RAIN, RAIN, GO AWAY – THE OPERATIONAL CHALLENGES OF USING RECYCLED WATER IN SOUTH WEST VICTORIA

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ABSTRACT

Recycled water usage is a critical component of wastewater treatment systems that do not have regulatory permission to discharge to waterways. Fourteen (14) agricultural reuse sites across Wannon Water utilise recycled water for pasture and fodder production, with the goal of an empty winter storage by March / April each year to contain wastewater effluent through the non-irrigation period.

There are several practical operational challenges in reaching this goal, from wastewater catchment to recycled water consumer. This paper explores these factors, including seasonal conditions, winter storage aquatic weeds, algal blooms, customer skills, tariffs, grazing withholding periods, livestock type, asset maintenance and upgrades.

Case studies and solutions are proposed specific to the South West Victoria context, spanning technical aspects, human resources and beyond to a new operational paradigm. Some of the more unique practical solutions include the use of amphibious weed harvesters, drones for site assessments and use of hybrid Class B / Class C classification. Looking to the future, our strategy may include conversion to livestock-free smart farms and evolution of recycled water for agriculture to recycled water for industry, in line with emerging circular economy goals.

1.0 INTRODUCTION

Wannon Water supplies recycled water to a mix of customers; industry (1), open space (9) and agriculture (13). Within the agriculture sites, there is a combination of Wannon Water owned sites (12) and private property (2). In recent years, there has been carry-over recycled water in some winter storages at the end of the recycled water irrigation season. Combined with wet winters, this has resulted in the storages reaching capacity before the start of the following irrigation season. This has prompted detailed investigation into the factors that influence recycled water use.

Recycled water use is multi-faceted and under real-life operations, it is not only dependant on rainfall and evapotranspiration. Winter storage aquatic weeds, algal blooms, customer skills, tariffs, withholding periods, livestock, and asset reliability all have a role to play in optimising recycled water use at Wannon Water. A selection of these factors are discussed in this paper, with solutions specific to the South West Victoria context.

Following discussion of a series of case studies, an alternative future for recycled water use in this region is proposed.

2.0 DISCUSSION

2.1 Rain, rain, go away

The South West Victoria region experiences consistent rainfall year round, with Spring, Summer and Autumn receiving similar rainfall totals (The Bureau, 2023 (a)). Spring and Autumn temperatures are mild and Summer experiences high variability. This influences the rate of evapotranspiration from plants, and ultimately, the demand for recycled water in open spaces and agriculture. Irrigation demand across Wannon Water's area of

operations ranges from approximately 2.5 to 4ML/ha in the East and 3.5 to 5.5ML/ha in the West (EPA Victoria, 2022).

Irrigation season 2022/23 has been challenged by high Spring rainfall. Record breaking rainfall was recorded for Hamilton in October and November 2022 and in Cobden and Mortlake for October 2022 (The Bureau, 2023 (b)). This significantly delayed the start to irrigation across the region.

In response to climate variability and a shortened irrigation season, contingency flood irrigation has been used at four sites to increase overall recycled water use. Mobile diesel pumps have been set up on the banks of the winter storages, with lay flat hose on the delivery side. Recycled water is pumped onto paddocks in short bursts (e.g. 6 hours). Farm tenants are able to cut fodder from the irrigated paddocks, though it should be noted that this has sometimes interfered with maximising irrigation output.

The use of contingency flood irrigation been an effective strategy at Terang Reuse Farm with up to 50ML available to be irrigated in a mean rainfall year. However, for Operations staff, this is labour intensive as it requires manually moving hoses and frequent supervision. A permanent headworks has now been designed to reduce the manual input required from Operations staff. This will support flood irrigation at this site for future instances of climate variability.

2.2 Aquatic plants in winter storages

In South West Victoria, recycled water is normally irrigated between November and March and stored from April to October each year. In recent years, two sites have been impacted by aquatic plants growing in the winter storage. Through wind and wave action, plant material is dislodged and moves around the storage, at times forming a thick blanket near the recycled water offtake / pump station. Plant matter is sucked into the pump station, causing blockages of pumps and irrigation sprinklers. Filters are in place immediately downstream of the pumps, but these have also been fouled and damaged by the plant material. Multiple instances of these blockages have had a significant impact on the ability to irrigate recycled water, and have contributed to emergency winter discharges.

