An Investigation into Agricultural Use of Reclaimed Water in the Willunga Basin, South Australia, 2001

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Abstract

In the Willunga Basin the lack of reliable, good quality water has restricted the expansion and development of primary industry. A privately funded pipeline from Christies Beach Wastewater Treatment Plant to the Willunga Basin was constructed to supply reclaimed water for agricultural irrigation. Using reclaimed water for irrigation presents unique management issues. The local council is currently negotiating to have the outflow of an upgraded wastewater treatment plant added to the overall reclaimed water scheme. However, the Christies Beach reclaimed water is not being fully utilised as yet, therefore, presenting a barrier to the inclusion of this additional source of water.

Keywords: Christies Beach, irrigation, reclaimed water, wastewater, water resources, Willunga Basin

Objectives

This project investigates the use of reclaimed metropolitan wastewater in the Willunga Basin. The research highlights the unique management issues that are presented when using reclaimed water for agricultural irrigation. Barriers to the use of reclaimed water in the Willunga Basin will also be explored. The Willunga Basin’s water reuse will be used as a case study for other regions considering harvesting this water resource.

Background

The idea of using treated municipal and industrial wastewater in conjunction with increasing pressures on existing water resources has led to wastewater reclamation being included as an important part of the cycle of water resources management (Asano & Levine 1998, p. 1). The inclusion of reclaimed water in the South Australian Government’s State Water Plan 2000 demonstrates the increasing significance of wastewater as a resource (Department of Water Resources 2000 a,b,c). Water reclamation may have a second benefit as it could possibly lead to a reduction in water with high nutrient loads being released into Gulf of St Vincent from Wastewater Treatment Plants (Department of Water Resources 2000a, p. 47).

There are four broad categories that have been identified as potential uses for large quantities of reclaimed water (Metcalf & Eddy 1991, pp. 1141-2; Gutteridge Haskins & Davey 1983, pp. 5). These are:
1. Irrigation reuse for agriculture and landscapes
2. Industrial reuse for cooling and process requirements
3. Water resources conservation such as artificial groundwater recharge
4. Municipal reuse such as recreational lakes and toilet flushing

Due to time limitations and in the interests of manageability, the focus of this study will be on agricultural use of reclaimed water in the Willunga Basin, south of Adelaide.

Methods

An extensive review of literature on the use of reclaimed water, methods of treatment, health guidelines and the South Australian government’s plan for water resources were undertaken. This information was used to provide background details and established the context for interviews.

An internet search of the City of Onkaparinga website revealed that a company called Willunga Basin Water Company has an interest in use of reclaimed water in the study area. It was my intention to conduct semi-structured interviews (Dunn 2000, p. 61) with representatives and clients of this company and other parties with the purpose of uncovering the issues that have surrounded the application of reclaimed water in the Willunga Basin.

A snowball recruitment technique (Cameron 2000, p. 91) was used to contact other parties with an interest in reclaimed water. In all five interviews were conducted, these were with:

- City of Onkaparinga: Project Officer of the Economic Development Department, Phil Bickley;
- Hydro Plan Irrigation Consultants: Director, John Gransbury – this company was responsible for the construction of the reclaimed water pipeline from Christies Beach to the Willunga Basin;
- Willunga Basin Water Company: Operations Manager, Glen Templeman – this company oversees the operation and administration of the reclaimed water scheme;
- Property Owner and Grower: Don Oliver – a fifth generation vigneron who has recently been connected to the scheme;
- Vineyard Manager: Lincoln Rayner – manager of a property that planted young vines when reclaimed water first came to the Willunga Basin.

Semi-structured interviews were conducted, as the individuals interviewed had varying associations to the reclaimed water scheme. Semi-structured interviewing allowed the interviews to be tailored to each set of circumstances (Dunn 2000, p. 61).

The Water Resources of the Willunga Basin

Existing Water Resources

The Adelaide and Mount Lofty Water Resources Management Region is shown in Figure 1. The Willunga Basin is contained within the McLaren Vale Prescribed Wells...
Area (PWA). In this region groundwater is a prescribed water resource (Department of Water Resources 2000b, p. 64) which means that the use of groundwater must be regulated by a licensing system (Department of Water Resources 2000b, p. 156).

Figure 1: Adelaide and Mount Lofty Ranges Water Resources Management Region

Source: Department of Water Resources (2000b, p. 36).

Table 1 depicts the water sources within the McLaren Vale PWA, the quantity available, its limitations and how much of each source is being utilised. The current licensing regime has overcommitted the groundwater resource beyond ‘...the known, sustainable, long-term yield of the basin’ (Department of Water Resources 2000b, p. 66). Consequently, water allocations have ceased being issued and some irrigators have begun supplementing their water supply with mains water (Department of Water Resources 2000b, p. 66).

The surface resource appears to be under-utilised. However its use has been limited by storage problems created by the lack of sizeable watercourse flows (Department of Water Resources 2000b, p. 64). The reclaimed wastewater shown in the table refers to the irrigation of the Willunga Golf Course with reclaimed water provided by the Willunga Wastewater Treatment Plant (WWTP).

