of seagrass were recorded in Lake Conjola in a study undertaken in 1985. The seagrass beds were patchy near the mouth of the Lake, possibly reflecting the mobile shoals with smaller areas at the end of each sheltered bay. The shape and location of seagrasses had changed in many parts of the Lake by 1994. The status of seagrass communities around the Lake is reported in the State of the Catchments report (DECCW, 2010) as poor. This analysis was based on an apparent 68% loss in seagrass area from 1985 to 2006. Previous studies have noted that increased recreational boating over shallow seagrass beds is a likely contributor to decline in some areas however natural fluctuations are also likely to be a factor.

The strategy to maintain and protect seagrass beds (AE1) is being managed by SCC and NSW Maritime. The *Boating Plan of Management* (2005) for Lake Conjola incorporates 4 knot zones along with channel markers and buoys to ensure that areas with seagrass populations are delineated and to ensure that erosion to the foreshore is minimised.

### 5.3.2 Sustainable Management of Fish Communities (AE2)

The sustainable management of the fish communities identified within Lake Conjola (AE2) has been addressed through the Department of Primary Industries fishing laws and prohibition of commercial fishing in Lake Conjola. Commercial fishing was prohibited in order to manage the spread of *Caulerpa taxifolia*. In addition, the Estuary Program in 2003/04 provided funding for signage, pamphlets and brochures regarding sustainable fishing practices.

The fisheries resources of Lake Conjola include several hundred species of finfish, crustaceans (crabs, shrimps and prawns), molluscs (octopus, oysters, clams etc.) and other invertebrates. As far as is known, none are unique to Lake Conjola. They are all species that occur widely along the coastline of south-eastern Australia. Indeed some species, such as Tailor, have a worldwide distribution. Some of the larger species in particular, such as flathead, whiting, bream, luderick, tailor, prawns and Blue Swimmer Crabs, are targeted by recreational fishers and are therefore of direct

socioeconomic value to the local community and visitors. The majority of species however are not targeted, but they still contribute to the overall health and wellbeing of the lake and the local community because they are part of the food chain for the larger, more desirable species or are part of the wider ecology of the Lake.

Utilisation of the fisheries resources of Lake Conjola is subject to a wide range of rules and regulations. Those relating to recreational fishing are detailed in the NSW Recreational Saltwater Fishing Guide (NSW Department of Primary Industries 2014 – available at: http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0020/202349/NSW-SW-Rec-Fishing-Guide.pdf These rules have been developed and refined over decades and are subject to regular review and modification in response to improvements in scientific knowledge. Rules and regulations governing recreational fishing include:

- A requirement for fishers to hold a Recreational Fishing Fee receipt (licence) unless exempt (under 18 years old, a holder of a Pensioner Concession card);
- Bans on the use of gill nets, cast nets, set (unattended) lines etc.;
- Limitations of the number of lines and hooks, crab traps or prawn nets that may be used;
- Full protection of some species;
- Limitations on when certain species can be targeted (e.g. closed season for Australian Bass and Estuary Perch);
- Limitations on the size of fish that may be retained (size limits);
- Limitations on the number of fish that may be kept (bag limit) or retained in possession (possession limit).

The status of fisheries resources in NSW (encompassing 108 species of finfish and invertebrates that are commercially and/or recreationally fished) is comprehensively assessed and reviewed every few years (Rowling et al 2010). The findings of these assessments are used to inform ongoing management activities and regulatory changes.

Fishing is only one aspect of the sustainable management of fish communities. The fisheries resources of Lake Conjola are dependent upon the extent, availability and quality of the habitat both within the lake and more broadly within the catchment and along the NSW coastline. Again, a wide range of rules and regulations are in place to prevent the degradation and loss of fish habitats. These include regulations in relation to:

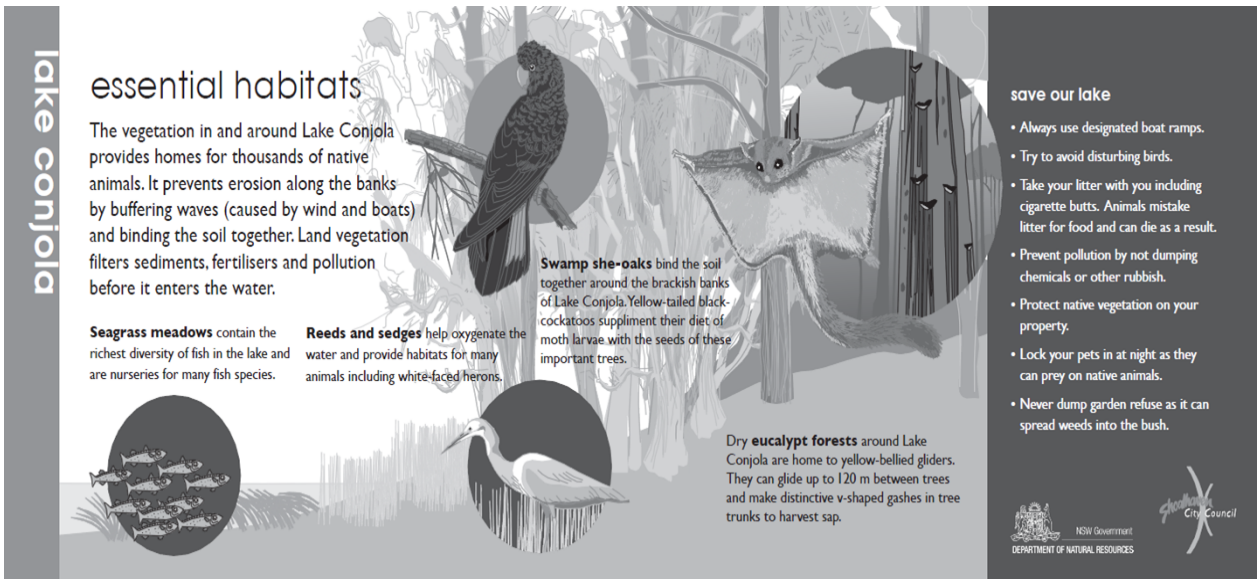
- Pollution of waters;
- Harming seagrass, seaweeds and mangroves;
- Dredging, excavation and filling of freshwater, estuarine and marine habitats,
- Obstructing fish passage;
- Clearing of native vegetation adjacent to the shoreline;
- Releasing fish or aquatic weeds into waterways etc.

Ensuring compliance with these rules and regulations is achieved by a combination of education and enforcement programs implemented by the officers of various State Government agencies (e.g. DPI Fisheries, Environment Protection Authority) and Shoalhaven City Council. Nevertheless, threats to the quality of the habitat, in particular water quality resulting from agricultural and urban land use practices within the catchment, are significant and require ongoing attention. Sediment and nutrient loads originating from the catchment ultimately enter and accumulate in the Lake. Settlement of sediments can smother seagrasses and benthic communities. If nutrients accumulate, concentrations can exceed biological thresholds resulting in blooms of nuisance algae and consequent anoxia.

### 5.3.3 Public Education (AE3)

Signs have been installed around Lake Conjola in order to address AE3 and to provide community education on the importance and value of the aquatic ecology of the Lake.

**Photo 6 Lake Conjola Education Signage**




### 5.3.4 SEPP14 Wetlands (AE4)

In natural systems, wetland vegetation is responsive to its environment. Interpretation of changes in spatial spread, abundance and composition may not necessarily indicate long term decline, increase or change in wetlands. These changes may be attributed to a variety of parameters e.g. dry / wet years, increased / decreased salinity, physical destruction and regrowth etc.

Figure **10** shows the areas of SEPP14 wetland associated with Lake Conjola.

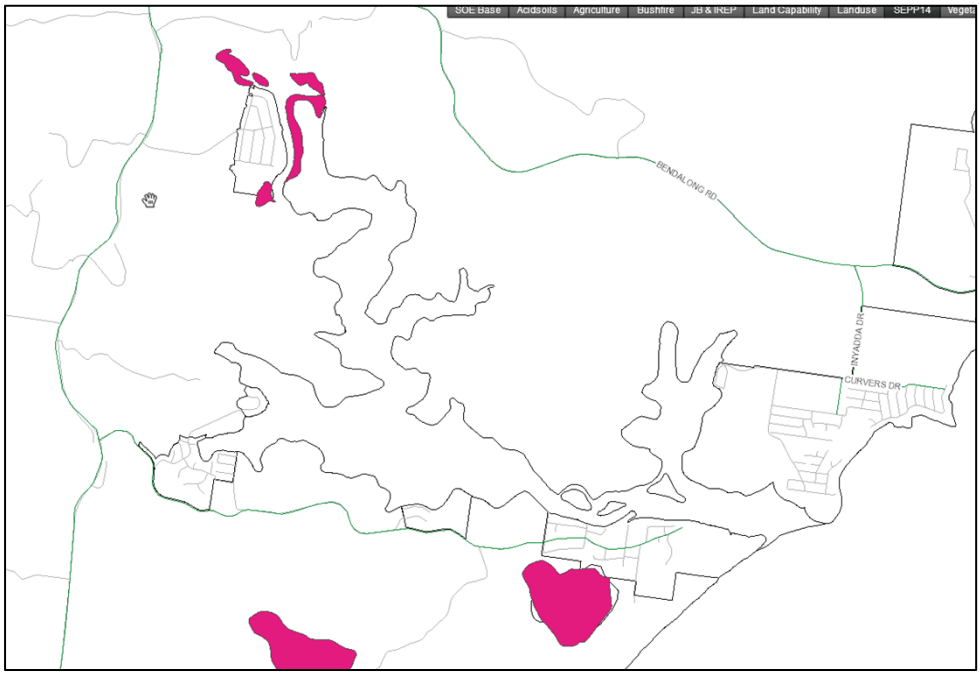
Wetlands around Lake Conjola are considered to be of national significance as habitat for migratory wetland species such as wader and shorebirds.

SEPP 14 wetlands are now consistently identified as E2, Environmental Conservation, in the Shoalhaven Local Environmental Plan 2014.