The first step in the ongoing management of the aquatic plants was to have them identified; two native species Red watermilfoil and Ruppia megacarpa were identified (**Figure 1**). Through understanding the growth cycle of the plants, targeted management can be designed. Wannon Water is in the early stages of this preventative strategy.

Secondly, a weed curtain was installed in the winter storage to create a clear zone around the pump station suction line (**Figure 2**). The curtain is full depth and permeable, to allow water flow towards the pump and exclude plant material. The curtain is anchored with a one tonne concrete block in the middle to resist the suction of the pump station, with boat winches on either end to adjust the curtain as the water level in the storage changes.

The need to prevent weed growth inside the weed curtain was also considered. An appropriate aquatic herbicide was selected with expert advice and dosed through liquid injection in late October / November, to coincide with the start of the irrigation season and the peak growth period of the plants. This was highly effective in Spring 2022 with very little growth occurring in the Summer following. While effective in the smaller area inside the curtain, this strategy was considered cost prohibitive in the broader winter storage.

Figure 1: Aquatic plants

Figure 2: Weed curtain

In times of high wind, wind and wave action have blown plant material over the curtain and into the pump zone. Specialised aquatic weed rakes were then used to clear the water inside the curtain. From a safe footing on the banks of the storage, Operations staff throw the rake into the water (with a chain attached), then drag the rake towards the bank. The weed matter is then manually removed. Due to the high potential for contact with recycled water, this strategy is only used as a last resort.

In the broader area of the winter storage, aquatic plants continue to grow, which is monitored on Operator Log Sheets. When surface coverage compromises pump operation, an alert is triggered to initiate manual harvesting of plant material. A contractor with a specialist amphibious craft drives down the banks of the winter storage and onto the water, then traverses the storage collecting floating and submerged plant material. Similar to a terrestrial backhoe, the craft collects a load then drives up the banks of the storage onto a stockpile (**Figure 3**). Over a 290ML storage, this is normally completed within two days and reduces pressure / blockages on the weed curtain.

Figure 3: Amphibious weed harvester

2.3 Look closely, but keep your distance

Terang Reuse Farm uses recycled water through two centre pivots and a large pop up sprinkler system, with 750 individual Hunter i25 sprinklers to irrigate perennial pasture. Over the past 20 years, the sprinklers have become prone to damage.

Sprinkler heads have become blocked from pasture grass growing into them during the non-irrigation season. Herbicide was the chosen control for this, however there has been difficulty with farm tenants taking carriage of this preventative maintenance task due to the size of the system, and difficulty locating the sprinklers in the paddock. Also, livestock trample the sprinkler heads in wet winter ground. Concrete protection plates were installed around each sprinkler, which reduced trampling damage, but increased the grass growth issues.

To address this, the sprinkler system was upgraded in Summer 22/23 by placing all sprinkler heads on a post. This was a considerable upgrade to eliminate grass tangling and livestock trampling issues.

The network of sprinklers was displayed in the GIS system, however site mark-out of each pipeline was considered inaccurate and impractical for the project. Therefore, post installation carried some risk of impacting underground recycled water pipelines.

Throughout the upgrade, the system was wet tested on multiple occasions to check for pinching of pipelines and to map damaged sprinkler heads for replacement (individually dismantling 750 sprinklers was considered inefficient). This could be done safely from a closed vehicle for around 50% of the sprinkler area. However, Operators could not get a good line of sight for paddocks in the rear of the property. An innovative solution was to use a drone, allowing a close view for system checks, while staying a safe distance away for Operator health protection. Through this work, multiple sprinklers were identified as having an erratic spray pattern, missing their support post, or missing altogether (**Figure 4**). Using this new monitoring technology, maintenance tasks could be resolved while protecting the health of staff.