Table 1: McLaren Vale Prescribed Wells Area Water Quantity, Limits and Use

<table>
<thead>
<tr>
<th>Water Resource</th>
<th>Use limit (GL/y)</th>
<th>Licensed Use (GL/y)</th>
<th>Other Use (GL/y)</th>
<th>Total Use (GL/y)</th>
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Surface Resource 6.2 - 1.6 1.6
Groundwater 6.0 6.5 0.0 6.5
Stormwater Runoff 0.6 - <0.1 <0.1
Reclaimed Wastewater 0.3 - 0.2 0.2

Prescribed Area Estimate 13.1 6.5 1.8 8.3

Source: Adapted from Department of Water Resources 2000b, p. 64

The figures shown in Table 1 fail to communicate the very desperate need for water in the Willunga Basin. John Gransbury summed up the situation when he said “the majority of land was held by ageing cereal and grain growers who couldn’t sell the land, it was worthless because there was no water available” (pers.comm, 12 April 2001). The expansion of primary industries had been brought to a stand still in the Basin because of the very limited water resources. Wineries were unable to keep up with the growing markets for their products. Mr Dean of McLaren Vale Winemakers said “We’re becoming recognised world-wide for our reds in particular… The dilemma we’ve faced is: how do you meet this demand” (Huppatz 1999).

It was this urgent need for water that brought together a group of Willunga Basin winegrape growers to fund a pipeline from Christies Beach WWTP (John Gransbury, pers.comm., 12 April 2001).

Reclaimed Water as a Resource

The Christies Beach WWTP services over 150,000 people and treats 27 million litres of household and industrial effluent each day (United Water 1999, URL). The Plant has an annual discharge of 9000ML (John Gransbury, pers.comm., 12 April 2001). The effluent receives secondary treatment and is also disinfected with chlorine (United Water 1999, URL; Major Projects Group undated, URL). The reclaimed water produced complies with a Class B rating (Major Projects Group undated, URL). This means that the biochemical oxygen demand $^2$ (BOD) must be less than 10mg/L, suspended solids must be less than 15mg/L and coliforms must be less than 10 organisms/100mL (Environment Protection Authority 1996, p. 20). Reclaimed water treated to this level can be used in agriculture if worker contact is minimised. It may come into contact with some crops but must not be used for spray irrigation (Environment Protection Authority 1996, p. 20).

After treatment some of the final effluent is discharged into Gulf St Vincent. The rest is stored in a 6-megalitre lagoon to be used for irrigation in the Willunga Basin (United Water 1999, URL). United Water anticipated that in summer the irrigation demand for reclaimed water will account for 90% of the volume handled by the plant (1999, URL).
The Pipeline

The pipeline from Christies Beach to the Willunga Basin cost the consortium of winegrape growers $7.2 million (Huppatz 1999). Furthermore, the scheme had no financial support from any level of government (John Gransbury, pers.comm., 12 April 2001). The cost of the pipeline was allocated to each member of the consortium in accordance with the quantity of reclaimed water their property was to be supplied (John Gransbury, pers.comm., 12 April 2001). Of the 9000ML available from Christies Beach the consortium only allocated themselves 2100ML, thus building in provision for growers outside the consortium to be connected to the scheme (John Gransbury, pers.comm., 12 April 2001).

As the pipeline extends throughout the Willunga Basin other growers are being given the opportunity to gain access the reclaimed water. Connection is provided at an initial cost of $6000 per megalitre to be supplied and then there is an ongoing charge of 53 cents per kilolitre that is actually used (John Gransbury, pers.comm., 12 April 2001).

The consortium created the Willunga Basin Water Company to administer and operate the facility. The Operations Manager of the water company, Glen Templeman, handles the day to day running of the pipeline and has regular contact with the growers linked to the scheme. He had the following to say of the cost “People only pay a premium for an item which they place a high value on” (pers.comm., 23 May 2001). In the Willunga Basin the demand for water has far outstripped the available supply of traditional water resources. Therefore, it is only natural that the growers in the region have determined that this new water source would have a high value and are prepared to pay the full cost to have reclaimed water supplied to them.

The Willunga Basin Water Company is now in a position to provide 3000ML of reclaimed water to the growers (Glen Templeman, pers.comm., 23 May 2001). This is assumed to be the upper limit of water that can be provided for summer irrigation without winter storage (Glen Templeman, pers.comm., 23 May 2001; John Gransbury, pers.comm., 12 April 2001). Options for winter storage are currently being investigated.

Reclaimed water has been the driving force behind the recent expansion and development of primary industries, especially winegrape vineyards (John Gransbury pers.comm., 12 April 2001).

Management Issues of Reclaimed Water

When reclaimed water is used for agricultural irrigation there are several management issues involved that are unique to this particular source of water. The additional considerations of using reclaimed water could potentially be a deterrent. However, irrigators have willingly adjusted their practices to accommodate the unique nature of this water resource.

