SALTY LAGOON REHABILITATION – A CHANGE IN CLIMATE

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Paper Summary

The rehabilitation of Salty Lagoon is a multidisciplinary effort, involving civil engineers, environmental engineers, environmental scientists, ecologists, laboratory staff, irrigation consultants, construction crews, government regulators and community representation.

Salty Lagoon requires rehabilitating to improve the ecological and cultural values which have been impacted over the past 65 years by effluent released from the Evans Head Sewage Treatment Plant (STP). The rehabilitation project is being undertaken by Richmond Valley Council ancillary to the augmentation of the Evans Head sewerage system.

In 2006, Council adopted a nine point plan for the rehabilitation of Salty Lagoon, which involves:

1. Implementing effluent reuse
2. Developing and implementing an ecosystem recovery monitoring program
3. Implementing STP augmentation
4. Considering reed harvesting
5. Considering revegetation
6. Implementing the preferred option for release of excess effluent which can not be reused
7. Regularly reviewing the monitoring program
8. Considering closure of the artificial channel
9. Reassess rehabilitation program after five years of monitoring

Council completed augmentation of the STP in 2007, and is currently working on implementing the ecosystem recovery monitoring program, the Evans Head effluent reuse scheme, and investigating options for the release of excess effluent which can not be reused. Implementation of the remaining points will be governed by the results of the ecosystem recovery monitoring program.

The ecosystem recovery monitoring investigates a wide range of environmental and ecological factors, and the outcome will result in a program that will not only allow the rehabilitation of this important coastal wetland, but will have implications and benefits for rehabilitation of other degraded wetland areas. The rehabilitation of Salty Lagoon demonstrates how a change in climate can be achieved through cooperation of diverse disciplines and competing stakeholders, under the guidance and leadership of the local Council.

Introduction

This paper presents the major findings of the Salty Lagoon Rehabilitation project. Salty Lagoon is a coastal ICOLL (Intermittently Closing and Opening Lakes and Lagoons), located within Broadwater National Park near Evans Head in Northern NSW. Salty Lagoon has been degraded through development in the catchment, including past sand mining, urban and industrial development, Broadwater Evans Head Road traversing the catchment, an STP which discharges into the catchment, a closed land fill, a waste transfer centre, and an aerodrome which still contains contamination from World War 2. Council has resolved to reverse the damage caused by releasing effluent to Salty Lagoon for the past 65 years.

History

Salty Lagoon and the surrounding area have significant ecological and cultural values. Prior to European settlement, the Evans Head district was the meeting place for the clans of the Bundjalung Nation, and Salty Lagoon was a sacred area for the female elders. Very few, if any, descendents of the local clan retain links to the area. As such, much of the traditional knowledge of Salty Lagoon and its significance may have been lost. However, female elders of the neighbouring Bandjalang Clan still consider Salty Lagoon to be an area of significance.

The Evans Head STP was constructed in 1942, when Evans Head was home to the largest WWII RAAF training centre in the southern hemisphere. Over 5000 RAAF personnel were stationed at Evans Head during that period. Effluent from the STP was discharged to a local drainage channel, which flowed to Salty Lagoon.

An artificial channel was constructed between Salty Lagoon and the Salty Creek in the period 1971 – 1976, allowing Salty Lagoon to interface with the ocean intermittently via Salty Creek. Prior to construction of the artificial channel, Salty Lagoon did not interface with the ocean, and was probably a fresh to brackish Groundwater Dependent Ecosystem, rather than the brackish to saline ICOLL which exists today. Salty Lagoon and the surrounding land became part of Broadwater National Park in 1974.

In November 2005, Salty Lagoon breached to the ocean, resulting in the death of an estimated 25,000 fish and eels and hundreds of water birds. Hot weather was identified as the most likely cause of the fish kill, while many birds suffered from the effects of suspected botulism after eating the dead fish and eels.

Richmond Valley Council, under the direction of the Department of Environment and Climate Change (DECC), is augmenting the Woodburn – Evans Head sewerage system. This augmentation involves:

- STP augmentation;
- Upgrading pump stations and rising mains;
- Telemetry upgrades;
- Sewer relining;
- Connecting Broadwater to centralised sewerage;
- Provision for future connection of North Woodburn to centralised sewerage;
- Developing an effluent reuse scheme; and
- Developing a sustainable release method for excess effluent which can not be reused.

As part of the augmentation, Council has resolved to rehabilitate the damage caused by 65 years of effluent releases to Salty Lagoon.

In 2004, RVC commissioned GHD to investigate methods for the sustainable release of excess effluent which could not be reused, and techniques for rehabilitating Salty Lagoon. GHD recommended the nine point rehabilitation plan.

