RETICULATED RECYCLED WATER SCHEMES – OPERATIONAL CONSIDERATIONS

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ABSTRACT

Most people agree that using recycled sewage water to irrigate public open space and sportsfields is a good use of this valuable resource. It reduces demand on potable supplies and provides good quality turf surfaces for sport and recreation when natural rainfall is insufficient. The benefits to the public are there to be seen.

However, despite this apparent consensus about recycled water, there are some fundamental questions that need to be answered before new recycled water schemes can get off the ground.
This presentation discusses these issues using illustrations from a couple of recent schemes in Victoria that RMCG has been involved with.

KEY WORDS

Recycled water, sports fields, urban amenity horticulture irrigation, Class A, dual third pipe.

1.0 INTRODUCTION

Utilising recycled water for urban irrigation has become a common element of the water security plans for many Victorian water authorities. In simple terms, reducing the volume of potable water used for irrigation increases the volume available for potable supplies.

However, the nature of recycled water supply is different to traditional water supplies in a number of subtle ways. This paper explores some of the operational issues relevant to recycled water schemes, and poses some suggestions about how these can be overcome. The issues are discussed under the following themes:

- Uses for recycled water.
- Water quality.
- Water sharing.
- Distribution infrastructure.

2.0 DISCUSSION

2.1 Uses for Recycled Water

Recycled water has been used for sportsfield irrigation in Australia and overseas for many decades. In Victoria the prevalence has increased dramatically in the past five to ten years, due primarily to water shortage caused by lower rainfall and reduced runoff into surface water catchment dams.

Golf courses have typically taken Class B & C recycled water because the risk to the public can be excluded and access can be controlled by measures such as irrigation practices, restricted water times (for example night-time watering), fencing and/or withholding periods to ensure the areas are dry before access by humans.

Urban sportsfields, however, are typically more open to the public. Only Class A water may be used for residential or municipal schemes where there is a high exposure potential to humans due to limited controls on public access.

Class A water is also now utilised for other urban purposes that allow direct human contact. In Bendigo these include dual pipe residential, commercial laundry, topping up recreational lakes, commercial carwashes, school gardens and grounds and artificial hockey surfaces.

Water authorities now take a commercial view of recycled water services, and customers paying tariffs for recycled water have high expectations from their recycled water service. Consequently, high operational standards are required to meet these customer expectations including:

- Reliable production of quality recycled water.
- Clear rules for sharing recycled water.
- Infrastructure that can distribute the water at the required flow and pressure.

This paper explores some of the issues in more detail.

2.2 Water Quality

The quality of water used for urban irrigation is critical. It has a bearing on the management of the irrigation, turf quality and the health of the end user.

Recycled water plants (or "factories" as they are sometimes called) are highly sophisticated facilities that operate to very tight water quality specifications. The removal of organisms that present risk to health is the key objective, and nutrients and toxins are also removed as part of the "reclamation" process. Aesthetic water quality (eg. odour, colour) is also an important consideration at the point of use. Those who work in these plants will know that the water quality targets can be very stringent and meeting them on a continuous basis is difficult.

Two key issues are discussed in this paper: salinity and nutrients.

Domestic sewage contains higher levels of dissolved salts than drinking water. Industrial trade wastes can also contribute significant quantities of added salt. Some recycled water plants include salt reduction (eg. Coliban Water in Bendigo) but most do not.

In simple terms, salinity affects the irrigation management. The higher the salinity, the higher the risk of poor results and consequently a higher level of irrigator understanding is required, as illustrated in Table 1.

Coliban Water, for example, has set a target maximum of 500 mg/L and has installed a desalination plant to achieve this. On the other hand, recycled water from Melbourne Water's Western Treatment Plant at Werribee has no salt reduction and has a salinity of approximately 1,300 mg/L.

Consequently, the salinity risk has not been a major issue for the City of Greater Bendigo. However, Wyndham City Council has had some poor results when trying to apply relatively high salinity water to fields with low permeability and indigenous clay soils. Solutions being explored at Wyndham include: deeper irrigation, higher permeability sand bases, switching to more salt tolerant grass species and reduced salinity (through shandy at point of use or desalination at the treatment plant).

Table 1: ***Salinity classes of irrigation waters (Guidelines for Wastewater Irrigation, EPA Victoria, Publication No. 168, 1991)***

Class	TDS (mg/l)	Electrical Conductivity (µS/cm)	Comments
1	0-175	0-270	Can be used for most crops on most soils with all methods of water application with little likelihood that a salinity problem will develop. Some leaching is required but this will occur under normal irrigation practices, except in soils of extremely low soil permeability.
2	175-500	270-780	Can be used if a moderate amount of leaching occurs. Plants with moderate salt tolerance can be grown, usually without special salinity management practices. Sprinkler irrigation with the more saline waters in this group may cause leaf scorch on salt sensitive crops.
3	500-1500	780-2340	The more saline waters of this class should not be used on soils with restricted drainage. Even with adequate drainage, best practice management controls for salinity may be required and the salt tolerance of the plants to be irrigated must be considered.
4	1500-3500	2340-5470	For use, soils must be permeable and drainage adequate. Water must be applied in excess to provide considerable leaching, and salt tolerant crops should be selected.
5	>3500	>5470	Not suitable for irrigation except on well-drained soils under good management especially in relation to leaching. Restrict to salt tolerant crops, or for occasional emergency use.

