

WERRIBEE IRRIGATION DISTRICT RECYCLING SCHEME: THE FIRST YEARS

ABSTRACT

Recycled water is seen as an increasingly important piece of the total picture in meeting societal needs for water into the future. Water from recycled sources is used to meet a range of needs across the world, from drinking water through to domestic uses and to meet irrigation needs.

The Victorian government announced in 2003 that water from the Western Treatment Plant at Werribee would be treated to "Class A" standards and supplied to the Werribee South Irrigation District to supplement the river water supply and provide further relief during droughts for the irrigation district.

This paper will explore the first years of operation of the scheme from the retailers perspective and share some of the outcomes, challenges, successes and learnings over this time.

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WERRIBEE IRRIGATION DISTRICT

The vegetable growing Werribee Irrigation District (WID) lies on Melbourne's rapidly-developing western urban fringe. Werribee South's main crops of broccoli, cauliflower, cabbage and lettuce are a key source of supply for Melbourne and beyond. The WID abuts both the Werribee River and Port Phillip Bay, and until recently, irrigators have been able to consistently rely on some 10,000 megalitres (ML) of water rights from SRW's water distribution system (predominantly concrete-lined channels) and 5,000 ML of groundwater licences in the underlying shallow Deutgam Groundwater Management Area.

Water for the channel system (referred to as 'river water') is sourced from the Werribee and Lerderderg Rivers via the Melton, Merrimu and Pykes Creek Reservoirs. The groundwater is replenished from rainfall, irrigation and leakage from the ageing concrete-lined channels. As the WID abuts Port Phillip Bay, the key driver of groundwater management is to avoid drawing down the aquifer to the point where seawater intrusion might occur.

SEASONAL CONDITIONS – 2003

The three reservoirs that supply the WID have been designed to operate on a multi-year basis where, for example, water supplied to irrigators early in the season (which begins on 1 July each year) has been harvested months or years earlier.

Whilst dry conditions emerged in the Werribee basin in the late 1990s, in the autumn of 2003 the drought worsened significantly as inflows dropped below the 97th reliability percentile. By the time the 2003/4 irrigation season opened on 1 July 2003, the reservoirs had dropped so low that only a 5% allocation was possible. This was an unprecedented announcement in a system accustomed to allocations reaching 100% early in the season.

With profoundly low inflows, the allocation rose slowly – by November it had reached a mere 30%. With crop plantings close to normal, many irrigators turned to groundwater – but the increased demand and negligible recharge saw the aquifer plunge, and in November SRW banned further groundwater pumping for the remainder of the season in order to protect the aquifer from seawater intrusion.

TOWARDS A RECYCLED WATER SCHEME

For irrigators, the groundwater ban was a lightning rod for their underlying anxiety about the water shortage and the unprecedented situation they found themselves in. By this time SRW was canvassing potential drought responses with government, this included a connection to Melbourne's urban supply. The groundwater ban led to the irrigators approaching government directly for support. The six Werribee members of SRW's Werribee Bacchus Marsh Customer Consultative Committee (WBMCCC) were in the forefront of this approach.

Two factors influenced the search for solutions. Firstly, water trading was not the answer, as the WID is not connected to other irrigation areas in Victoria. Secondly, whilst the WID had for some years been seen as a likely destination for recycled water from Melbourne's western wastewater treatment plant (just to the west), it was clear that the infrastructure couldn't be built in time to help irrigators through the current season.

Consequently, the only emergency supply possible within a month or two was a connection to Melbourne's urban supply. This, however, posed two problems. Firstly, at normal prices the water was considered unaffordable by irrigators (well above \$1,000/ML), and secondly, with Melbourne itself facing water restrictions how could the water be sourced?

Through more than a month of concentrated discussions and negotiations involving SRW, irrigators, the then Minister for Water (Hon John Thwaites), Department of Sustainability & Environment, Melbourne Water, and City West Water, answers to these gradually emerged – and the architecture of the WID Recycled Water Scheme was developed.

Two principles were important in shaping the Scheme. Firstly, it needed to provide both relief in the current season and for the longer term. Secondly, if pricing was to be less than cost recovery, government would seek environmental benefits in return.