This plan is consistent with the principles of Ecologically Sustainable Development, as defined in the NSW *Protection of the Environment Administration Act (1991)*.

Sewage Treatment Plant augmentation

Rehabilitation of Salty Lagoon commenced with the augmentation of the Evans Head STP, which improved the water quality and reduced the nutrient load released to the system. The Evans Head STP required upgrading due to increased sewage loads from an expanding population, and increased effluent quality requirements of the DECC.

The old plant, established in 1942, consisted of an Imhoff tank and sludge digester only. Augmentations were done in 1970 and 1991, adding a grit removal channel, flow balance tank at the inlet works, primary sedimentation tank, two trickling filters, two humus tanks, a primary sludge digestion tank and sludge drying beds. UV disinfection was added in 2005 in an attempt to reduce the pathogen

numbers in the effluent. Unfortunately, poor effluent clarity prevented the UV system from achieving optimal performance. The plant had a capacity of 3700 equivalent person (ep), with a connected permanent population of 3500 ep. Average dry weather flows (ADWF) increase by 25% over the summer holiday period.

In 2005, NSW Department of Commerce prepared detailed designs for an 11,000 ep Intermittently Decanted Extended Aeration Tank STP, to be constructed in two stages of 5,500 ep each.

Council applied for State Government subsidy of the upgrades, through the Country Towns Water Supplies and Sewerage Scheme (CTWSSS). The subsidy was not granted. The need for the upgrade become critical, so Council funded the $12M by raising the sewer charges for 7125 sewer connections throughout the Council sewered areas. This equates to $1680 per connection, or $159 per connection per year over 20 years at 7% interest. Retrospective funding has now been promised, with a 25% subsidy anticipated.

In 2007, Reeds Construction completed Stage 1 of the augmentation, completing all civil works for both stages. An electrical and mechanical fit out is required for the plant to operate at 11,000 ep. Construction works commenced on site in August 2006 and the sewage was brought on line in August 2007.

The new STP consists of:

- an inlet works for flow reception, fine step screen, grit arrestor, flume and flow division;
- deodorisation bed;
- two 5500 ep extended aeration tanks for secondary treatment;
- a balance/catch tank attached to aeration tanks;
- chemical (alum and magnesium hydroxide) dosing systems;
- two new sludge tanks;
- a sludge dewatering area;
- a supernatant pumping station;
- a drainage pumping station;
- amenities building;
- electrical works including SCADA and telemetry systems
- electrical switchroom building;
- pits and pipeline systems for conveyance of sewage, effluent, sludge and supernatant;
- UV Disinfection System and building;
- ancillary works associated with site services, including road works, drainage, lighting, fencing and site landscaping;
- flow measurement equipment.

Ecosystem recovery monitoring program

The ecosystem recovery monitoring program is required to:

- Identify changes and trends in Salty Lagoon;
- Inform future stages of the rehabilitation program; and
- Identify when Salty Lagoon has been rehabilitated.

GHD conducted ecological and water quality monitoring of Salty Lagoon and the surrounding environment between 2004 and 2006. GHD found a general trend of increasing water quality with increasing distance from the STP discharge point. An example of this general trend is shown in Figure 1. The results of this monitoring were used to develop the nine point rehabilitation program.

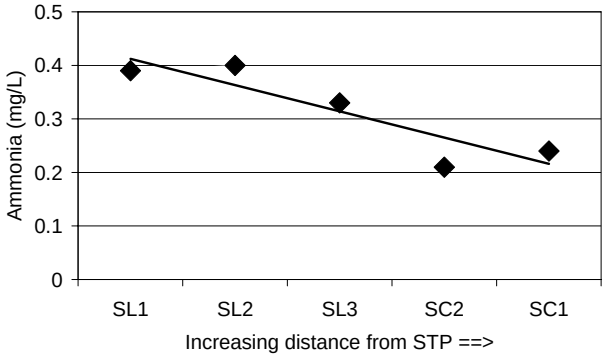

Figure 1. Ammonia concentration decreased with increasing distance from the STP

discharge location in the Salty Lagoon/Salty Creek wetland system (autumn 2005).

In August 2007, Salty Lagoon and Salty Creek discharged to the ocean. Fortunately, no fish or bird kill resulted. The breach occurred at low tide, when the pressure differential across the sand bar was greatest. The lagoon substantially emptied in five hours, but continued to trickle out for a further two days. Intensive water quality monitoring was undertaken in the weeks following the breach. Salty Lagoon and Salty Creek operated as a tidal system for several weeks until the sand bar reformed. Figure 2 shows water depth in Salty Lagoon during and following the breach event.

