ISSUES FOR RECLAIMED WATER RE-USE AT TATURA WWTP

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LAND BASED RECLAIMED WATER RE-USE – ISSUES AND CHALLENGES EXPERIENCED AT TATURA

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ABSTRACT

In early 1994, the newly formed Goulburn Valley Water inherited Tatura's sewerage reticulation system and wastewater treatment plant (WWTP). The extremely poor condition of the sewerage system, and the insufficient treatment of waste by the WWTP instigated a seven million dollar upgrade.

Before the commissioning of the upgrade in October 1999, emergency discharges to Mosquito Depression were often required due to both insufficient irrigation area and winter storage. The upgrade was aimed at enabling zero discharge from the WWTP through the construction of a winter storage, and increased land for irrigation.

The challenge adopted by the Authority was to provide a long-term means of managing a wastewater load equivalent to a city of 200,000 people, in an environmentally sustainable way. This challenge involved developing treatment technologies appropriate to high strength waste, implementing appropriate trade waste agreements and initiating long-term reclaimed water reuse agreements with farmers adjacent to the waste management facility.

This paper discusses the operational problems experienced, and issues confronted by the Authority in the development and management of long term wastewater re-use practices.

KEYWORDS

Tatura, zero discharge, trade waste, wastewater treatment, high rate anaerobic lagoon, third party wastewater re-user, sodicity, salinity.

1.0 INTRODUCTION

The Tatura WWTP is located in the Goulburn Valley 20 kilometres west of Shepparton. Tatura is in an irrigation region where water is supplied from the Goulburn River through a channel system to many fruit and tomato growers, and dairy and beef farms. The network of industries in the Goulburn Broken Catchment are recognised as one of the nations "food bowl" centres, providing some 25% of Victoria's rural output. These primary producers supply three major industries in Tatura including Tatura Milk Industries, Unilever (Rosella) and Snow Brand.

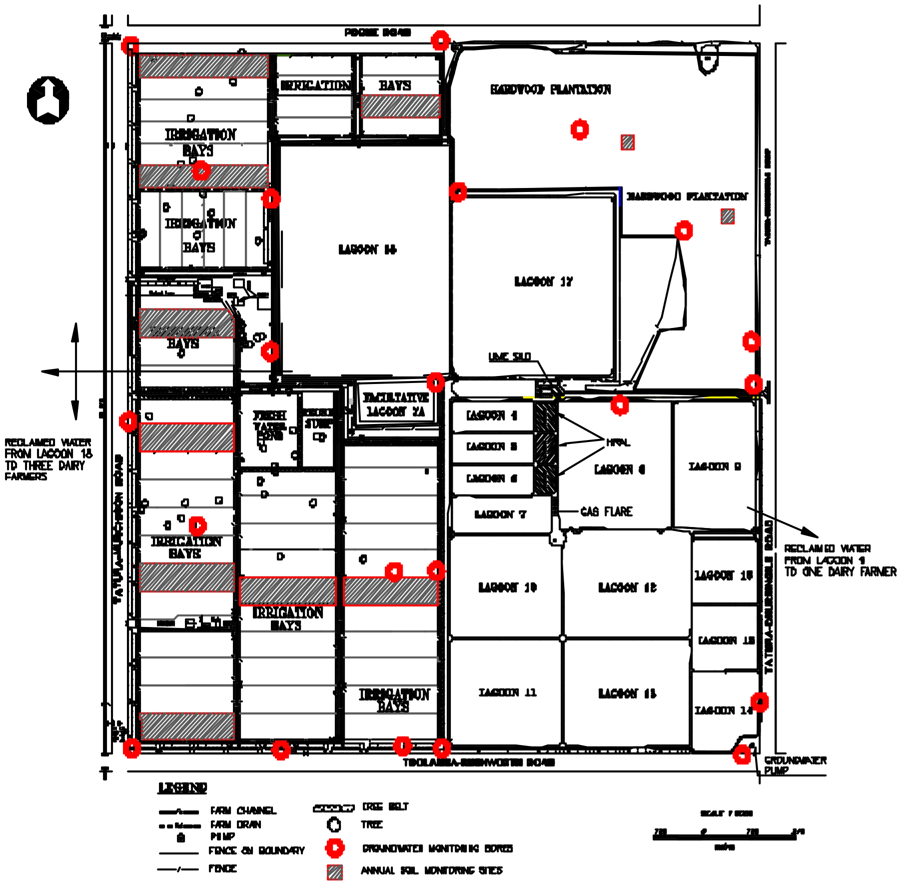
Whilst the economic benefits have provided substantial value to the region, it has also caused detrimental effects on our environment. Rivers were regulated to provide water for irrigation, trees were cleared for agricultural production, and floodplains were used as drains. This has consequently contributed to rising groundwater tables, salinity problems and accelerated eutrophication of our waterways.