By December 2003, the architecture of the WID Recycled Water Scheme had been broadly agreed within government:

- Class A recycled water would be supplied to participating irrigators (noting it would be the following irrigation season before this was on stream);
- prior to the recycled water coming on stream, the WID would be connected to the Melbourne urban system, with water coming from SRW's repayment of earlier 'drought advances' for the Macalister Irrigation District from the Thomson Reservoir; and
- participating irrigators (i.e. for both recycled water and potable water) would receive concessional pricing (set at the price of irrigation water) on both for a limited period.

Recognising that the salinity of the recycled water would be around 1,800EC units, which limits crop production and quality, specialist advice recommended a target of 1,000EC units by 2009.

Consequently, the Scheme would have an interim phase until 2009; to continue beyond that point irrigators would have to elect to participate for the long term.

This set the scene for two actions. Firstly, testing irrigator interest in participation, and secondly, establishing the connection to the Melbourne urban system. The latter had to start immediately, for there was only a very short window to establish the connection to an about to be commissioned new water main – so the \$300k plus link was initiated in anticipation of sufficient irrigator support.

For the Scheme itself to proceed, government was keen to see the majority of irrigators participating. There were, however, very mixed views within the irrigator community – with debate about the safety and market impacts of using recycled water, the way the Scheme had been developed, and the nature of the agreement. SRW's communication with irrigators since the start of the season had been quite extensive, but it intensified further through late December as the Scheme was explained and irrigators were invited to elect in writing to

participate in the Scheme. By early January irrigator participation was sufficient, and on 8 January 2004 Minister Thwaites gave the go ahead.

IMPLEMENTATION

The potable water supply came on line later in January, and proved an important (but limited) supplement to the 40% river water allocation for the 2003/4 season. For participating irrigators, this water came at the same price as irrigation water (around \$126/ML); a small number of other irrigators also used the potable water, but at the commercial rate of some \$1,300/ML.

There were two other aspects of the implementation task. Firstly, Melbourne Water faced the challenge of designing, building and achieving regulatory approvals for the 55ML/day Class A recycled water plant and pipeline connection to the WID – a project of some \$20M that was completed in about a year.

Secondly, the broad architecture of the Scheme had to be translated into detailed arrangements – and captured in Customer Supply Agreements (between SRW and each participating irrigator), Bulk Supply Agreement (between Melbourne Water and SRW), and Regional Environment Improvement Plan (involving the EPA, Melbourne Water, SRW and irrigators).

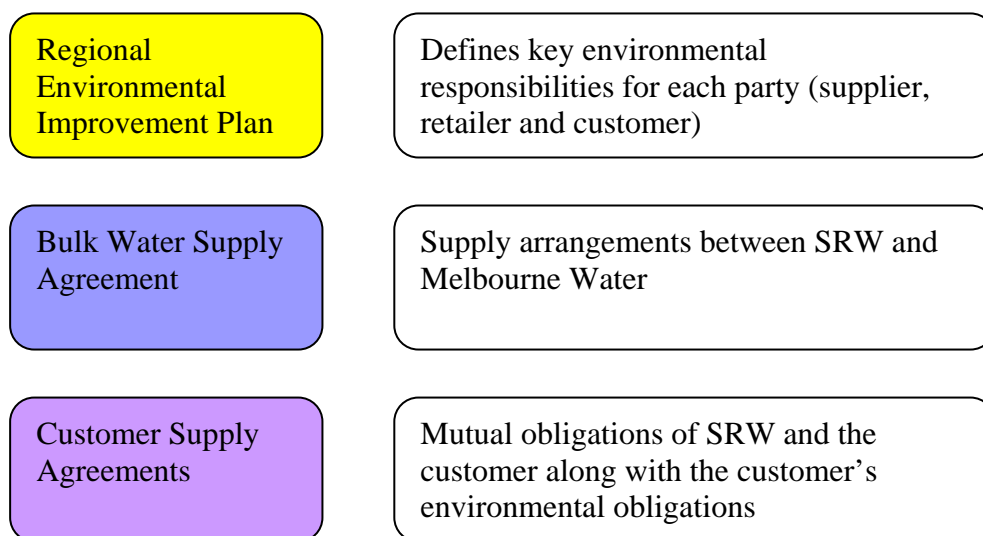
Much of this detail was negotiated through an independently-chaired Stakeholder Reference Group comprising agencies and irrigator representatives. This process was long and tortuous, with very mixed views within the irrigator community about recycled water, the architecture of the Scheme, government and agency intentions, and the merit of land-use planning controls that prevented urban development in the WID.