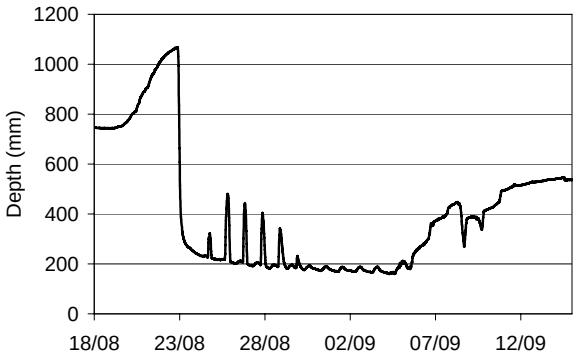

Figure 2. Salty Lagoon emptied in two hours, and remained open to the ocean for two weeks prior to the sandbar reforming.

Council engaged WorleyParsons to prepare the ecosystem recovery monitoring program. A stakeholder group was convened, with the goal of establishing a vision for Salty Lagoon, and developing key questions for the monitoring program to address. The stakeholder group consists of representatives from Richmond Valley Council, DECC, Department of Primary Industries, Department of Water and Energy, WorleyParsons, Bandjalang Clan, Woodburn Evans Head Reclaimed Water Committee, and the National Parks Advisory Committee. The success of this committee can be attributed to the participative approach taken by all members, with consultative and consensus decision making processes employed.

The vision was defined as: "Improved ecological and cultural values for Salty Lagoon."

The key questions, developed in consultation with the stakeholders, are:

- Are the ecological and cultural values of the Salty Lagoon Ecosystem improving over time?
- What risks may hinder the improvement of ecological and cultural values? and
- What options are available to mitigate risks and aid improvement?

WorleyParsons have been engaged to conduct the ecosystem recovery monitoring program, which consists of:

Status assessment: a baseline survey to characterise the current condition of the Salty Lagoon ecosystem.

Trend assessment: sampling replicated over the recovery period with the aim of evaluating changes in the system over time and includes monitoring of target indicators to document the response to management measures to be implemented; and

Event response: this component of the monitoring program outlines a protocol for monitoring catastrophic events. Results of this monitoring will help to inform decisions about feasible management options for Salty Lagoon including whether to close the artificial channel connecting Salty Lagoon and Salty Creek.

Initial results from the status assessment fish sampling program are based on 1176 fish caught and measured from seven sites within Salty Lagoon and Salty Creek. Gambusia holbrooki (mosquitofish) dominated the catch at all sites except near the beach, with freshwater and estuarine species mixed together within the middle reaches of the creek and lagoon. The fish sampling identified the majority of the freshwater species recorded from the system 10 years previously, and some new estuarine species not previously recorded. The estuarine areas had lots of school prawns as well as a smaller number of other commercially significant fish species. Unfortunately, no Oxleyan Pygmy Perch or other species of high conservation significance were identified.

Effluent reuse

Effluent reuse will reduce the hydraulic and nutrient load released to Salty Lagoon. This reduction will occur gradually over an 18 month period, culminating in no effluent released to the environment on hot, dry summer days, when irrigation can be maximised.

A number of options were investigated to utilise the effluent produced at the Evans Head STP (see Table 2).

Table 2. Options for effluent reuse at Evans Head.

Options investigated	Result
Agricultural reuse	No suitable crops grown close to STP. Not viable.
Direct potable reuse	Rejected by NSW Health.
Indirect potable reuse	Rejected by NSW Health.
Urban reuse/dual reticulation	Only viable for green field developments. No sites available in Evans Head for a green field development.
Open space irrigation	Feasible.
Industrial reuse	No interested users in close proximity.

GeoLINK Environmental Consulting and Rothwells Pumps and Irrigation prepared the detailed design for Stage 1 of the Evans Head Effluent Reuse Scheme. The first stage will have capacity to irrigate approximately 1.8 ML per day of reclaimed water from the Evans Head STP during peak summer periods, minimising the need for release of effluent. Areas to be irrigated include schools, sporting fields, and open space within Woodburn and Evans Head.

The Federal Government's Community Water Grants program has provided $50,000 each to Woodburn Public School, Woodburn Oval Committee, Woodburn Bowls Club, Evans Head Bowls Club and Stan Payne Oval Committee, $188,000 to Evans River K-12 School, and $300,000 to the Woodburn Evans Head Golf Club to establish the effluent irrigation systems.

In addition to these irrigation areas, Council is investigating options to further treat the effluent to a standard suitable for toilet flushing at Evans River K-12 School.

The effluent reuse scheme will result in a gradual reduction and eventual cessation of dry weather effluent flows to Salty Lagoon.