1.1 Tatura Wastewater Treatment Plant

When Rodney Water Board and Shepparton Water Board amalgamated in 1994, the newly formed Goulburn Valley Water took ownership of the rundown and undersized Tatura treatment complex. Since that time, significant improvements in the wastewater treatment and disposal systems have taken place.

The Tatura WWTP provides wastewater treatment services for the urban and industrial areas of Tatura. The local community comprises around 3,000 people, but due to industry, the waste load treated at the Tatura WWTP is equivalent to that produced from a residential population of 200,000 people. The hydraulic load on the WWTP is approximately 1200 megalitres (ML) of wastewater annually, of which 70% is derived from industry and 30% from domestic sources.

Figure 1: ***Site Layout of Tatura Wastewater Treatment Complex***



2.0 DISCUSSION

2.1 The Problem

Waste quality and treatment

Originally, the Tatura WWTP was designed to treat a much smaller hydraulic load. The plant was originally configured as an aerated lagoon system, followed by evaporation lagoons. Over the years as the town's industries expanded, it became evident that the plant did not have sufficient capacity to treat or dispose of the wastewater. The Plant became massively overloaded causing poor treatment of waste and constant generation of foul odours (principally H_2S).

Wastewater quality from industry had also been poor, causing corrosion and deterioration of sewage pumps and associated works in the wastewater conveyance system.

Wastewater disposal

Offsite discharges to the Mosquito Depression during winter were often required due to insufficient winter storage capacity. In extremely wet years, temporary storage capacity was made through the construction of a bund around a treelot where the wastewater would be stored before ultimately being discharged to the drain. This method of disposal is unacceptable, especially when watertable levels in the region are already high.

The drain used during discharges flows through the township of Tatura. The outlet of this drain enters the Mosquito Depression, which eventually ends up in the Murray River. This method of discharge presented a very poor and undesirable visual image to the public.

2.2 The Solution

Waste quality and treatment

The Plant upgrade aimed at providing a long term, cost effective means of treating the waste. The three aerated lagoons that previously provided primary treatment were covered with a reinforced poly propylene (RPP) cover and converted to High Rate Anaerobic Lagoon (HRAL) reactors. The HRAL's trap the gas under the covers and transport it via a pipe system to a flare where it is burnt (and the gas is converted from methane to carbon dioxide, reducing greenhouse emissions). This has eliminated bad odour problems, whilst potential also exists for co-generation of electricity using this gas from the anaerobic lagoons.

Additionally, the aerators which were originally located on the primary lagoons, were relocated to the lagoons immediately downstream of the HRAL's. This was to assist in the conversion of effluent from the HRAL's to an aerobic state as quickly as possible and avoid odour generation from this now facultative area. An additional facultative lagoon was built and provision made for future installation of an aerator. Effluent distribution can now be achieved via two alternative routes (refer to figure 1). Firstly, effluent can proceed from the HRAL's to the aerated lagoons, to the new facultative lagoon then to lagoon 18. The second option allows waste to pass through the HRAL's, to the aerated lagoons and via lagoons 7, 8, 9, 17 and 18 before it is used for irrigation.

The HRAL's have provided more than 90% removal of Chemical Oxygen Demand (COD) from the raw waste, despite increases in organic loading from industry. This efficiency means that the aerators have been rarely required, providing significant savings in power consumption. This has allowed for a vast improvement in water quality in the final irrigation storage lagoon.