This culminated with SRW supporting an independent legal review of these documents, and particularly the generic Customer Supply Agreement, on behalf of the irrigators and involving their representatives. In November 2004 this review opined that the generic Customer Supply Agreement was reasonable, and participating irrigators began the formal sign-up process involving both this Agreement and completing their individual Site Management Plan under the Regional Environment Improvement Plan.

This enabled the first deliveries of Class A recycled water in January 2005. The supply of potable water ended in December 2004, and the temporary connection has since been removed.

ARCHITECTURE OF SCHEME

There are three main documents that underpin the scheme's operation:



Regional Environmental Improvement Plan

The Regional Environment Improvement Plan (EIP) for the WID Recycled Water Scheme aims to:

- Identify and explain the management of the environmental and health risks associated with operation of the recycled water scheme; and
- Address the concerns of growers and the wider community where these are met by the implementation of management controls.

The EIP sets out the roles and responsibilities of all parties, but in particular the responsibilities of Southern Rural Water, Melbourne Water and Customers who are signed up to the scheme.

Key requirements of Melbourne Water are to meet Class A health treatment standards, monitoring quality parameters and working toward the reduction of salinity of the water to 1000EC by 1 July 2009.

Southern Rural Water's key responsibilities included managing the salinity of delivered water through compliance with the shandy rules (a set of rules which defines the shandy mix of river water and recycled water based on river water salinity and water allocation), monitoring soil, groundwater and other environmental impacts and managing customer compliance to their customer site management plan.

Customer responsibilities include marking of irrigation pipes in lilac, management of spray drift and attendance at information sessions on recycled water.

Bulk Recycled Water Agreement

The Bulk recycled water agreement sets out the terms and conditions for supply of recycled water from Melbourne Water to Southern Rural Water. Key parameters of this 5+5+5 year contract include the minimum and maximum daily volumes, pricing schedules and a reliability target of 95% per month, excluding natural and unavoidable (force majeure) events.

Pricing was on the basis of a starting price as outlined above escalating by CPI up until 2009 when the interim scheme was planned to finish, when a new price is to be negotiated, mindful of fixed and variable costs and principles outlined in the Water Industry Regulatory Order and as enunciated by the Essential Services Commission. At that time it was expected that salinity will have been reduced to 1000EC – thus meeting irrigation user’s quality requirements.

Customer Supply Agreement

Customer Supply Agreements are established between Southern Rural Water and each customer electing to join the Recycled Water Scheme. These agreements specify the customer’s rights and obligations under the scheme. Most customers sign up for an equivalent volume as their water right – of which 25% is provided on a “take or pay” basis (25% is the likely volume deliverable in a ‘normal’ season given the Scheme’s rules for shandyng the recycled water with river water to manage the former’s salinity). Customers order recycled water in the same manner as for river water, through our “Irrigation Planning Module”, either via phone or web site.

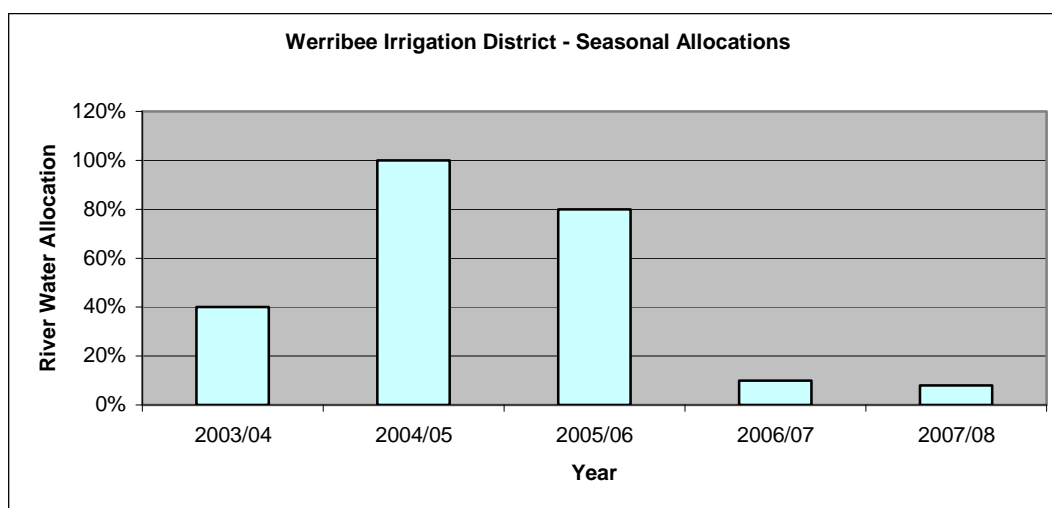
The supply agreement specifies the pricing up to 1 July 2009 during which the price of recycled water supply is tied to the river water price. Post 1 July 2009, a consultative process was outlined whereby the pricing would be reviewed in the context of the expected “salt reduced water” supplied and the expectation that customers would relinquish entitlements to river water sales, which could then be used for environmental flow purposes in the Werribee system.