The objectives of the zone are

- To protect, manage and restore areas of high ecological, scientific, cultural or aesthetic values.
- To prevent development that could destroy, damage or otherwise have an adverse effect on those values.
- To protect water quality and the ecological integrity of water supply catchments and other catchments and natural waterways.
- To protect the scenic, ecological, educational and recreational values of wetlands, rainforests, escarpment areas and fauna habitat linkages.
- To conserve and, where appropriate, restore natural vegetation in order to protect the erosion and slippage of steep slopes.

**Figure 10 Lake Conjola SEPP14 Wetlands *(SCC)***

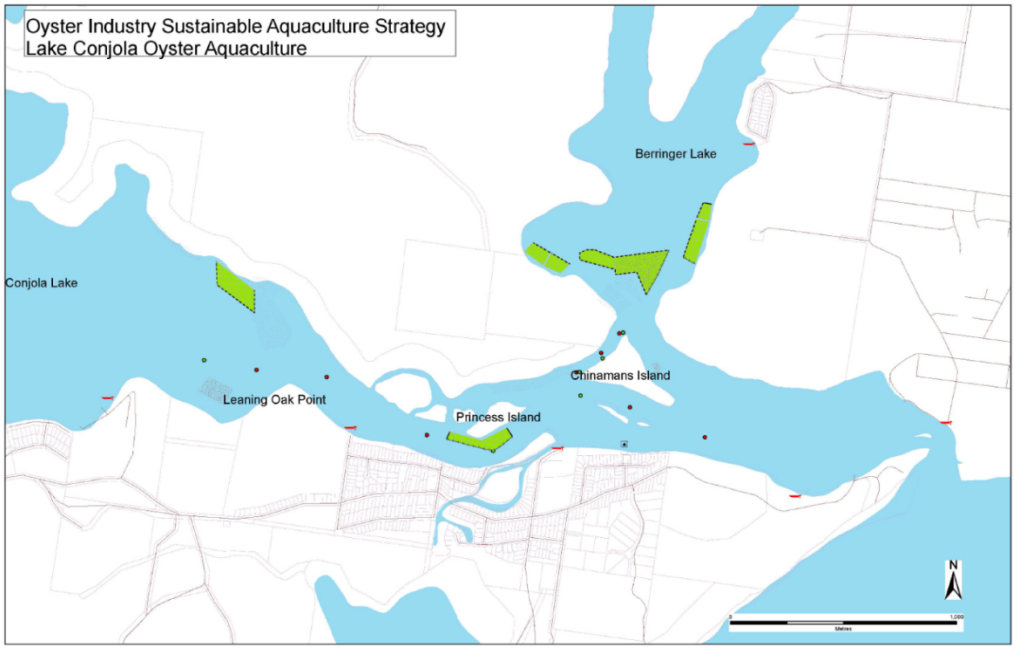



### 5.3.5 Oyster Leases

During preparation of the EMP, oyster leases covered an extensive area from Roberts Point to Berringer Lake. Figure 12 highlights five areas identified as priority oyster leases determined during a study undertaken in 2006 by the Department of Primary Industries (DPI). DPI has in place a *NSW Oyster Industry Sustainable Aquaculture Strategy* that endeavours to maintain the condition of existing oyster leases throughout NSW. During the review of the EMP it was determined that at present there are no strategies or actions developed by Shoalhaven City Council relating to the management of oyster leases in Lake Conjola.

DPI has indicated that oyster leases will remain available and that it's up to potential lease holders to assess the viability of oyster production in Lake Conjola.

**Figure 11 Lake Conjola Oyster Leases *(DPI 2006)***



### 5.3.6 Riparian Zones

Riparian zones are those areas which interface between land and water. Plant habitats and communities along the banks are called riparian vegetation, characterized by hydrophilic plants i.e. those that are adapted to living in aquatic environments. Riparian zones are significant in ecology, environmental management and civil engineering because of their role in soil conservation, habitat biodiversity and the influence they have on fauna and aquatic ecosystems, including grassland, woodland and wetlands. The Office of Environment and Heritage (DECCW 2006) promotes three riparian categories and objectives as outlined below.

- Category 1 Environmental Corridor
  - Provides biodiversity linkages by maintaining connectivity for the movement of aquatic and terrestrial species along the riparian corridor and between key destinations such as the Lake and the upper catchment.
  - Provides a 'core riparian zone' (CRZ) with a minimum width of 40m from the top of the bank and a vegetated buffer of 10 m minimum width to protect the CRZ from edge effects.
- Category 2 Terrestrial and Aquatic Habitat
  - Provides basic habitat and preserves or emulates as much as possible a naturally functioning stream (not necessarily linking key destinations).
  - Provides a CRZ with a minimum width of 20 m from the top of the bank and a vegetated buffer of 10 m minimum width to protect the CRZ from edge effects.
- Category 3 Bank Stability and Water Quality
  - Prevents accelerated rates of soil erosion and enhances water quality.
  - Contributes to the overall basic health of a catchment.
  - Provides a minimum riparian width of 10 m from the top of the bank.

## 5.4 Recommendations/Actions

**Now under the heading of Biodiversity & Ecosystem Protection & Rehabilitation – Section 9**

Estuaries provide critical habitats for a range of species and as such the ecological values of the estuary need to be maintained for future generations. The following recommendations are made in relation to the ecology of Lake Conjola, and further summarised in Section 9:

- Identify key estuarine vegetation communities around the Lake, such as saltmarsh, that have the potential to migrate landwards with sea level rise. Prioritise these areas for protection;
- Continue liaising with South East Local Land Services in their work with land owners to fence off sensitive riparian land
- Continue to increase community awareness in regard to the management of *Caulerpa taxifolia* when required;
- Promote ongoing research into the management of *Caulerpa taxifolia*;
- Research the impacts of mechanical intervention, including dredging, on Lake ecology and continue to research hydrological and ecological processes at work in and around the Lake;
- Undertake research into the appropriateness of entrance dune vegetation with regard to flooding, entrance shoaling and environmental risks;
- Carry out research and/or monitoring to identify and implement actions that would preserve, and potentially enhance, shorebird habitat;
- Provide opportunities for lease holders should they determine that aquaculture is a viable enterprise.

# 6. Review of Recreation and Tourism Objective, Strategies and Actions

## 6.1 Background

Lake Conjola is highly valued for the recreation and tourism opportunities that it offers. It has long been recognised as a prime location to live and visit due to its largely unspoilt natural environment. The Lake provides a large expanse of protected water for power boating, skiing, sailing, canoeing, swimming and fishing.

As a result, there is a substantial economic dependence in the local community on the income generated from recreation and tourism.

During development of the EMP, conflicts associated with recreational activities were identified. These included:

- Conflict between passive and active recreation activities;
  - Both activities being carried out in the same areas at the same time
  - Boat noise
  - Inappropriate boating controls
- Cumulative impacts of development around the Lake;
  - Excessive foreshore development generating poor quality runoff, particularly sewage
  - Inequitable allocation of water use areas
- Informal boat launching;
  - Lack of public boating facilities.

It was recognised that an uncoordinated and uncontrolled approach to recreation and tourism may lead to deterioration of Lake ecology. This in turn could potentially impact on tourism and the range of recreational pursuits in the region. As such the following objective was developed in relation to recreation and tourism.

**Management Objective**

**Maintain and encourage a range of safe and compatible recreational opportunities that are consistent with the ecological and aesthetic values of the Lake.**

## 6.2 Strategies/Actions – 1998 EMP

The strategies developed around recreation and tourism in the EMP focused on equitably sharing the resources of the Lake and formalising current uses to ensure the resources are protected and conserved in the future. The strategies developed are outlined in Table 5.

**Table 5 Recreation and Tourism Strategies and Actions**

| ID | Strategy | Action | Action Completed | Comments |
|---|---|---|---|---|
| REC1 | Improve and manage boat launching facilities | Assess usage of formal and informal launching sites. | Yes | Actioned through the BPOM (2005)<br>Investigation & community consultation will commence in 2016 |
| | | Assess feasibility of new boat launching facility in western part of lake, in particular Killarney. | Yes | |
| | | Assess relocation of caravan park boat ramp. | Yes | The boat ramp will remain in this location. |
| | | Assess areas of bank erosion near formal and informal launching sites. | Yes | The foreshore rehabilitation program assesses areas of bank erosion |
| | | Provide formal boating access in western area of the Lake. | No | Investigation, community consultation and design will commence in 2016 |
| REC2 | Coordinate future tourist development to preserve the ecological and recreational values of the Lake | Develop a local tourism plan. | Not done | See Shoalhaven Tourism Master Plan |
| | | Assess the cumulative impacts of current development on the ecology and water quality of the Lake. | Estuary Health Report Card completed | Estuary Health Monitoring Program with information provided through Estuary Health Report Cards. Monitor major development. |
| REC3 | Minimise conflict between boating activities | Review and develop new Lake boating controls. | Yes | Addressed through the BPOM |
| | | Enforce speed limits. | Yes | Ongoing through BPOM and signage |
| | | Install boat speed limit signage. | Yes | |
| | | Initiate public education of boating controls. | Yes | |
| | | Monitor effect of new Lake boating controls on bank erosion and other environmental factors. | Yes | The foreshore rehabilitation program assesses areas of bank erosion |
| | | Investigate the need for a potential statutory mechanism for defining active/passive waterway usage areas. | Yes. Swimming areas | Review required |

| ID | Strategy | Action | Action Completed | Comments |
|---|---|---|---|---|
| | | | defined. | |

## 6.3 Review of Complete and Incomplete Actions

Most of the strategies/actions developed during the 1998 EMP have been addressed.

### 6.3.1 Management of Boat Launching Facilities (REC1)

There is formalised boat access to various sections of the Lake as highlighted in Figure 6; however at the time of the EMP review a number of informal boat launching ramps were observed. As part of REC1 Council, in partnership with NSW Maritime (now Roads & Maritime Services, RMS), continues to manage and upgrade the formal boat launching facilities available to recreational users of the Lake.