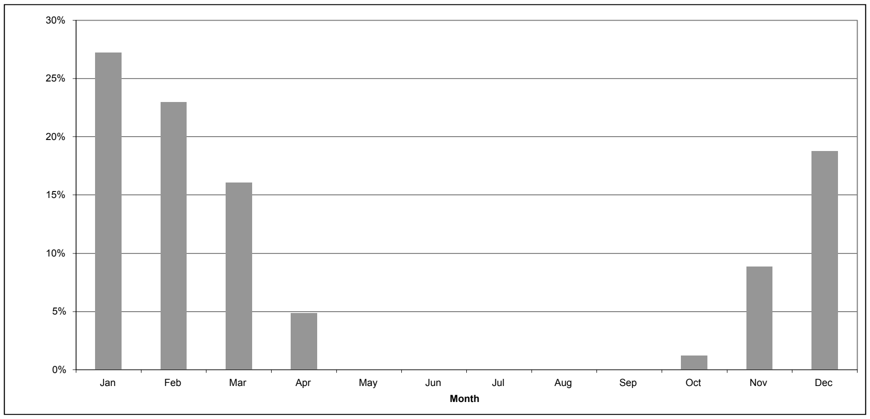
Another important water quality parameter is nutrients. Nutrients can be very useful because they are required for healthy plant growth. For many years secondary treated recycled water has been used to irrigate agricultural pastures and, as long as the level of nutrients applied is balanced by the amount harvested through grazing or fodder production, the risk of accumulation or runoff of nutrients can be managed. The recycled water effectively provides a replacement for fertiliser use.

However, in amenity horticulture, such as sportsgrounds, the demand for nutrients is lower and grass clippings are typically retained on-site. Careful management is required in these circumstances to avoid the build up of nutrient levels.

In summary, consistent quality recycled water is an important consideration for irrigation managers if they are to achieve the desired results when irrigating with recycled water. Salinity and nutrients are key parameters to be focussed on.

2.3 Water sharing

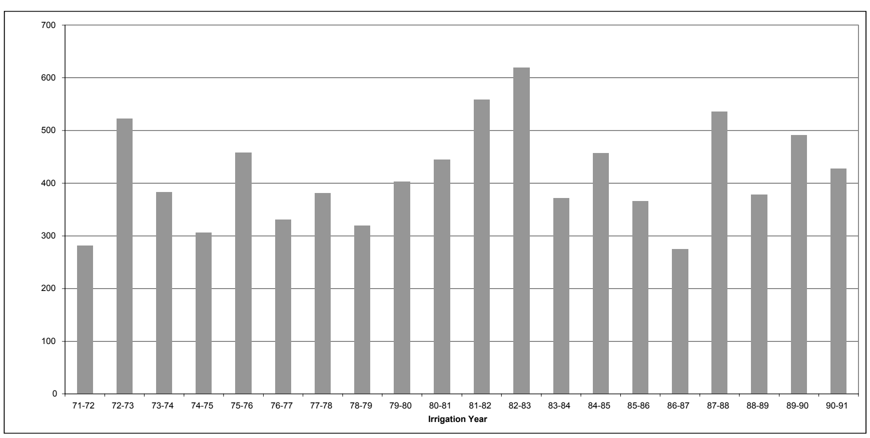
Recycled water is thought to be a reliable resource, and up to a point that is true. However, the demand and supply of recycled water varies seasonally and annually.
Seasonal climatic variations affect the irrigation requirement. The distribution of irrigation requirement across a year is shown in Figure 1 below. Typically in Victoria, there is little or no irrigation demand over the winter, moderate demand in autumn and spring, and very high demand in summer.



<u>Figure 1:</u> ***Distribution of seasonal Irrigation Requirement (Werribee)***

However, the flows of sewage through a treatment plant are either steady throughout the year, or show a slightly opposite trend due to winter stormwater contributions. Consequently, if the recycled water stream is to be fully utilised, winter storage lagoons must be provided to carry the water through from winter to the irrigation season.