Participating customers have to meet the requirements of their Customer Site Management Plan, which outlines their key environmental obligations including the marking of recycled water irrigation pipes, management of spray drift, attending information sessions, soil testing and periodic audits.

THE FIRST YEARS

Seasonal Conditions

The seasonal conditions in Werribee South have been dire over the past four years, save for one significant rainfall event in February 2005 which had a significant, albeit transient impact on river water supply allocations. After the record low year in 2003/4, the February 2005 event allowed the 2004/05 season allocation to finish at 100% and provided a starting allocation of 50% for the following season. Minor inflows allowed a final allocation of 80% in 2005/06. The following seasons have set new record lows in terms of reservoir inflows, with river water allocations starting at 5% (2006/07) and 0% (2007/08) and next exceeding 10% in either season.

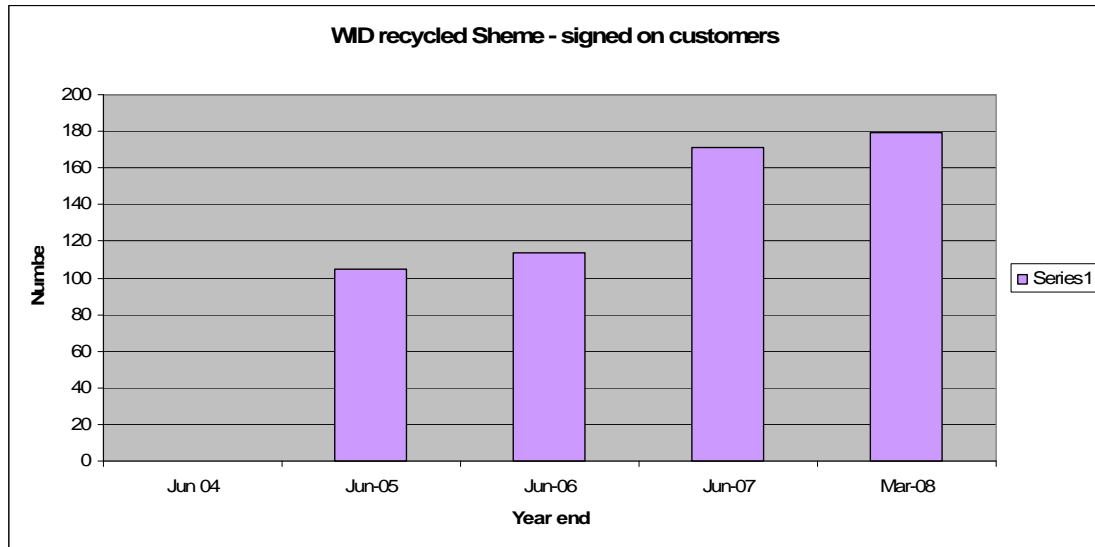


The poor inflows and river water allocations also impacted on the groundwater availability for the irrigation district. A groundwater ban was established on 10 November 2003 and eased to 60% availability of licensed volume on 30 June 2004. After returning to normal license conditions on 1 July 2005 after the total usage ban, the aquifer level declined during late 2005 and early 2006 and a 75% restriction was implemented on 1 July 2006. Again, with poor river water allocations and reduced river flows and rainfall, aquifer levels continued to decline and a full groundwater ban (with a few minor exemptions) was implemented on 27 June 2007, which remains in place.