In 2004, NSW Maritime inspected formal and informal launching. Results from the inspection, including management recommendations, are provided in Appendix C.

The *NSW Maritime Boating Plan of Management* (BPOM) 2005 developed for Lake Conjola was implemented to achieve the following:

- Protect and sustain the recreational and environmental values of the waterway;
- Ensure that boating practices maximise user safety, enjoyment, public safety and amenity;
- Consider the needs of shore-based estuary users as well as boating-based activities;
- Review shore-based boating-related facilities or infrastructure such as launching ramps; and,
- Provide a framework for consultation.

NOTE: At the time of finalising this document, RMS informed Council that the Regional Boating Plan Shoalhaven – Illawarra (February 2015) is finalised and publicly available http://maritimemanagement.transport.nsw.gov.au/documents/shoalhaven-illlawarra-regional-boating-plan.pdf

SCC and RMS intend to consider its implications for boating management in Lake Conjola as part of a future review of the estuary management plan.

### 6.3.2 Coordinate Future Tourist Development (REC2)

Of relevance to Lake Conjola, the *Shoalhaven Tourism Master Plan 2012 – 2017* aims to work with local communities to enhance the visual impact, appeal and product base of key localities and to develop special interest, activity based marketing based on fishing, boating, canoeing, cycling and mountain-biking. The challenge for Council, communities and business is to implement these aims whilst preserving the natural values of the Lake.

### 6.3.3 Minimise Conflict between Boating Activities (REC3)

During preparation of the EMP conflicts between passive and active users of the waterway became evident. These conflicts are, in part, addressed by the BPOM developed by NSW Maritime in 2005. The actions under strategy REC3 were to implement boating controls, speed limits, speed limit signage and public education of boating controls, all of which were, and continue to be, addressed by the RMS.

## 6.4 Recommendations/Actions

**Now under the heading of Access, Recreation & Tourism – Section 9**

In order to maintain and encourage a range of safe and compatible recreational opportunities, consistent with the ecological and aesthetic values of the Lake, it is recommended that the strategies and actions are regularly addressed and updated. The following recommendations are made in relation to the strategies/actions:

- Ensure EMP strategies and actions are updated when the new Regional Boating Plan is revised;
- Continue to educate the boating community in relation to boating controls, including enforcement of 4 knot zones;
- Restrict informal boat access points and upgrade existing nominated boat ramps and parking facilities and investigate and design new boat ramp at West Lake Conjola
- Ensure that any community engagement activities are targeted to visitors as well as residents;
- Ensure objectives and outcomes from the *Shoalhaven Tourism Master Plan* are incorporated into the EMP for Lake Conjola.

# 7. Review of Lake Entrance Management Objective, Strategies and Actions

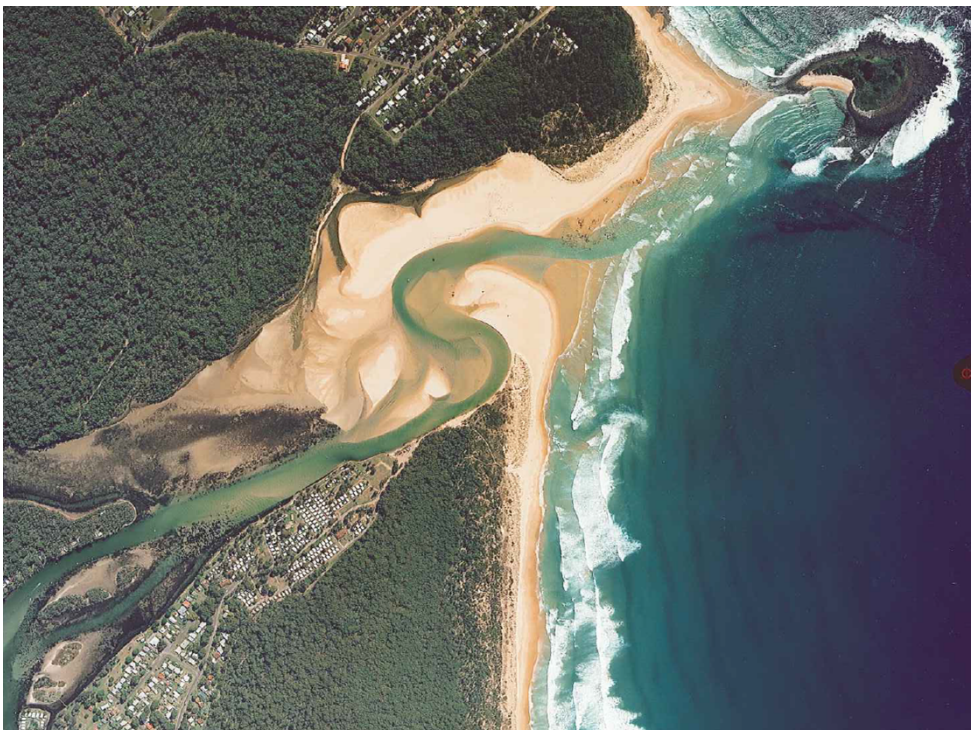
## 7.1 Background

Lake Conjola is classified as a barrier estuary. It has steep valley sides and a central basin that formed when the sea level rose and drowned the river valley formed 6,500 years ago. It is an immature estuary that has remained largely unaffected by river sedimentation.

A study undertaken in 1999 identified four basic entrance states, specifically

- **Regime State**: describes the steady end state whereby the entrance naturally and gradually establishes in the absence of any sudden changes caused by major floods and storms.
- **Flood Scoured State**: Flood Scoured state describes the condition whereby a sudden change occurs to the entrance as a result of a significant flood leading to a net loss of sand from the entrance shoals and widening of the entrance.

**Photo 7 Flood Scoured State, 1999**



- **Intermediate State**: characterised by rapid infilling of entrance shoals after a major flood and before reaching regime conditions (1-2 years).
- **Storm Washover State**: describes the scenario whereby a sudden change occurs to the entrance caused by major to severe storm waves washing over the entrance spit leading to blocking of the entrance channel.

Historically the entrance to Lake Conjola has been generally open.

Flood risk to surrounding development during low level flood events requires mechanical intervention at 1m AHD. Effects on the ecology of the Lake, with continued artificial openings, are unknown.

Entrance behaviour is a complex process due to the unpredictable nature of coastal processes acting to infill the entrance with beach sand and fluvial processes, resulting from catchment runoff, acting to scour sand out of the entrance. In order to improve understanding of the complex entrance behaviour, studies were undertaken by Shoalhaven City Council and Patterson Britton and Partners in 1996 and 1999, with findings presented in the Lake Conjola Entrance Study.

The issues identified during the development of the EMP in relation to the Lake entrance are outlined below and remain similar over time.

- Perceived deterioration of water quality when the entrance is closed.
- Flood risk when entrance is closed;
- Impacts on aquatic ecology of artificial opening regime;
- Reduced entrance scour from increased opening frequency; and
- The position and frequency of artificial entrance openings.

**Management Objective**

**To achieve a more natural opening regime with minimal human intervention which takes into account flooding, water quality and ecological concerns.**

## 7.2 Strategies/Actions – 1998 EMP

In order to achieve the management objective outlined above the strategies and actions outlined in Table 6 were developed.

**Table 6 Lake Entrance Management Strategies and Actions**

| ID | Strategy | Action | Action Completed | Comments |
|---|---|---|---|---|
| EM1 | Develop an appropriate management policy for the Lake entrance | Assess the relative contribution of the barrier dune to entrance shoaling through photogrammetric techniques. | Yes | Entrance review determined that sand from the barrier dune can cause shoaling of the entrance |
| | | Identify and/or confirm historical Lake opening position along barrier dune from aerial photography. | Yes | Entrance review identified locations of historical Lake openings. |
| | | Investigate cost and benefits of various management strategies which include options other than dredging the entrance channel. The dredging strategies should include assessment of effects on erosion of dune adjacent to the entrance channel. | Yes | Flood Risk Management Study and Plan (FRMS&P) |
| | | Assess the impacts of entrance | Yes | FRMS&P 2013 has identified that in larger |

| ID | Strategy | Action | Action Completed | Comments |
|---|---|---|---|---|
| | | conditions on flooding. | | flood events the state of the entrance will not impact on flooding in Conjola |
| | | Develop, document and adopt an Entrance Management Policy using the outcomes of the floodplain management study and the actions listed above. | Yes | FRMS&P 2013<br>2013 Interim Entrance Management Policy adopted with improved consultation. |
| EM2 | Investigate effects of artificial opening on Lake ecology and water quality | Collate information on the effects of artificial Lake opening on the abundance, distribution and community structure of various biological groups. | Not done | Potential for research topic |
| | | Assess the feasibility of carrying out a biological monitoring program using appropriate indicator organisms/community and/or vegetation identified above. | Yes | Estuary Health Monitoring Program - vulnerable lands assessment. |
| | | Monitor faecal coliforms at selected sites during rises in Lake levels, during and after artificial Lake entrance opening. | Yes | Refer section 2.3.1 |
| EM3 | Increase community awareness around entrance management issues. | Prepare brochure/poster | Complete | Lake Conjola specific brochure distributed in 2013/2014 to address issues of community concern. |

## 7.3 Review of Complete and Incomplete Actions

Much of the urban area on the shores of Lake Conjola is low lying and susceptible to inundation if the levels in the Lake exceed approximately 1 m AHD. The Lake is a popular tourist destination with many attractions situated on low lying land. It is therefore important that water levels in the Lake are monitored and the entrance effectively managed in order to minimise disturbance to the local community, tourism industry and assets.

Since completion of the Lake Conjola Sewerage System in 2008, it is now no longer necessary to open the Lake solely to maintain water quality.

### 7.3.1 Lake Entrance Management Policy (EM1)

In the past the Lake entrance has been managed in accordance with the *Lake Conjola Entrance Management Plan,* developed by Manly Hydraulics Laboratory (MHL) in 2003. The plan aimed to ensure a permanently open entrance, with entrance dredging works implemented when necessary, to prevent closure as an interim measure until the sewerage system was completed. A permanently open entrance was necessary because when the entrance was closed and water levels were raised, private septic systems would become inundated and leak sewerage.