Since March 1994, the Authority has been working with Industry to improve the standard of trade waste discharges. This has resulted in the application of new Trade Waste Agreements for the two major industries in town. To assist each company, Goulburn Valley Water offered to part fund (50%) the cost of a waste management audit of each industry. These independent audits have assisted industry to minimise generation of waste, and will provide pre-treatment of the residual waste.

The Authority will also be extending their charging parameters for major trade waste companies and will now incorporate charges for total nitrogen, total phosphorus, sodium and organic loadings. Reducing salt loads entering the plant is aimed at assisting the sustainability of irrigation practices.

Wastewater re-use

With an increasing focus by Regulatory Authorities such as the Environment Protection Authority and the Murray Darling Basin Commission on reducing discharges to surface waters, the Authority gave preference to a move to 100% land-based re-use.

In 1998, a 360 ML winter storage lagoon was built and 100 hectares of land was acquired and developed for irrigation. This increased the irrigation area to approximately 120 hectares which includes the existing 20 ha of treelots.

Electrical Conductivity (EC) levels in the final effluent were relatively high after the construction of the winter storage and were predicted to increase from around 2,500ìS/cm to 3,500ìS/cm. EPA guidelines suggest that reclaimed water of this nature could cause significant risk to the environment and/or the crop being grown. To achieve a sustainable outcome, the Authority needed to shandy the wastewater with channel water to achieve an EC of no more than 1000 ìS/cm (preferably 800 ìS/cm).

Final effluent quality during the 1999/2000 irrigation season averaged 3,000 ìS/cm. The dilution required to reduce salt loads to acceptable levels would mean that a shandy ratio of approximately 1:3 (1 part wastewater to 3 parts channel water, assuming that channel water averages approximately 200 ìS/cm) would be required. High salt levels consequently increased the total volume of water to be managed by the Authority which led to the development of long-term reclaimed water re-use agreements with four dairy farmers adjacent to the waste management facility.

For the farmers to have enough water for shandying, Goulburn Valley Water provides each farmer with a Bulk Water Entitlement of Goulburn Murray Water (channel water) equal to the quantities of reclaimed water taken, which effectively increases the farmer's water rights.

2.3 Management and sustainability issues

Third party wastewater re-use regulatory requirements

To use the reclaimed water for irrigation on dairy farms required approval from EPA, Victorian Dairy Industry Authority (VDIA) and Tatura Milk Industries and each of these bodies provided the Authority with specific requirements to be met for the project to proceed. Individual site management plans were developed for each dairy farm to ensure that the requirements specified above were met. These site management plans consisted of detailed descriptions of the site (the location of each farm, farm layout, soil type, groundwater status), reclaimed water quality, land use practices, on-farm water management (eg annual water usage, farm storage availability and drainage details), current soil status, management skills required and environmental monitoring responsibilities. Consultations with the farmers allowed all of the information to be collated, and submitted to EPA for approval.

In addition, the VDIA had requirements for reclaimed water use on dairy farms, which complimented EPA requirements. The VDIA based their program on the principles of Hazard Analysis Critical Control Point (HACCP), to ensure that reclaimed water users do not affect food safety, in so far as milk and dairy products are concerned. To satisfy the VDIA requirements, annual on-site farm audits will take place to make sure that specific farm records and farm management practices are being adhered to.

Examples of such requirements include:

- Stock must not be allowed to graze for 5 days on pasture following irrigation with reclaimed water.
- Reclaimed water is not allowed to be used to supply stock drinking troughs, or used in milking sheds or for equipment washing.
- Fencing is required around farm storages/channels where reclaimed water is being used
- Should *E.coli* levels exceed a median of 1,000orgs/100ml, or a notification level of 5,000orgs/100ml, the use of reclaimed water is to cease until levels improve.
- Should *E.coli* levels be between 1000orgs/100ml and 5,000orgs/100ml then farmers are to increase their stock withholding to 20 days rather than 5 days.

Groundwater

High groundwater tables are a local problem in the Shepparton Irrigation Region (SIR). Groundwater levels at Tatura WWTP and surrounding properties are approximately 1 to 2 metres below the natural surface and range between 2,000 and 9,000µS/cm, effecting some existing tree plantations. To minimise the effect that the Tatura WWTP may have on the groundwater, the Authority installed a groundwater interception scheme on the southeastern corner of the plant. Any water collected is pumped back into the evaporation lagoons (lagoon numbers 10,11,12 and 13).