Customer sign on

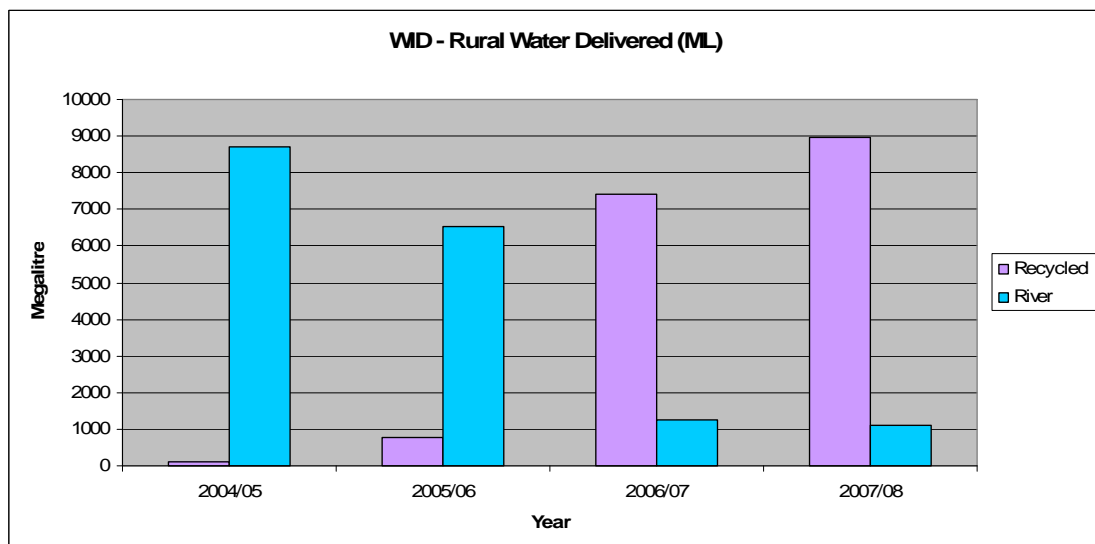
As outlined earlier, Southern Rural Water worked hard with irrigators to establish a critical mass to enable the scheme to proceed. The improved outlook saw only a gradual increase in customers signing on during 2004/05 and 2005/06; however the drought conditions in the

following two years saw a significant increase in the number of customers signed on, albeit reluctantly in some cases, due to the lack of alternative water sources.



Water Delivered

As confidence in the scheme increased and as the drought bit harder more customers signed on. This resulted in a major transformation in water reliability. Rather than the supplementary source of water that the scheme was initially designed to provide – it became the primary source of water for most customers in the district, providing major challenges for both the production and supply to meet our customer requirements



Reduced Environmental Flow into Port Phillip Bay

Over 20,000 megalitres of recycled water has been provided to Werribee Irrigation District customers which otherwise would have been

released into Port Phillip Bay. Based on trends of medians over the last two years, the effective diversion of treated effluent from marine discharge for beneficial recycling equates to nutrient load reductions in the order of 180 tonnes of total nitrogen per annum and 100 tonnes of phosphorus per annum.

CHALLENGES AND RESPONSES

Meeting Customer Demand

With the change in reliance on the recycled water scheme, we have regularly received orders from our customers where demand has exceeded supply capacity by up to 100%. Also, with channel systems which operate optimally at around 150ML per day capacity, we incur significant higher proportional water losses when operating the channel system at low volumes such as this.

To meet this challenge, we have moved to seven day operation of the channel system to optimise water deliveries – six days of recycled water and one day of river water. The Environmental Improvement Plan allows for this where the river water allocation is below 50%. We have also moved to a roster system where we supply half the irrigation district for two days and then move to the other half of the district for the next two days. Each area has three, two day supply periods each fortnight, allowing for one river water delivery day each week, in which Melbourne Water undertakes essential maintenance.

We have worked closely with Melbourne Water who were able to bring forward some planned capacity expansion for the system and increase the supply volume from 55ML per day to an average of 61ML per day for the past 18 months.

System Reliability

There have been some significant challenges with reliability of supply over the first few years. Following the major rainfall event in February 2005, the plant was not able to produce Class A recycled water for a period of six weeks due to the compromised pathogen removal capability of the lagoon systems due to lower detention times as a result of the storm inflows. At that time there was ample river water available to meet customer needs.