The long term goal of the NSW Government is to retain or progressively reinstate natural entrance behaviour and to progressively remove, relocate or modify assets or activities that are affected by inundation if the entrance is allowed to return to a natural regime.

In 2011/12 an Interim Entrance Management Policy was produced. The policy outlines the circumstances under which Shoalhaven City Council (SCC) is to artificially open Lake Conjola entrance and provides a decision making procedure for undertaking the works. The policy aims to:

- Minimise risk to public safety associated with excessive inundation of foreshores and associated infrastructure as a result of low level flooding;
- Minimise interference with natural entrance opening processes and minimise associated impacts on ecological processes;
- Respond to local community values;
- Articulate the procedures to be initiated for entrance operations including entrance breakouts;
- Articulate key responsibilities for management of the entrance; and
- Detail the procedures for monitoring the Lake Entrance.

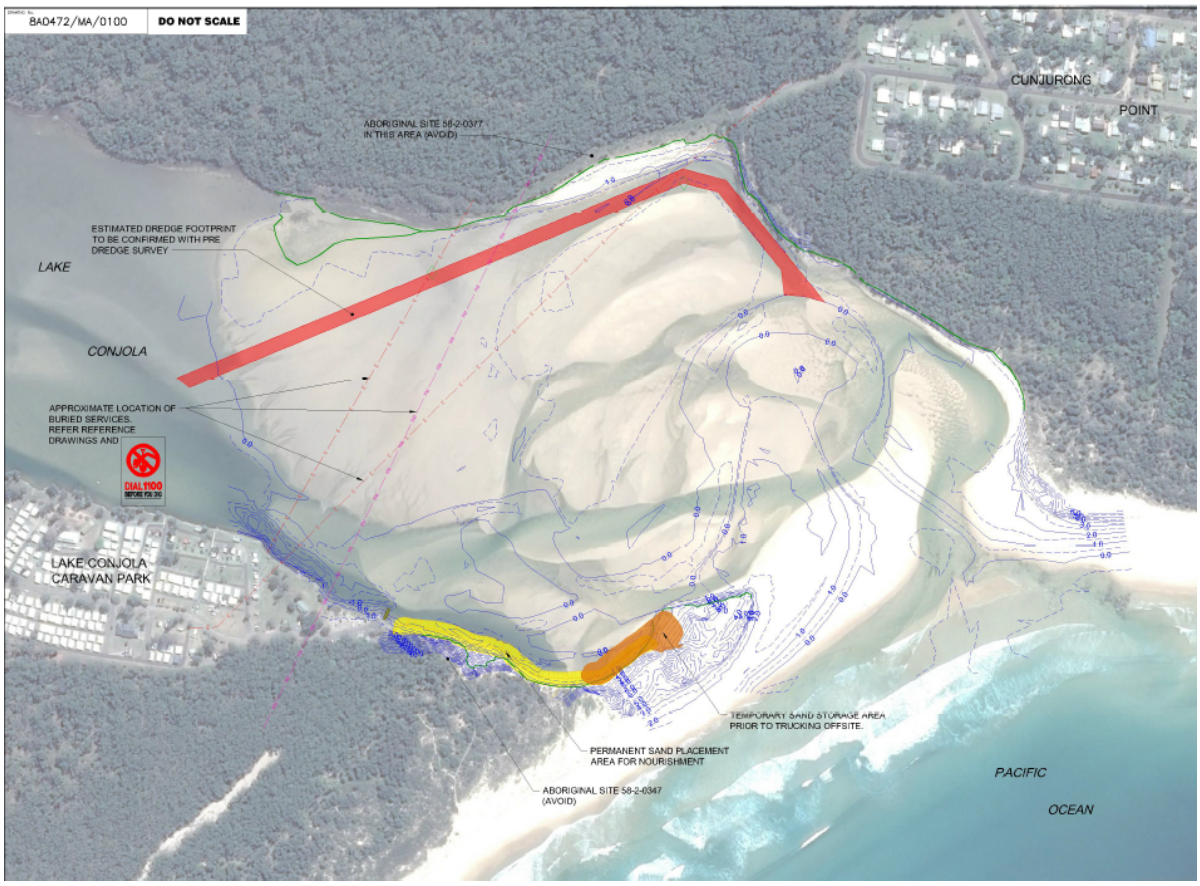
**Shoalhaven Dredging Project**

In 2014, the Citywide Dredging Feasibility Study investigated the practical aspects of dredging at several Shoalhaven waterways, including Lake Conjola.

In 2015, the Shoalhaven Dredging Project Review of Environmental Factors was prepared and a plan for trial configuration dredging at Lake Conjola was developed. The aim of the dredging is to emulate the natural ebb and flood channels in the entrance in order to maintain a more persistent opening.

This plan for the trial configuration dredging is shown below.

**Figure 12 Lake Conjola Configuration Dredging *(Royal Haskoning July 2015)***



### 7.3.2 Effect of Artificial Openings on Lake Ecology (EM2)

Investigations into the effect of artificial openings on the Lake's ecology and water quality (EM2) are ongoing. As outlined in Section 2, water quality monitoring is undertaken on a regular basis. Various papers have been prepared relating to the impact artificial openings may have on the ecology of ICOLLs such as Lake Conjola.

Research papers have determined that whilst there is evidence that the macroinvertebrate ecology of the beach berm may recover relatively quickly after an artificial opening (Gladstone *et al*., 2006), ecosystems in and around the ICOLL are likely to be subject to more significant and longer lasting impacts.

Potential environmental impacts of artificial entrance management within the ICOLL and its fringing environments have been documented by Stephens and Murtagh (2012) as follows:

- Marinisation through increased and more stable salinities leading to changes in aquatic vegetation communities. Specifically, moving to more regular tidal range and inundation periods may also promote the establishment or expansion of mangroves at the expense of other vegetation types.
- The hydrology of fringing wetlands is changed when consistently opening entrances at lower levels through the reduction in inundation levels and periods (Spurway *et al*. 2000). Many coastal lakes in NSW have fringing communities of the endangered ecological community coastal saltmarsh (Creese *et al*. 2009) that rely on periodic inundation.
- Fish kills can occur as a result of anoxic conditions in ICOLLs following artificial opening (see Wilson *et al.* 2002 for a description of processes leading to anoxia). Fish kills can be the most immediate environmental impact and have the greatest visual and olfactory impact for local communities (Wilson *et al.* 2002, Arundel 2006 and Stephenson 2011).
- Reduced fish habitat and stock (Jones and West 1995). Direct loss of habitat can occur where seagrass beds have established in entrance channels that then change as a result of artificial opening. Whilst the impact of artificial entrance opening on fish communities remains largely unpredictable, Jones and West (1995) document the short-term visitation of larger economically important fish species to the detriment of the abundance of smaller resident species after artificial entrance opening. The salinity regime of individual lakes contributes to the structuring of fish assemblages on a regional scale (Jones and West 1995, NSW Fisheries, 1999).
- Increased sand shoaling at the entrance (Haines 2008) and reduced opening duration (Spurway *et al*. 2000) due to inefficient scour of entrances at low opening levels.

### 7.3.3 Community Awareness of Entrance Opening (EM3)

As part of the *Interim Entrance Management Policy* and the *Flood Risk Management Study and Plan,* community consultation sessions were conducted and brochures, web pages and flyers produced to raise community awareness of entrance behaviour and management. The need for community awareness is ongoing and will need to be continually addressed in order to ensure the community is well informed regarding the state of the entrance and its management.

In 2014 a brochure titled, 'Lake Conjola – lake processes and sustainable management', was letterboxed in all the urban areas on the northern and southern side of the Lake and provided to all tourist parks. See Appendix C.

## 7.4 Recommendations/Actions

The following recommendations are made in relation to the ongoing management of the Lake entrance:

- Continue to review entrance management practices to ensure they are in line with best practice guidelines, NSW Government requirements and available research;
- Monitor the impacts of the trial configuration dredging on entrance behaviour and review the entrance management policy if required
- Continue to engage with the community regarding the natural processes of the Lake and the potential impacts of mechanical interventions;
- Undertake research into the role of the entrance sand spit and dune vegetation with regard to flooding, entrance shoaling and environmental risks. Cross reference and review all available studies to determine additional research requirements – if any;

# 8. Adapting to Climate Change – new management area.

## 8.1 Background

Climate change is changing the way in which we manage our coasts and waterways.

As a result of climate change sea level rise is predicted. This in turn could result in a rise in the Lake water level causing inundation of low lying urban areas and ecological communities.

An adaptive approach to managing the impacts of climate change needs to be adopted.

The potential effects of climate change on the physical, chemical and biological processes of coastal lakes as outlined by Haines and Thom (2007) are provided below:

- Increases in rainfall intensity could increase the potential for delivery of sediments and nutrients from the catchment;
- Changes to ocean water levels will impact on foreshore erosion; and
- Undertake long term strategic planning to improve community resilience to climate change
- Increasing Lake water levels will result in inundation of fringing wetlands, some of which (such as saltmarsh) may migrate landward if there are no intervening human structures. However, to the potential detriment of existing brackish and terrestrial vegetation communities; the rate of climate change may be faster than the rate at which some species can adapt.

## 8.2 Recommendations/Actions

The following recommendations are made in relation to climate change management,

- Undertake long term strategic planning to improve community resilience to climate change
- Implement development controls
- Buffer zones to manage against Lake level rise
- Consider the Shoalhaven Adaptation Plan

# 9. Cultural Heritage – new management area

## 9.1 Background

Both Aboriginal and non-Aboriginal people place cultural values on natural areas including aesthetic, social, spiritual and recreational values. Cultural values may be attached to the landscape as a whole or to individual components, for example to plant and animal species used by Aboriginal people. Cultural values may consist of both physical remains and non-physical manifestations such as knowledge, stories and memories.