Also, because some years are wetter than others, the total irrigation demand can vary considerably. Figure 2 shows a typical pattern of annual irrigation demand over a twenty year period. In this example, the peak demand in the dry year of 1982/83 was almost double the lowest year, and 50% greater than the average demand. Again this is the opposite trend to the variation in recycled water flows, which tend to be higher in wet years due to stormwater contributions and lower in dry years particularly when water restrictions are in force and customers implement grey water recycling.



<u>Figure 2:</u> ***Distribution of annual irrigation requirement (Warrnambool)***

Recycled water is reliable if schemes remain small only using a portion of the flows available, as has been the case in the past. However, once the combined summer demand of all customers exceeds dry weather inflows, winter storage is required.

And, in dry years when the combined annual demand of all customers exceeds sewage inflows, some customers will miss out (even with a winter storage).

In summary, the ability of recycled water schemes to reliably supply irrigation water to customers depends upon the volume of winter storage available, and the overall area of land irrigated. Once the scheme becomes committed beyond a certain point, systems for prioritising or sharing water become necessary. This can be achieved through establishing a hierarchy of use, which involves identifying which uses are more important than others. For example, an oval used for top level competition might be given high priority. Trigger points based on storage levels and flow through the treatment plant would also be required so operators know when to move into water sharing mode. In some ways this could work like town water restrictions.

2.4 Distribution Infrastructure

Reliability of supply for irrigation water is critical during the irrigation season, particularly during the peak of summer. Storage and pressure are common distribution challenges that need to be resolved in the design of a reliable system.

The supplier or the customer can provide winter storage. Coliban Water's Bendigo scheme includes winter storage as part of the scheme, so customers can rely on summer supply without the need for their own storage. In Kyneton, Coliban Water supplies water during winter to the local racecourse, where a 40 ML lake has been built inside the track. The race-club can irrigate as required from this lake during the irrigation season.

Supply pressure is a critical consideration where recycled water is used for irrigation. Typically sprinkler systems are designed to operate at a set pressure at the supply point (minimum say 400 kPa). If the actual supply pressure is too low, or if it fluctuates over a wide range, the distribution uniformity of the irrigation system will be low as shown in Figure 3.

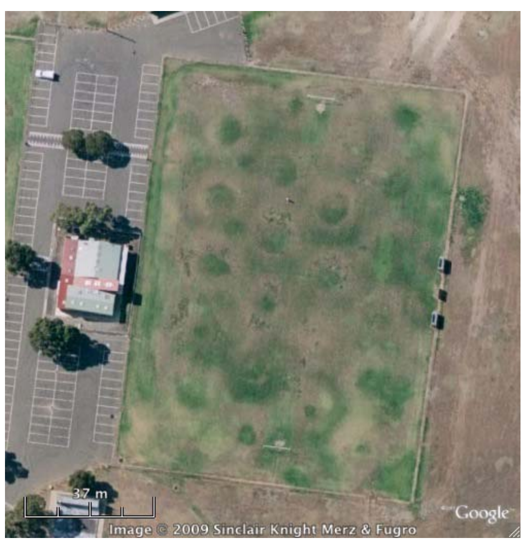


Figure 3: ***Doughnut effect due to low supply pressure.***

Low supply pressure can be overcome by boosting pressure on site. Two typical set ups are in-line boosting and break-tank.
In-line boosting installations include a simple pump with variable speed drive connected directly to the recycled water supply main. These types of systems are suitable where the supply pressure is insufficient to meet the required pressure for the irrigation system. For example, in Werribee, the supply pressure in the recycled water scheme is only 150 kPa, yet the sprinklers typically need 500 kPa. However, the risk with these booster systems is that the upstream hydraulic gradeline can be drawn down below zero or to the point where other customers relying on a gravity supply will be affected. Typically in-line boosting should be used to provide extra grade, not as a substitute for insufficient distribution capacity.

Break tanks can also be used, but again not as a substitute for adequate distribution capacity. At Canterbury Park in Eaglehawk, a new break-tank upstream of the existing pump station was found to be the most economical way to go. A tank capacity of approximately 2 kL was installed, with an 80 mm modulating level inlet control valve, plastic float and 40 mm orifice plate, and 80 mm outlet to pump suction. Like the in-line booster, this type of installation also has the capacity to flatten the hydraulic grade and therefore impact on the supply to other customers.

Where recycled water service assemblies include reduced pressure zone backflow prevention, the pressure losses through these can be significant and also need to be considered in the hydraulic design.

In summary, storage and pressure are two key issues that need to be considered when designing recycled water connections. Particular care is needed to match the supply pressure with that of the irrigation system, particularly when connecting to an existing system.

3.0 CONCLUSIONS

Recycled water can generate considerable aesthetic and amenity values, providing green open spaces and good playing surfaces, especially in dry climates. However, their success depends upon a number of operational considerations including water quality, water sharing and distribution infrastructure.

4.0 ACKNOWLEDGEMENTS

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