Wind-driven turbidity events are also experienced at WTP from time-to-time. These are generally briefer in duration, but are a cause of frustration given that supply outages in the order several hours to several days can occur.

During most years – and particularly during the January-April period – algae outbreaks bloom to the extent where Class A recycled water production is ceased, the most recent being an event which started in late December 2007 and continued, intermittently to affect production over the first week of January 2008.

In response to the algae blooms, MWC has undertaken significant improvements to its processes to reduce the likelihood of outbreaks and better manage outbreaks that do occur. This includes:

- Implementation of an improved sampling/monitoring program aimed at early detection and at providing more comprehensive data for SRW
- Installation of improved on-line monitoring equipment to improve sewage treatment process control and reduce levels of ammonia (which contributes to favourable growth conditions for algae) in treated effluent
- Installation and trialling of on-line chlorophyll analysers which may WTP operators with real-time monitoring capability for algae
- An investigation – currently underway – into the effectiveness of chlorination at reducing algae levels in recycled water (cell presence and toxicity levels)
- Improving (via monitoring) the understanding of the relationship between cell counts and toxicity with a view to validating the correlation for local conditions at WTP
- Trialling of local field test-kits for blue-green algae toxicity – which could provide rapid-response data on toxicity levels and reduce the need for time-consuming field sampling and laboratory monitoring
- Installation and trialling of ‘ultrasonic algae destroyers’ in the WTP treatment lagoons.

At the time of writing, Southern Rural Water is working with Melbourne Water and City West Water on a reliability study with an objective of improving reliability and establishing appropriate contingency plans for the 2008/09 summer period, along with a longer term strategy for plant and process reliability.

Crop Issues

While the overall performance and reliability of the scheme has met our customer’s requirements, we have had two occasions where customers have brought to our attention crop problems which they suspect water supply was the source of the issue.

The first was relating primarily to lettuce crops planted in early to mid September 2005 which affected around 15 farmers over 50 hectares.

Young lettuce showed stunted and uneven growth and significant damage to the root stock. An exhaustive investigation was undertaken by the Department of Primary Industries was unable to establish a cause. However, out of this improved monitoring has been established.

The most recent incident occurred early in 2008 where around 10 growers experienced similar problems with lettuce across around 15 hectares. The damage was less severe and there was an improved recovery rate and harvesting. During this occasion, both high salinity (>2,500 EC) river water and recycled water were supplied to the growers of the affected crops and it also coincided with some extreme temperature days. At the time of writing an independent investigation was underway.

Impact of drought and recycled water on the soil

As a requirement of participation in the recycled water scheme, each customer has a baseline soil test undertaken and soil samples taken annually to assess the impact of the recycled water scheme on the soils in the district. This requirement has provided a very useful basis for tracking globally trends in soil health and assessing the impact of on farm management.

From the soil results from 2007, we were able to discern that around two-thirds of the participants in the scheme have had an increase in the overall salinity of the soil, whilst the other third have stayed at the same level or the salinity has actually declined. Interestingly, because of the drought, soil salinity in areas irrigated only with river water also increased, no doubt influenced by the drought and the high salinity river water, which has been regularly above 2,500EC over the past two years.

Our assessment is that on farm practices are clearly a key influencer of soil salinity and as a result of this have launched the Land and On-Farm Management Committee – a body convened by SRW and made up agronomic experts and customers with an objective of identifying and communicating best practices in salinity management. Arising from an initiative from this committee, Department of Primary Industries have been able to secure some “smart water” funding for the establishment of six demonstration sites to trial, assess and communicate a range of practices showing effective salinity management practices.

Producing Quality Crops with High Salinity Recycled Water

Over the life of the WID the market gardeners have had to respond to a number of challenges, none more so than producing good quality

crops using high salinity water in an environment where their customers and the ultimate consumer expects more and more.

Farmers have had to employ a range of practices, customised to their own sites and crops, to meet this challenge. While each irrigator has their own approach, several on farm practices have emerged through trial and error to maximise yield and maintain crop quality, particularly for lettuce. Some of these include...