Aboriginal people have utilised the resources of the area for the last 20,000 years, especially the Lake and coastline.

The Lake Conjola area is situated within the lands of the Wanda Wandian speaking people and the Budawang/Murramarang tribes of the Dhurga language group.

The Narrawallee Creek Nature Reserve and Conjola National Park contain a large number of Aboriginal sites including burials, middens, campsites, rock shelters and grinding grooves.

An AHIMS search of recorded sites around Lake Conjola has identified 32 sites comprising 22 artefact scatters, 4 middens, 3 burials and 3 Potential Archaeological Deposits. A burial site on the south side of Lake Conjola, at the top of a high dune, was exposed when the dune eroded in 1998. The skeletal remains were salvaged and repatriated at a different location.

There is some potential for further skeletal remains to be present within the sand dune.

Non Indigenous people have used the area for industry and recreation since the 1800s, particularly logging, silica mining, fishing and informal camping and beach activities along the coast.

## 9.2 Recommendations/Actions

- Consult and involve relevant Aboriginal community organisations and representatives of traditional custodian families about all aspects of management of Aboriginal sites and values associated with Lake Conjola;
- Protect Aboriginal sites from damage by human activities, carry out surveys and risk assessments as required;
- Precede all works which have the potential to impact on Aboriginal sites, with an archaeological assessment; and,
- Continue to incorporate Aboriginal heritage considerations into all relevant planning and natural resources management decisions.
- Design and install Aboriginal Cultural interpretive signage at a prominent and appropriate location.

# 10. Recommendations/Actions Summary Table

It is recommended that the following management areas, strategies and actions be incorporated into the EMP and that a review of these actions be undertaken in approximately 5 – 10 years.

Monitoring of each strategy and action should be ongoing to document results and effectiveness.

**Table 7 EMP Review 2015 Management Strategies and Actions**

| ID | Strategy | Action | Responsibility |
|---|---|---|---|
| **A** | **Access, Recreation and Tourism** | | |
| A1 | Minimise conflict between water based activities | Ensure EMP strategies and actions are updated when the Boating Plan of Management is revised. | Roads & Maritime Services (RMS)/SCC Environmental Services |
| | | Continue to educate the boating community in relation to boating controls, including enforcement of 4 knot zones. | RMS |
| | | Restrict informal boat access points and upgrade existing nominated boat ramps and parking facilities and investigate and design new boat ramp at West Lake Conjola | SCC Environmental Services and Assets and Works |
| A2 | Coordinate future tourist development with *Shoalhaven Tourism Master Plan* | Ensure objectives in the *Shoalhaven Tourism Master Plan* are incorporated into EMP for Lake Conjola i.e.<br>• Explore options for dredging the channel – to improve navigation and safety.<br>• Strengthen the two small retail precincts with foreshore picnic facilities and small pontoon / jetty / board walk where boats and canoes can tie up and get a coffee, ice cream etc.<br>• Upgrade directional signage to National Park day use areas and walking tracks in the Narrawallee Creek Nature Reserve. | SCC Environmental Services /Crown Lands<br>SCC Environmental Services<br>SCC Environmental Services/NPWS |
| A3 | Community engagement | Ensure that any community engagement activities are targeted to visitors as well as residents. | SCC Environmental Services |
| **B** | **Biodiversity and Ecosystem Protection and Rehabilitation** | | |
| B1 | Preserve and improve riparian buffer zones | Identify key estuarine vegetation communities around the Lake, such as saltmarsh, that have the potential to migrate landwards with sea level | SCC Environmental Services |

| ID | Strategy | Action | Responsibility |
|---|---|---|---|
| | | rise and prioritise these areas for protection.<br>Continue liaising with the Local Land Services in their work with land owners to fence off sensitive riparian land. | Local Land Services and landowners. |
| B2 | Community engagement - *Caulerpa taxifolia* | Continue to increase community awareness in regard to the management of *Caulerpa taxifolia*, when required | SCC Environmental Services/Department of Primary Industries(DPI) |
| B3 | Continue to monitor *Caulerpa taxifolia* | Promote ongoing research into the management of *Caulerpa taxifolia* | DPI |
| B4 | Investigate research opportunities to assist in protecting the natural values of the Lake and inform management decisions. | Research the impacts of mechanical intervention, including dredging, on Lake ecology and continue research into the hydrological and ecological processes at work in and around the Lake. | SCC Environmental Services |
| B6 | Further research entrance dune vegetation | Complete further studies into the appropriateness of entrance dune vegetation with due regard to flooding, entrance shoaling and environmental risks. | SCC Environmental Services |
| B7 | Preserve, and potentially enhance, shorebird habitat | Carry out research and/or monitoring to identify and implement actions that would preserve, and potentially enhance, shorebird habitat. | NPWS, SCC, OEH, Crown Lands |
| B8 | Maintain opportunities for aquaculture | Provide opportunities for lease holders should they determine that aquaculture is a viable enterprise. | DPI Fisheries and leaseholders |
| **C** | **Catchment Inputs and their Impact** | | |
| C1 | Community engagement – water quality | Provide a web portal with accurate & up to date water quality data.<br>Include information on what the community can do to improve water quality | SCC Environmental Services<br>Aqua Data portal is on Council's web site http://shoalhaven.nsw.gov.au/Environment/Aqua-Data |
| C2 | Update Estuary Health Report Card | When OEH funding becomes available, update the Estuary Health Report Card | OEH, SCC Environmental Services |
| C3 | Improve water quality data collection and dissemination of results | Regularly review test parameters and sampling locations to ensure they are representative of Lake water quality and that they are in accordance with NSW Government Guidelines. | SCC Environmental Services |
| | | Investigate deployment of a | SCC Environmental Services |

| ID | Strategy | Action | Responsibility |
|---|---|---|---|
| | | permanent water quality probe with results uploaded regularly to Aqua Data. | |
| C4 | Ensure ongoing improvement to water quality in regard to sewage management | Continue to inspect and regulate compliance of remaining on-site sewage management systems in the Lake Conjola catchment. | SCC Environmental Services |
| | | Continue the monitoring and reporting program of the Conjola Regional Sewerage Scheme in accordance with Environmental Protection Licence requirements and implement rectification or upgrade works when/if required to ensure minimal impacts on the Estuary. | SCC - Shoalhaven Water & Environmental Services |
| C5 | Undertake works to minimise sediment loads | Investigate the viability of implementing water quality control structures such as sediment traps, artificial wetlands and trash racks to decrease sediment loading to the Lake and assess effectiveness once implemented. | SCC Environmental Services |
| | | Identify locations where roads/tracks intersect streams (GIS analysis) and implement appropriate mitigation works. | SCC Environmental Services |
| C6 | Apply planning tools to improve water quality | The Shoalhaven Growth Management Strategy 2014 states that there is no potential for urban expansion at either West Conjola or Lake Conjola, however, there may be potential for some dual occupancy or infill development. Ensure compliance of erosion & sediment controls at building sites through Shoalhaven DCP 2014, chapter G2 - Sustainable Storm Water Management & Erosion/Sediment Control. | SCC Planning and Development Services |
| | | Through the CCB, request that the community report potential breaches to Council. | |
| C7 | Manage impacts of Acid Sulfate Soils | Acid Sulfate Soils are mapped in the Shoalhaven LEP 2014 (SLEP 2014). Any land identified in the maps is subject to controls in Clause 7.1 of SLEP 2014 and Shoalhaven DCP 2014 Chapter G26 - Acid Sulphate Soils and Geotechnical (Site Stability) | SCC Planning and Development and Environmental Services |

| ID | Strategy | Action | Responsibility |
|---|---|---|---|
| | | Guidelines. | |
| C8 | Provide a consistent approach to bank protection and revegetation | In order to address the ad hoc construction of retaining walls on private properties, promote the use of the *Environmentally Friendly Seawall Guidelines* (DECC and SMCMA, 2008). | SCC Planning and Development Services and Environmental Services |
| | | Develop an ongoing foreshore monitoring program to ensure minimisation of sediment loads entering the Lake. | SCC Environmental Services |
| | | Ensure that buffer zones are maintained as per the Shoalhaven Local Environmental Plan 2014 | SCC Environmental Services |
| C9 | Undertake a foreshore vulnerability study | Undertake a foreshore vulnerability study | SCC Environmental Services |
| **CC** | **Adapting to Climate Change** | | |
| CC1 | Undertake long term strategic planning to improve community resilience to climate change | Utilise expert input for scenario planning and processes to inform Council and community decision making and continue to liaise with the CCB Resilience Working Group. | SCC Environmental Services<br>Griffith University<br>OEH |
| CC2 | Implement development controls | Continue to implement development controls in order to minimise risk to developments in low lying flood prone land. | SCC Planning & Development Services |
| CC3 | Buffer zones to manage against Lake level rise | Develop buffer zones around the Lake foreshore to manage future Lake level rise. | SCC Planning & Development Services |
| CC4 | Consider the Shoalhaven Adaptation Plan | Identify public infrastructure potentially affected by sea level rise and develop appropriate adaptive management strategies. | SCC Planning & Development Services |
| **E** | **Entrance Management** | | |
| E1 | Adopt best practice for entrance management | Continue to review entrance management practices to ensure they are in line with best practice guidelines, NSW Government requirements and available research. Monitor the impacts of the trial configuration dredging on entrance behaviour and review the Entrance Management Plan if required. | SCC Environmental Services<br>OEH |
| E2 | Community engagement – entrance management and | Continue to engage with the community regarding the natural | SCC Environmental Services |