Excess effluent release investigation

An alternate release location for the excess effluent which can not be reused is required to allow Salty Lagoon to return to a natural condition, without the addition of water or nutrients. DECC have consistently advised that long term effluent discharges to Salty Lagoon are not permitted, regardless of quality. Continued discharge of high quality effluent to Salty Lagoon is only permitted while ever it is necessary for rehabilitation of the lagoon.

Investigations have been carried out over the past 15 years to find a release option which satisfies all the legal, technical, social, environmental and political requirements. Table 3 lists the options which have been investigated, and the result of those investigations.

Table 3. Options for release of effluent at Evans Head.

Options investigated	Result
Release to Richmond River	Rejected by DECC
Recharge Woodburn Aquifer (shallow)	Rejected by Department of Health
Deep aquifer injection	Not technically feasible
Ebb tide release to Evans River	Rejected by DECC and the community
Deep water ebb tide discharge east of the estuary mouth	Investigations are ongoing

Following completion of the investigation into ebb tide release to the Evans River, DECC directed Council to investigate a deep water ebb tide discharge, east of the estuary mouth. Stage 1 of this investigation involved deploying an Acoustic Doppler Current Profiler to measure current strength and direction near the mouth of the Evans River. Three sites were identified as worthy of further investigation: Site A was 0 m from the estuary mouth, in 2 m of water; Site B was 200 m from the estuary mouth, in 5 m of water; and Site C was 800 m from the estuary mouth, in 8 m of water. While Site A gave the best dilution, Site C was chosen based on social factors. Stage 2 of the investigation identified Site C1, 500 m north of Site C and away from recreational areas, which may be suitable for continuous release.

Future stages of the excess effluent release investigation include the Environmental Impact Assessment, detailed design, construction, and commissioning. Once the alternate sustainable effluent release option is operational, effluent releases to Salty Lagoon can be eliminated completely.

Key lessons

Richmond Valley Council has learnt a number of lessons throughout the Salty Lagoon rehabilitation project, which have implications for the future of the rehabilitation project, and are relevant to other applications. These lessons include developing and maintaining a cooperative working relationship with Government departments and officials, consulting with the right stakeholders, and learning by doing.

Richmond Valley Council and DECC staff have developed a cooperative working relationship over the past two years, based on regular open communication. Staff members in each organisation have kept their counterparts informed of all developments, both positive and negative. This has lead to a greater trust and awareness of each others responsibilities and obligations, which has resulted in a deeper understanding of the actions of each organisation. The success of the Salty Lagoon rehabilitation project can be largely attributed to this inter-organisational relationship.

Stakeholder consultation was conducted towards the end of the Salty Lagoon Rehabilitation Program development (the nine point plan), resulting in scepticism, and opposition from a number of stakeholders, and apathy from others. Most stakeholders felt they were being told what to think. The development of the ecosystem recovery monitoring program used the opposite approach. The stakeholder group was assembled at the beginning of the project, and were regularly consulted about the outcomes and future direction of the project. This developed a spirit of cooperation and ownership, with competing stakeholders working together to achieve common goals. This stakeholder group will be consulted in a similar manner throughout the remainder of the rehabilitation project.

The entire rehabilitation project has been a process of “learning by doing”. When GHD commenced the initial studies, little detail was known about the Salty Lagoon system. As a consequence, the parameters investigated did not fully represent the key ecosystem processes. However, it provided an understanding of the system from which WorleyParsons developed the baseline assessment to fill the data gaps, and the trend assessment. Richmond Valley Council expects that future studies will identify further data gaps.

Conclusion

The ecosystem recovery monitoring program is investigating a wide range of environmental and ecological factors, and the outcome will result in a rehabilitation program that will not only allow the rehabilitation of this important coastal wetland, but will have implications and benefits for rehabilitation of other degraded wetland areas. The rehabilitation of Salty Lagoon demonstrates how a change in climate can be achieved through cooperation of diverse disciplines and competing

stakeholders, under the guidance and leadership of the local Council.

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Author Biography

Adam Wilson, Richmond Valley Council's Services Planning Engineer, has been working on Evans Head Sewerage Augmentation for 3 years. He is managing the Salty Lagoon rehabilitation project, establishment of the Evans Head effluent reuse system, investigations into a sustainable effluent release strategy, development of the Broadwater Sewerage Scheme, and Council's Beachwatch program. Previously, Adam worked for Qld Department of Primary Industries & Fisheries regulating intensive livestock facilities, and Qld Department of Natural Resources & Water monitoring and modelling water quality in the Condamine Ballone Catchment. Having graduated with a Bachelor of Environmental Engineering in 2001, Adam is currently studying Masters of Project Management.