An extensive network of groundwater monitoring bores was also installed at the time of the upgrade. Monitoring for potential contaminants, salt and groundwater level is now part of the Authority's environmental management system.

In addition, 8,000 native trees and shrubs were planted at the completion of the upgrade. It is anticipated that they will act as a windbreak, and as natural groundwater pumps (providing they are not effected by saline groundwater).

Salinity and sodicity of soil

The constituents of wastewater that can threaten sustainability are pathogens, heavy metals, toxic organic substances, boron, sodium, nutrients (particularly nitrogen and phosphorus) and salts. From these the last three provide the greatest potential limits to sustaining wastewater irrigation. The rest pose few problems for wastewater in the Goulburn Valley. Irrigation that moves beyond the rootzone can add to groundwater and induce salinity and water logging (Surapaneni *et al* 1998).

From research trials at Shepparton and Mooroopna WWTP's, Goulburn Valley Water has recognised that wastewater irrigation can lead to soil degradation via salinity, sodicity and water logging. Annual soil monitoring on all properties irrigated with reclaimed water is now part of the Authority's routine monitoring. Baseline soil samples that were taken before reclaimed water was used for irrigation suggest that some of the soil by Australian definition is already sodic (Exchangeable Sodium Percentage, ESP>6). Likewise, some soil electrical conductivity results exhibited levels of >0.16dS/m (soils with <0.16dS/m are defined as low in salinity). Careful long-term monitoring and management by the Authority will be crucial.

Studies show that applications of Gypsum improve internal drainage by offsetting the increasing sodicity in the soil. This was assessed at the initial baseline sampling and will be assessed at each subsequent sampling period, to determine gypsum requirements.

There are issues associated with farms under continuous cultivation and increased soil sodicity. The combination of sodic irrigation water and cultivation may create hard-setting, impermeable soils. Care will have to be taken to ensure that reclaimed water re-use does not increase soil sodicity. Any changes in soil characteristics will be detected through annual soil sampling and managed appropriately.

Salt and nutrients

As the reclaimed water is diluted to a ratio of 1:3, nutrient loading on the site is not likely to be an issue, in fact, additional nutrients will need to be added to maintain plant requirements. Table 1 presents nutrient loads (in kilograms) to land during the 1999/2000 irrigation season.

Based on average wastewater quality data for Total Nitrogen and Total Phosphorus, shandied levels reduce nutrient concentrations to 8mg/l and 3mg/l respectively. If farmers were irrigating paddocks at 8ML/ha/yr, calculations indicate that loads would equal 64kgN/ha/yr and 24kgP/ha/yr. Rye/Clover pastures have requirements of 220kgN/ha/yr and 50kgP/ha/yr.

Annual salt and nutrient loads in Table 1 were calculated utilising monthly irrigation volumes and monthly nutrient concentrations of the final effluent quality. Due to commissioning delays last season, it is expected that the volume of reclaimed water used, and the area of land irrigated will increase next irrigation season.

Table 1: ***Total Salt and nutrient loads (kg) to land – 1999/2000***

	Total Dissolved Solids	Total Kieldahl Nitrogen	Total Phosphorus
Wastewater to land (kg)	879,860	11,505	2,121

Environmental monitoring responsibilities

At Tatura WWTP, comprehensive wastewater tests are completed monthly, and during irrigation both *E.coli* (bacteria) and field tests are performed weekly. It is the responsibility of the Authority to cease supply of irrigation water if *E.coli* levels exceed regulatory limits.

Reclaimed water users must also keep records of the Electrical Conductivity of the water they have applied during each irrigation (shandied EC value) dates irrigated, areas irrigated and dates stock were put back on irrigated pasture.

As described, annual soil monitoring and a coordinated groundwater monitoring program is underway.

Plant operations

The Authority anticipated operational problems on commissioning the WWTP's irrigation system. In most cases the problems were minor and could be overcome by operational staff. It is not expected that the problems experienced will persist in further irrigation seasons.