| ID | Strategy | Action | Responsibility |
|---|---|---|---|
| | Lake processes | processes of the Lake and the potential impacts of mechanical interventions. | |
| E3 | Increase understanding of the role of the sand spit in entrance management. | Undertake research into the role of the entrance sand spit and dune vegetation with regard to flooding, entrance shoaling and environmental risks.<br>Cross reference and review all available studies to determine any additional research requirements. | SCC Environmental Services<br>OEH |
| **F** | **Flooding** | | |
| F1 | Community education and engagement - flooding | Continue to update the community in relation to the risks associated with flooding and strategies for mitigating those risks. Manly Hydraulics Laboratory Shoalhaven portal for rainfall and Lake levels<br>http://new.mhl.nsw.gov.au/users/Shoalhaven/ | SCC Environmental Services |
| | | Install a flood board upstream of the existing MHL gauge. | SCC Environmental Services/SES |
| F2 | Continue to apply flood development controls | Ensure the controls identified in the NSW Floodplain Development Manual and Shoalhaven DCP 2014 G9, Development on Flood Prone Land, are applied in determining development applications | SCC Planning and Development Services |
| F3 | Align estuary, coastal and flood plans | Ensure that the management strategies developed in the *Flood Risk Management Plan* are appropriately considered in the *Estuary Management Plan* and the *CZMP*. | SCC Environmental Services |
| **CH** | **Cultural Heritage** | | |
| CH1 | Community engagement | Involve relevant Aboriginal community organisations and representatives of traditional custodian families in management of Aboriginal sites. | SCC Planning and Development Services |
| CH2 | Protect Cultural Heritage | Protect Aboriginal sites from damage by human activities. Carry out surveys and risk assessments as required. | SCC Planning and Development Services |
| CH3 | Assessment | Precede all works with the potential to impact on Aboriginal sites with an | SCC Planning and Development Services |

| ID | Strategy | Action | Responsibility |
|---|---|---|---|
| | | archaeological assessment. | |
| CH4 | Planning to conserve Cultural Heritage | Continue to incorporate Aboriginal heritage considerations into all relevant planning and natural resources decisions. | SCC Environmental Services |

# 11. References


*Burrill Lake – Interim Entrance Management Policy* Peter Spurway & Associates P/L 2008

*Boating Plan of Management Lake Conjola Estuary* NSW Maritime March 2005

*Conjola National Park Plan of Management* NSW National Parks and Wildlife April 2009

*Draft Guidelines for Preparing Coastal Zone Management Plan* NSW Government, Environment, Climate Change and Water 2011

*Guidelines for Preparing Coastal Zone Management Plan* NSW Government, Environment, Climate Change and Water 2011

*Hazel Rowbotham Reserve Plan of Management* Shoalhaven City Council June 2002

*Lake Conjola Entrance Study* Patterson Britton and Partners 1999

*Lake Conjola Entrance Management Plan* Manly Hydraulics Laboratory 2003

*Lake Conjola Entrance Management Dredging Works Review of Environmental Factors* Manly Hydraulics Laboratory 2003

*Lake Conjola Flood Study* BMT WBM 2007

*Lake Conjola Estuary Management Plan* 1998

*NSW Natural Resources, Monitoring, Evaluation and Reporting Strategy* Department of Environment, Climate Change and Water 2010

*Riparian Corridor Management Studies and Overview: South Coast Region Landcom Managing Urban Stormwater: Soils and Construction* DECCW 2006

*SCC Stormwater Management Plan* Shoalhaven City Council 2002-2005

SCC maps online http://www.shoalhaven.nsw.gov.au/PlanningampBuilding/Mapsonline.aspx

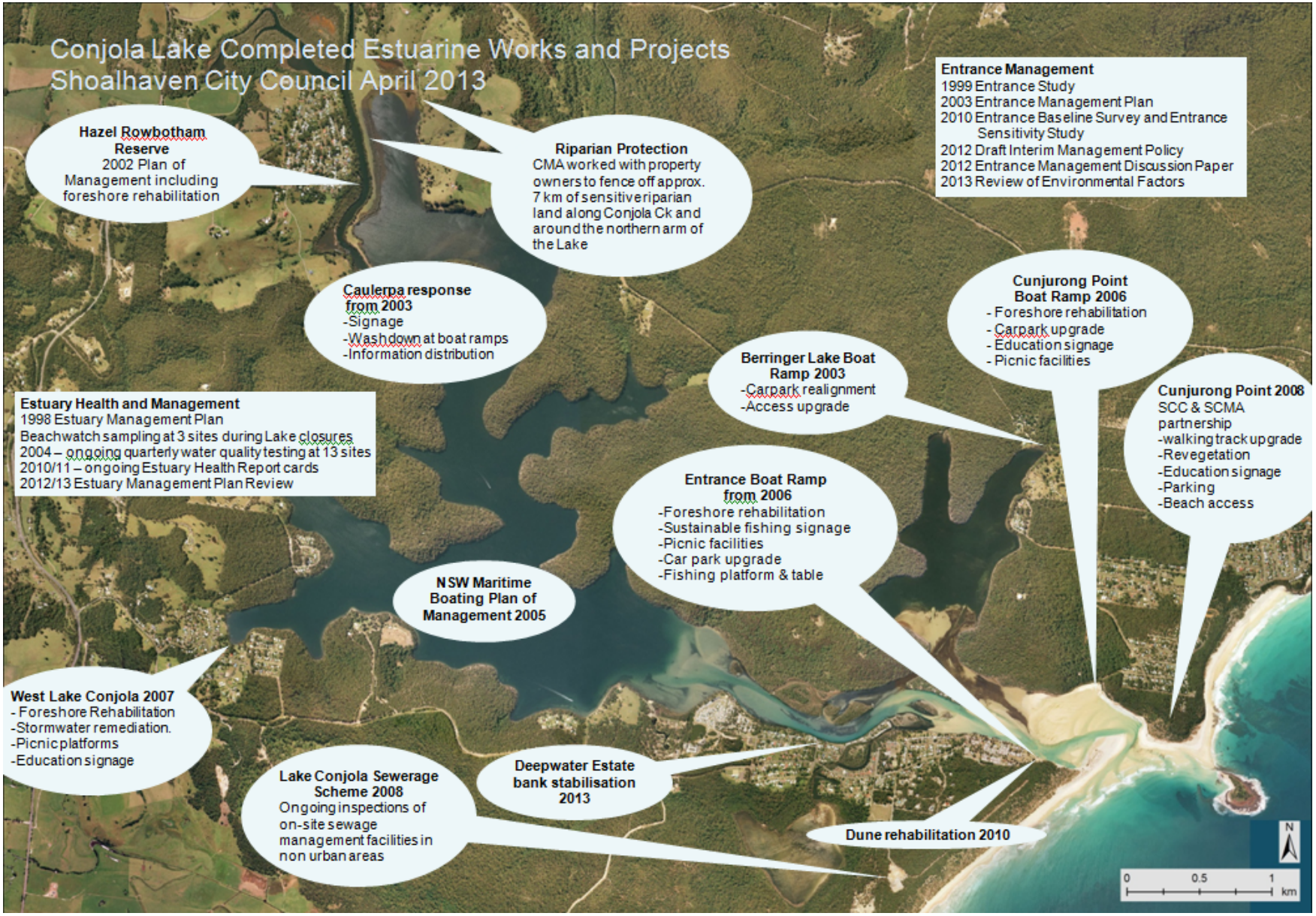
*Summary of Climate Change Impacts – Illawarra Region – NSW Climate Change Action Plan* Department of Environment, Climate Change and Water 2009

*The Risky Business of ICOLL Management* Stephens and Murtagh 2012

Wetland Inventory of the Lower Shoalhaven, Shoalhaven City Council and Shoalhaven Catchment Management Committee 2004

*Environmentally Friendly Seawalls – A guide to Improving the Environmental Value of Seawalls and Seawall-Lined Foreshores in Estuaries* Department of Environment, Climate Change and Water and Sydney Metropolitan Catchment Management Authority 2009

**Appendix A**: Completed Conjola Projects *this hasn't been updated – can't find the word file*



## Appendix B

# Estuary Health Report Card

OEH Technical Report on the preparation of Estuary Health Report Cards.
http://projects.umwelt.com.au/shoalhaven-coastline/docs/RO4_SCZMP/appendix/7_R04_App_4a.pdf

## LAKE CONJOLA ESTUARY

Estuary Ecosystem Health Report Card 2010-11

### Ecosystem Health

Based on the indicators assessed, the health of Lake Conjola is good. Algae levels were consistently low, with water clarity always high. While increases in the important habitat of saltmarsh were observed, decreases in seagrass distribution occurred.

This assessment is based on chlorophyll a and turbidity collected by Council between January 2010 to February 2011, and estuarine vegetation change between 1985 and 2006 calculated by the NSW Department of Primary Industries. While this assessment is a snapshot in time, it provides a baseline against which future sampling can be compared, allowing us to track how well we are managing this important estuary.