- Increase in water application – particularly during the hotter weather. This can be up to an additional 30% of water applied to crops,
- With the higher salinity of the water there is challenge in having the nutrients taken up by the plants. This has led to considerable experimentation with the use of fertiliser. In general, more fertiliser is being used forcing up farm costs,
- A shift toward more sulphate fertiliser instead of nitrate fertiliser to increase trace elements available in the soil – particularly potassium and magnesium,
- An increased focus on gypsum application.

Farmers have also observed that rainfall events where greater than around 8mm of rain falls can have a dramatic positive effect on the quality of crops. Anecdotal observation and some case studies show that the Werribee South soils are extremely responsive to rainfall and management practices. This allows the effective leaching of salts from the soil through a crop cycle given the right conditions and on farm practices.

Decision not to proceed with the Salt Reduction Plant

The original architecture of the scheme was predicated on the delivery of salt reduced water being delivered on or about 1 July 2009, with the participating growers giving up their sales entitlements (Low Reliability Water Shares from 1 July 2008, following the unbundling of water entitlements) and the pricing of recycled water renegotiated after this date.

During 2007, Melbourne Water completed work on a range of studies which concluded that the capital cost of building a salt reduction plant to meet future water needs from the Western Treatment Plant was in the order of \$360 million, leading to an annual cost per megalitre of \$2700 to \$3000. This is well above the commercial capacity of the irrigators and it was deemed too great a subsidy to expect the balance of Melbourne Water's customers to bear.

To address the longer term implications of this decision, Southern Rural Water has initiated the “Western Irrigation Futures” project. The objective of this project is to develop a long term strategic investment plan for the Werribee and Bacchus Marsh irrigation districts, to address key issues which include:

- Securing fit-for-purpose and reliable water supply
- Establishing water requirements for future agricultural production
- Identifying options for water supply infrastructure
- Establishing environmental requirements for sustainable production.

The process for this project is modelled on the highly successful “MID2030” project completed in the Macalister Irrigation District during 2007. Initial stakeholder consultation is progressing and work has commenced on phase 1 – which is building the Atlas of the various attributes of the irrigation districts and catchment.

TOWARDS THE FUTURE

Short Term

As we approach to 2008/09 season the prospects remain poor for a good season of river water allocations. With several dry months, the catchment is exceptionally dry and SRW’s supply dams will effectively be emptied by 30 June 2008. Allocations for next year will be fully dependent on rainfall and subsequent inflows. The recycled water scheme again, will be critical in maintaining the continued production from the Werribee Irrigation District.

We will be working closely with Melbourne Water to optimise quality and reliability of supply to meet grower’s needs and our expectation is that we will move to seven day supply early in the season. Key to this will be the implementation of the recommendations of the reliability study.

We look forward to further initiatives coming from the land and on farm management committee and the potential this has to influence on farm practices in a way that supports the sustainability and productivity of the soil. An encouraging case study, where work was undertaken collaboratively with a farmer using recycled water, showed a stunning turnaround in crop quality and soil salinity over one cropping cycle.

As the interim period of the scheme will come to a close on 1 July 2009, we will be working with customers, Melbourne Water, the EPA, DHS and government over the next 9 months to examine the potential to extend the scheme beyond 1 July 2009. A key input into this will be a scheduled audit from of the Regional Environmental Improvement Plan

to be undertaken on environmental impacts of the scheme since inception.

Longer term

We see the key initiative is the Western Irrigation Futures project, outlined earlier, which will hopefully map a clear path forward for the Werribee Irrigation District and the recycled water scheme.

REFLECTIONS ON THE FIRST YEARS

While clearly one of the objectives of the recycled water scheme was to provide relief from drought, few could have envisaged how severe this would be in the Werribee Basin from 2006 to 2008, or just how critical the recycled water scheme would become over those years.

While cautiously optimistic about grower acceptance and take up of the scheme, again it would have been hard to imagine that over 90% of the irrigated market garden area would have been signed up to the scheme.

A key change since the scheme inception was that the 1,000EC salinity target could not be met at reasonable cost by 1 July 2009. With the drought, changes to global costs for relevant materials and a deeper understanding of requirements for such a plant it is apparent that this is not achievable. We are now looking at options to sustain and continue the scheme and retain the benefits it provides to the environment customers and community.

The overwhelming reflection is that of appreciation for those who had the foresight, drive and persistence to establish the scheme and for those who have contributed to its operation over the last four years. For, while less than perfect, our customers and community are far better off with the scheme than without.