Figure 4: Drone monitoring and sprinkler missing a post (arrow)

2.4 Sub-optimal recycled water use

Following repeated instances of having carry-over recycled water in winter storages, investigation has identified that some customers are significantly under-irrigating compared to modelled pasture demand (i.e. 60% of modelled demand). Support has been provided through recycled water training and ongoing reporting of winter storage levels.

To extend this support, a simple Microsoft Excel Irrigation Report is now sent to all customers weekly throughout the irrigation season. Weekly irrigation demand (in mm) is calculated using the past week's rainfall and evapotranspiration. Rather than the more complex calculation of soil water deficit, this simple report has supported some customers to have more confidence in their site's irrigation potential. It has increased recycled water usage to more closely match the site's modelled irrigation demand.

A further challenge to optimal recycled water use in agriculture was identified to be livestock type. Class C recycled water requires a five day withholding period between irrigation and grazing for dairy livestock, compared to four hours for non-lactating cattle (EPA Victoria, 2021). Pivot irrigation can take up to three days to complete, followed by the withholding time, then grazing, before irrigating again. To reduce the time taken for this cycle (and increase irrigation output), the farmer was able to separate their herd into lactating and non-lactating livestock, with only non-lactating livestock grazing on paddocks irrigated with recycled water. This reduced the withholding time to four hours, which improved overall efficiency at the site.

As a further support for recycled water sites running dairy livestock, it was identified that some sites known as Class C supply consistently produced Class B standard recycled water in the earlier months of the irrigation season (e.g. October to December/January). Class B recycled water has a four hour withholding time for both lactating and non-lactating livestock (EPA Victoria, 2021). Therefore, these sites were reclassified as Class B/C (i.e. hybrid); Class B withholding times now apply early in the season to allow for a reduced withholding time and Class C thereafter when water quality declines. This adaptive approach is preferred by site users for efficiency and optimal recycled water use.

3.0 A NEW FUTURE

Solutions for recycled water management and use will continue to be focussed on customer training, maintenance, monitoring and asset upgrades. A multi-faceted approach will continue to be required to achieve recycled water targets and to avoid unplanned discharges to the environment for existing customers and schemes.

But what else might the future hold? Recycled water use in the region is dominated by irrigation of open space and agriculture. While this provides significant support for community wellbeing and economic development, strategically, these end uses are unreliable. Recycled water demand is confined to the Summer months and subject to variability in rainfall and evapotranspiration. Market drivers such as the price of hay also provide a ceiling to cost recovery/surplus within the agricultural sector.

Until recycled water has regulatory approval to supplement potable water supplies, in this region, the answer may inevitably lie with industry, which can often provide a year-round demand for recycled water. Industrial recycled water use may also address Circular Economy drivers, through the ability to polish recycled water for ongoing cyclical use.

Wannon Water has committed to running an Expression of Interest within each Pricing

Submission cycle, to scan the landscape for emerging markets. So far, hydrogen power generation is indicated as a future potential, which may reflect the market trend identified by the Jacobs white paper in 2019 (Swisher et al., 2019). Actual uptake will depend heavily on proximity to complimentary infrastructure such as energy nodes, so this will not be the solution for all sites across the region.

Niche horticulture products such as blueberries and garlic have also emerged with a strong interest in recycled water. So is there a future in livestock-free smart farms? Instead of the current model, where recycled water use is dependent on the individual enterprise of grazing farm tenants, is there a model where high value crops are irrigated with minimal disruption? Or is there a middle ground where farmers who have a second farm (or more) in their enterprise, can use recycled water sites for cropping and fodder production only, to support livestock elsewhere? New monitoring and management technologies on pivot irrigation systems show great potential for remote management and efficiency.

4.0 CONCLUSION

Recycled water use in South West Victoria presents some unique challenges and solutions. An investigative approach is required to fully understand the many factors that accumulate to influence system performance overall. While we continue to address seasonal challenges, further work is needed to secure markets and customers with more stable year-round demand.

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To our recycled water customers – thank you for your ongoing support of sustainability in the South West.

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