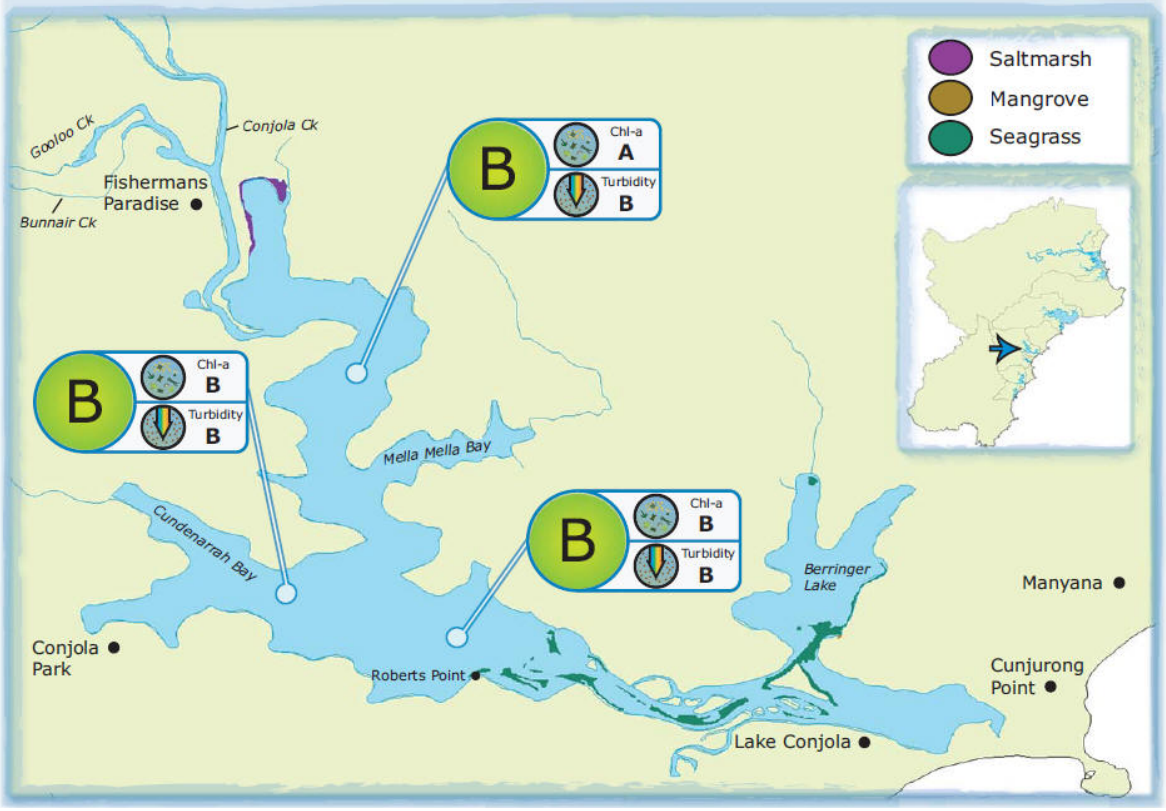
For more detailed information about Council's sampling program and the methodology for analysing data, please refer to the accompanying technical report located on Council's website.

### Estuary Information

| | |
|---|---|
| Catchment area ($km^2$): | 139.1 |
| Estuary area ($km^2$): | 6.7 |
| Estuary volume (Ml): | 26798.7 |
| Estuary type: | Intermediate barrier estuary |
| Entrance: | Intermittently open |
| Major tributaries: | Conjola, Gooloo and Bunair Creeks |
| Average Yearly Rainfall: (Stn No:68229) 2010: | 1279mm (total) |
| Land Use (Area): (2005 data) | Urban: 1.6% Forest: 75.4% Rural: 21.4% Other: 1.6% |

### Lake Conjola Estuarine Vegetation

Saltmarsh A | Mangroves (unscored) | Seagrass D



## Water Quality Indicators (Grades based on OEH Estuary Health Assessment Methodology)

***Chlorophyll a*** *indicates the amount of microscopic algae, called phytoplankton, growing in the water. Excessive input of nutrients from catchment runoff (urban stormwater, agricultural runoff, and sewage overflows) can increase chlorophyll a levels and lead to algal blooms and detrimental effects on estuarine plants and animals.*

For 2010/11 Lake Conjola overall received a good rating for chlorophyll a with 26% of total samples exceeding guideline values, with these samples barely exceeding the guideline. The site adjacent to Roberts Point had the greatest percentage of exceedances with 29%. As a comparison, chlorophyll a data collected by the State Government between 2008 and 2009 all complied with guideline values, but was based on a different sampling regime.

***Turbidity*** *is a measure of light scattered by suspended particles such as sediment, algae and dissolved material in the water which affect its colour or murkiness. Turbidity can increase from sediments transported in catchment runoff (particularly after heavy rainfall), shoreline erosion and increased microscopic algae. Increased turbidity can have negative impacts on seagrasses and fish.*

For 2010/11 Lake Conjola overall received a very good rating for turbidity with 6% of total samples exceeding guideline values, with these samples barely exceeding the guideline. As a comparison, turbidity data collected by the State Government between October 2008 and 2009 all complied with guideline values, but was based on a different sampling regime.

*Grades*


## Estuarine Vegetation Indicators (Grades based on % gain or loss in extent)

***Seagrasses*** *are aquatic flowering plants that form meadows near shore. They are highly productive, provide nursery and foraging habitat (for fish, crustaceans and molluscs), bind sediments against erosion and help regulate nutrient cycling. They are very sensitive to changes in water clarity.*

Seagrasses in Lake Conjola decreased by 68% between 1985 and 2006 and therefore received a grade of poor. Seagrasses have decreased in multiple locations, including Conjola Creek, Berringer Lake and the near shore area spanning from Cundenarrah Bay to Roberts Point. Previous studies have noted that increased recreational boating over shallow seagrass areas is a likely contributor to decline in some areas. However, natural fluctuations may also be a contributing factor.

***Mangroves*** *grow between mid and high tide levels. They are an important food source, provide habitat for a number of species such as crabs and juvenile fish, protect shorelines and cycle nutrients and carbon. While an increase in mangroves can be a positive outcome where they are recolonising in areas previously removed, increases in mangrove distribution can sometimes be at the expense of other important habitat types such as saltmarsh, which could be viewed as a negative outcome.*

There is a very limited area of mangroves in Lake Conjola so no comparison can be made.

***Saltmarsh*** *is a community of plants and animals that grows above the mangroves at the highest tidal levels. Saltmarsh is important in estuarine food webs, providing a site for invertebrate breeding and a feeding area for economically important fish and shorebirds. Saltmarsh decline is a worrying trend from a number of estuaries in NSW and has led to saltmarsh being listed as an endangered ecological community under the Threatened Species Conservation Act 1995. Declines in recent years have been linked to both increased sedimentation from catchment land use pressures and sea level rise.*

Saltmarsh in Lake Conjola increased by 108% between 1985 and 2006 and therefore received a grade of very good. This increase has occurred primarily around Sunny Hills Bay east of Fishermans Paradise, possibly as a result of improved land management practices, and is a positive sign for the estuary.

***Note:*** Analysis of change in extent of estuarine vegetation was completed using two different aerial photo interpretation methodologies for the 1985 and 2006 surveys. As a result, some of the change observed may be due to the different methodologies, as well as actual losses and gains in vegetation extent.

This report card is an initiative of Shoalhaven City Council, with financial and technical support from the NSW Government Estuary Management Program

NSW GOVERNMENT Office of Environment & Heritage

Shoalhaven City Council

**Appendix C**

# Lake Conjola Brochure – Lake processes and sustainable management

## The water looks dirty, what's wrong with it?

It's natural for ICOLLs to be closed at times. During long periods of closure the water changes colour. This doesn't mean that the Lake is dirty or unhealthy. During 2012, while the Lake was closed, weekly Beachwatch monitoring was undertaken at three sites. Test results rated 'Good' or 'Fair' which indicated it was safe to swim. Beachwatch monitoring will continue during Lake closures and results will be posted on Council's website.

Sediment and pollutants are washed into the Lake by heavy rain and water quality is affected whether the entrance is open or closed. For this reason it's best to avoid swimming for at least a day after heavy rain, especially near storm water outlets.

Council, residents and visitors all play a part in keeping the catchment and the Lake clean and healthy.

## What about the fish?

Fish stocks in ICOLLs are constantly adapting and changing.

After a long period of closure, salinity reduces and preferred angling species may become depleted.

When an ICOLL is opened, large numbers of mature fish and prawns head for the ocean and younger fish repopulate the Lake. These changes are natural cycles. It may be difficult to catch a legal size fish at times, but there is no evidence to suggest any permanent decline in fish numbers in Lake Conjola.

## What's the best location for a mechanical opening?

A central to northern location is favoured because

- Green Island protects the northern area from wave energy and storm wash-over.
- Littoral drift causes the spit to grow northwards, naturally forcing the entrance channel towards Cunjurong Point.
- With a channel located along a rocky shoreline, such as Cunjurong Point, there are benefits to both scouring and persistence of the opening.
- Migratory birds, such as Little Terns, nest on the sand spit at Lake Conjola, and are endangered. During the nesting season from September to March, the key requirement is to minimise disturbance to the nesting area. Only a northern intervention can be considered at this time.


January 2009


Mechanical Intervention - May 2010


1964 photo credits: Denis and Robyn Wood

'ICOLL Management - Strategies for a Sustainable Future' and other useful links at Conjola District Lakecare Association: http://goo.gl/7HEIY

Beachwatch results: http://goo.gl/K8J5V

Management of Coastal Lakes and Lagoons in NSW: http://goo.gl/ahkKV

Shoalhaven City Council

Denis Wood 1964

# LAKE CONJOLA

## Lake processes and sustainable management


Robyn Wood 1964

Many coastal lakes close naturally, often for years. They are known as ICOLLs - Intermittently Closed and Open Lakes and Lagoons.

World-wide, ICOLLs are quite rare. The NSW south coast is home to most of Australia's ICOLLs and probably, most of the world's ICOLLs! Shoalhaven has nine of the 70 ICOLLs in NSW. Council is responsible for managing four: Swan Lake, Burrill Lake, Tabourie Lake and Lake Conjola.

Shoalhaven City Council

ICOLLs are very sensitive to human disturbance. This makes them one of the most complex and difficult coastal environments to manage. Council must comply with NSW Government legislation and management is undertaken in partnership with Government agencies and the community.

## Why is the Lake closed?

**It's natural for the Lake to be closed at times. In NSW, about 70% of ICOLLs are closed most of the time.**

The Lake entrance is changing constantly, from maximum open conditions after a big flood, to being completely closed due to drought and severe coastal storms. In between these events, the entrance channel naturally drifts north until it's hard up against Cunjurong Point.

These changes are caused by water and wind constantly moving sand into and around the entrance.

**Water**

- coastal storms with big swells wash offshore sand over the spit and into the entrance
- rainfall in the catchment may 'refresh' the channel by carrying some sand offshore
- floods dramatically and quickly wash sand out to sea, and scour a more central channel
- wave action carries sand from south to north along the beach (littoral drift), pushing the entrance channel north.

**Wind**, predominantly from the south-east, blows large amounts of sand into the entrance.

The combination of storm wash-over, littoral drift and wind, carries approximately 68,000 cubic metres of sand around the entrance every year.