To enable zero discharge to surface waters from the WWTP, Goulburn Valley Water now rely on formal agreements between four off-site users to use their allocated amount of reclaimed water annually. Despite the variations in seasons, each third party re-user must take their annual allocation so that lagoon storages can run at optimum levels.

Exceptions to the agreement were made in the first irrigation season (1999/2000) because the upgrade was still in the final stages. The Authority had problems installing pumps and pipe work, hence a late start to the season was made. Table 2 emphasizes the shortfall in water usage by the dairy farmers.

Table 2 : ***Reclaimed water re-users allocations and the amount of reclaimed water used in the 1999/2000 irrigation season.***

Reclaimed water re-user	Allocated reclaimed water (ML)	Reclaimed water used in 1999/2000 irrigation season (ML)
L.J. & C.A. Merritt	50	79
Veriloo Pty Ltd	140	83
F. & A. LoPiccollo	180	65
J.K. & B Kennedy	130	80

Lagoon water balance models indicate that there will be enough storage capacity to cater for the additional water over the forthcoming winter period. Operational problems may still arise in late winter however, if heavy rains occur.

Apart from the late start to irrigation with reclaimed water due to construction, less water than anticipated was taken due to the dry season. The channel water allocations to each farmer was reduced due to the low water levels in the catchment storages meaning each farmer needed to develop a very accurate water budget to ensure that they did not run out of water. This conservative approach actually reduced the volume of reclaimed water used even though the year was so dry.

The newly lasered WWTP property also utilised less reclaimed water than anticipated. Run-off from the irrigation bays is collected and returned to a recirculation dam for re-use. In some instances this run-off water also needed to be shandied with channel water for further irrigation due to its high salt load. Consequently, less reclaimed water was being used.

The pump supplying reclaimed water for irrigation from the winter storage was oversized and its inability to adequately throttle the flow rate caused difficulties in shandying to the correct ratio. To rectify this problem, a smaller temporary pump was installed so that the correct volume of wastewater could be delivered for mixing with channel water.

Problems were also encountered with turtles being sucked into pumps from the winter storage causing restriction of flows and often blocking the system. If the problem was not attended to quickly enough pumps were at risk of being seriously damaged. All the while fresh water was being used, exhausting the resource for shandying purposes.

Dairy farmers' experiences to date

The expansion of the WWTP, which created greater availability of water for irrigation, came at the right time for the four dairy farmers who have experienced three consecutive dry years.

On receiving the water for the first time, farmers were a little apprehensive towards making sure that they could achieve the right EC mix, and that the water would not pose a threat to their livestock. Each farmer was issued with an EC meter and a record book for recording their irrigations and relevant details.

One farmer had some problems initially with mixing channel water and wastewater. This was quickly overcome by mixing the water in the farm channel (rather than the re-use sump) like the other 3 farmers.

All farmers commented on how much their pasture growth rates improved in paddocks where reclaimed water was used, and how much greener the pastures were.

Two farmers decided to laser paddocks to accommodate more irrigation next season, which was justified by their increase in available water, and the increased value of the farm due to the security of water supplies.

To date, the Authority has received extremely positive feedback from all off-site re-users. Close contact is kept with the farmers and next irrigation season they will be more experienced with the watering operations.

3.0 CONCLUSION

The newly constructed High Rate Anaerobic Lagoons (HRAL) now provide very efficient primary treatment with the balance of the organic load removed in the aerobic lagoons. Effluent is stored in new irrigation storages for re-use over summer.

The new winter storages eliminates the need for annual discharges off-site to surface waters, and minimises risks of toxic cyanobacteria blooms in our waterways. The reclaimed water is utilised by local farmers, reducing their fresh water and fertiliser requirements.

To date, small problems with pumps and shandying on the WWTP site have been overcome, and experience gained from the 1999/2000 irrigation season will be employed in subsequent irrigation seasons.

Off-site users are extremely happy with their new water supply, and look forward to next season when they will be able to utilise their full reclaimed water allocations. The additional nutrient supplied in the reclaimed water may reduce overall fertiliser needs.

Environmental issues such as salinity, sodicity and high groundwater tables have been acknowledged by the Authority and careful monitoring of the effects of reclaimed water on the environment will be crucial for the long-term sustainability of the site.

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