The 1999 Lake Conjola Entrance Study found that from 1937 the entrance had been open 62% of the time and closed 8 times, with closure often lasting several years. In every case closure was triggered by a severe storm.

Between 1991 and 2013, Lake Conjola has been mechanically opened many times to alleviate minor, nuisance flooding. These mechanical openings are generally short lived due to two factors

- the water level at the time of opening is too low to create the surge required for effective scouring of the channel and
- storm wash-over carries offshore sand back into the entrance.

## Why doesn't Council keep the Lake open?

It's often suggested that keeping the Lake open is the best way to avoid flooding and 'improve' the Lake.

The 2013 Flood Risk Management Study and Plan demonstrates that the Lake can flood from just catchment run-off or it can flood with just ocean inundation (when the entrance is open) or with a combination of both, as occurred in April 2013.

In order to address low level persistent flooding when the entrance is closed, Council's Entrance Management Plan allows for mechanical opening when the water level is at 1m AHD. Prior to intervention Council must gain approval from government agencies.

There is no evidence to show that a permanently open entrance will improve estuary health.

So the millions of dollars required, for training walls or large-scale dredging to maintain an open entrance, is difficult to justify. Council's preference to date has been to support actions that have demonstrated benefits, such as the construction of the sewerage system and the implementation of the Flood Risk Plan.




## Appendix D

# NSW Maritime Boating plan of management 2005, Review of facilities

| Description | Condition | Parking | Environmental | Washdown Facilities | Main Issues |
|---|---|---|---|---|---|
| **Fisherman's Paradise** | | | | | |
| Excellent concrete ramp suited for most sizes of vessel. The minor inconvenience for the Lake user who may choose to launch here is a long trip down Conjola Creek, wholly within a 4-knot zone, before reaching the Lake's unrestricted waters. | Excellent. Scour on both sides of the ramp itself could use minor repairs. | Sealed parking area adequate. | Nil. | Tap and hose in parking bay at exit of parking area. Improved drainage required on road shoulder downslope to prevent long-term road pavement damage. | Nil |
| **Lake Conjola West (Valley Drive)** | | | | | |
| A small ramp, part bitumen sealed and part sand / gravel. Location at the head of Yooralla Bay in reserve, adjoining quiet residential area on Valley Drive. Holding jetty 16m long with 5m long T-head also provides access for recreational fishing. | Appropriate for use and location. | Very limited formal parking. Traffic conflicts in cul-de-sac head. Need to monitor informal parking on slope in reserve. Eventual damage to reserve could require bollards to protect grass cover. Usage to date sustainable. | Heavy *Caulerpa* infestation in this part of the estuary. | Tap and hose in cul-de-sac head. Directional signage on main road requires clarification. | Limited parking will restrict usage with no opportunities for expansion. |
| **Cundenarrah Bay (off Lakeside Drive)** | | | | | |
| An informal launching point for small craft is located on privately owned (Aboriginal) land (previously Crown Reserve subject to a Native Title land claim granted by the Minister for Lands). It is accessed from a gravel track off Lakeside Drive. | Boat access shallow but reasonable. Access track degraded. Foreshore erosion evident - localised to launching area. | Degraded bush area suited to 2 or 3 vehicles. Vehicle access track degraded, requires scour protection and gravelling. | Erosion of track producing fine sand and some clay material, and some localised impact on the bay during heavy rainfall is likely.<br>Some bank undercutting below She-oaks. Foreshore nearby mostly sandstone shelf. | None provided. Existing general NSW DPI *Caulerpa* signage insufficient. The nearest (West Conjola) washdown point is not convenient for users of this launch point. Additional washdown facility required here. | Access track and carpark require maintenanceContinued public use is under negotiation. Washdown facilities are required if access is to continue. |
| **Sandra (Havilland) Street (Yooralla Bay)** | | | | | |

| Description | Condition | Parking | Environmental | Washdown Facilities | Main Issues |
|---|---|---|---|---|---|
| Twin gravel tracks at Sandra Street (off Havilland Street) provide access to a short concrete ramp. A sandy holding beach is located nearby. | Adequate. Eastern track very steep, requires drainage and gravelling. | Limited opportunities for roadside parking will limit ramp usage. | Heavy *Caulerpa* infestation in this part of the estuary. | None provided. Suggest washdown area should be provided. | Track access and lack of washdown facilities both require attention. Potential new launching ramp and trailer parking area in the reserve to the east of Havilland Street warrants consideration. |
| **Prior Street** | | | | | |
| Access along a reserve to sound gravel / sand ramp.<br>Confusing signage associated with previous ramp closure requires removal. | Some local scour of access track in steep section immediately off sealed road. | On street only. | Sand build-up caused by log groyne will be preventing sand drift towards Killarney. Insignificant erosion downdrift was noted. Minor erosion upstream of ramp has been managed by placement of bricks and rubble to stabilise undercutting below She-oaks. | None provided. Suggest washdown area should be provided. | Track access and lack of washdown facilities both require attention. Removal of signage previously closing this ramp. |
| **Killarney (private)** | | | | | |
| Private concrete ramp with gravel approaches. Long sandy holding beach / ski beach and swimming area. | Private facility. Rough gravel entrance and approach road. | Paid entry and ample parking on private land. | Heavy *Caulerpa* infestation in this part of the estuary. | Adequate – tap and hose provided on sealed lay-by on access road. | Private ownership and access which could be closed. This would make unmanageable demands on other existing launching facilities for large boats. |
| **Conjola Lakeside Van Park (private)** | | | | | |
| Old short concrete ramp provides good access to Lake for park users. A newer concrete ramp in excellent condition cannot be used due to potential seagrass impacts. | Adequate. | Used by park patrons only, no parking necessary. | Heavy *Caulerpa* infestation in this part of the estuary. | A hose adjacent to the launching ramp will shortly be relocated at the rear of the park to manage noise issues associated with motor flushing. This may not encourage wash- down prior to leaving the area. However a large number of regular users store boats at the caravan park, so transfer of weed to other estuaries is less likely. | Nil. |
| **Norman Street** | | | | | |
| Informal access to Lake via sandy foreshore at the end of Norman Street. | Poor - 0.3m drop- off from pavement to scoured sandy | Limited parking along road verge. | Heavy *Caulerpa* infestation in this part of the estuary. Water | None evident, NSW Maritime would | No washdown, limited launching access due to scour. NSW Maritime recommends that Council review use and |

| Description | Condition | Parking | Environmental | Washdown Facilities | Main Issues |
|---|---|---|---|---|---|
| Shallow water would limit use to small boats. | beach would suit four-wheel drive use only. | | very shallow at launch site. | recommend provision of tap and hose nearby. | either upgrade to a sealed access and concrete ramp and provide washdown facility or close off to public use if funding is unavailable. |
| **Aney Street** | | | | | |
| Track through low she-oak forest gives access to gravel launching area on shallow tidal creek. Popular all-year launching for local small tinny use. Also utilised daily in peak season by nearby caravan park users. | Ramp itself is adequate for usage. However access track and parking is over flat, boggy degraded soils that will continue to destabilise in wet weather. | Limited in wet weather by poor drainage. | Damage to *Zostera* seagrass beds in creek either side of launching area is noted. Seagrass also likely at shallow creek entrance to Lake. Vehicle damage to She-Oak forest and wetland fringe by soil compaction and trackside parking. No mapped *Caulerpa* infestation in this part of the estuary at present. | None nearby. | Environmental degradation (marine and terrestrial) makes continued use unsustainable. NSW Maritime recommends that Council consider closure. |
| **Entrance Boat Ramp** | | | | | |
| Council facility provides boat launching for small to medium vessels. Concrete ramp with bitumen approach road accessed through Lake Conjola Entrance Tourist Park. Public toilets located here. | Ramp and approaches good. | Informal parking on irregular gravel carpark area does not lend to effective trailer parking. Vehicles parking on grass beyond the grave carpark were evident at time of inspection. Could use further bollards to limit vehicle access to grassed recreation areas. | No *Caulerpa* infestation in this part of the estuary. | None provided, none necessary. | Removed from main Lake basin by shallow flood-tide delta and long 4-knot zone. Shallow water limits use for larger vessels. Sand shoals will continue to move around. Confusion at Tourist Park entrance for non-locals. Directional signage to public ramp could be improved. NSW Maritime recommends that Council consider sealing the gravel carpark and parking arrangement formalised for more effective vehicle and trailer parking and to prevent vehicles parking on grass. |
| **Cunjurong Point** | | | | | |
| Concrete ramp on northern shore of Lake Conjola located near entrance. | At the time of inspection, marine sand build-up limits use to small to medium vessels at higher tides. | Bitumen roadside parking with overflow parking along gravel access road if needed. | No *Caulerpa* infestation in this part of the estuary. | None provided -not necessary. | Ramp mostly unusable at medium tides or lower. Boat turning circle area requires signage to prevent illegal parking. |
| **Berringer Lake** | | | | | |
| Informal soft access and landing area at end of Berringer Crescent provides the only public launching | Reasonable conditions for launching, beach | Parking amongst trees for up to six vehicles. Overflow parking along | Heavy *Caulerpa* infestation in this part of the estuary. Sand launching area | None provided. Nearest facilities on | Standard of vehicle access and tight manoeuvring around trees unacceptable given the level of use at this location. NSW Maritime |

| Description | Condition | Parking | Environmental | Washdown Facilities | Main Issues |
|---|---|---|---|---|---|
| point into Berringer Lake. Multiple launch points used as holding and ski beaches. Some conflict of usage expected at peak times | stable. Approach tracks require better definition.Manoeuvrability limited amongst trees. | roadway available. | shallow.<br>Small patches of healthy *Zostera* seagrass in shallow water adjacent to launching site. | Inyadda Drive out of Manyana. Local washdown area required considering level of existing usage and shallow water. | recommends that Council consider sensitive improvements to the launching and vehicle manoeuvring area, to limit launching to a single formalised ramp and to provide a turn-around area. NSW Maritime also recommends that wash down facilities be installed. |

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**Document Status**

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