The management issues include:
• Health concerns and Safety Measures (National Health & Medical Research Council 1999; Environment Protection Authority 1996; Bitton 1994, pp. 371-3)
• Water quality issues (Metcalf & Eddy 1991, pp. 1145-1153)
• Suitability of crop for irrigation with reclaimed water (Metcalf & Eddy 1991, p. 1145)
• Consistency of water quality and reliability of supply (Metcalf & Eddy 1991, pp. 1174-6)

Each of these issues are described below as well as how the Willunga Basin Water Company and irrigators are addressing these problems.

Health Concerns and Safety Measures

Contaminants of health significance may be biological or chemical (Bitton 1994, p. 371), however when reclaimed water is being used for irrigation biological agents present the greatest health risks (Metcalf & Eddy 1991, p. 1155). A wide range of potentially infectious organisms are contained in reclaimed water (National Health & Medical Research Council 1999, p. 7). Guidelines for the quality of reclaimed water and its suitability for various applications has been established to minimise these risks. The level of treatment and hence the resultant quality of the reclaimed water dictates the acceptable methods of irrigation (Environment Protection Authority 1996, p. 20). For example, the Class B reclaimed water from the Christies Beach WWTP is suitable for drip and subsurface drip irrigation but is not to be used for spray irrigation.

The Willunga Basin Water Company has implemented a number of safety measures to ensure that the health risks of using reclaimed water are minimised (Glen Templeman, pers.comm., 23 May 2001). These measures include:

• Erecting warning signs at every property linked to the reclaimed water scheme;
• Using colour-coded pipes to distinguish the pipes used for reclaimed water;
• Limiting irrigation methods to drip or subsurface drip irrigation. Spray irrigation is not permitted;
• The reclaimed water is not to be used for mixing of sprays. For example, pesticides;
• Growers must observe personal hygiene at all times.

All growers are issued with an information booklet when they are connected to the scheme. This booklet provides information on the health and safety measures that are required (Lincoln Rayner, pers.comm., 23 May 2001).

Water Quality Issues

There are several water quality management issues of which irrigators must be aware. These include salinity, nutrient levels and other miscellaneous problems (Metcalf & Eddy 1991, p. 1145). Salinity is the most important water quality consideration when determining suitability as it affects plant growth (Metcalf & Eddy 1991, p. 1145). The reclaimed water from Christies Beach has a salinity of 900mg/L (John Gransbury
pers.comm., 12 April 2001). This compares favourably to the salinity concentrations of the groundwater which ranges from 640mg/L to 1900mg/L (Department of Water Resources 2000b, p. 64). None of the people I have interviewed expressed a concern with salinity in relation to crop irrigation. However, it was pointed out that there was the potential for the salt content to cause environmental problems in the future (John Gransbury, pers.comm., 12 April 2001).

Another management issue is the nutrient load of the reclaimed water. The nutrients can either provide a fertiliser for crop growth or exceed the plants needs and cause problems (Metcalf & Eddy 1991, p. 1153). High nutrient content, especially nitrogen, could meet plant requirements in the early to mid-growing period but could exceed requirements in the flower and fruiting period (Metcalf & Eddy 1991, p. 1153). Indications are that the opinions of growers vary greatly in relation to the nutrient load of the reclaimed water, and especially its application late in the growing season (John Gransbury, pers.comm., 12 April 2001). The grower and the vineyard manager I spoke to believed that the nutrients in the water are “mostly beneficial” (Don Oliver, pers.comm., 29 May 2001; Lincoln Rayner, pers.comm., 23 May 2001). One of the properties has only had vines since the reclaimed water was introduced to the region about 20 months ago. Of the young vines the manager believed that the “extra nutrients of the water had pushed them on”. However, he also admitted that in the future it may be necessary to reassess the application of reclaimed water late in the growing season as it could affect productivity (Lincoln Rayner, pers.comm., 23 May 2001).

Miscellaneous problems include the unique impact of reclaimed water on the irrigation infrastructure. Biological growth clogging irrigation lines is one example. Drip irrigation systems are the most susceptible because they are totally enclosed (Metcalf & Eddy 1991, p. 1153). Growers anticipate having such problems and intend to control any growth with applications of chlorine as needed (Don Oliver, pers.comm., 29 May 2001).

**Crop Suitability**

A crop could be unsuitable for irrigation with reclaimed water if special management is required to maintain acceptable crop yields (Metcalf & Eddy 1991, p. 1145). Don Oliver, a fifth generation winegrape grower in the McLaren Vale, has a crop of ultra-premium grapes. These grapes require very little water and absolutely no fertiliser, consequently, in this situation irrigation with reclaimed water is unsuitable. Groundwater will continue to be used for the irrigation of these grapes (Don Oliver, pers.comm., 29 May 2001).

**Consistency of Water Quality and Reliability of Supply**

The consistency of water quality can be affected by either problems within the WWTP or by variation of the incoming sewerage to the treatment plant (Metcalf & Eddy 1991, p. 1174). Supply of the reclaimed water to the irrigator may also be unreliable. Lagoons in the Willunga Basin Water Company’s distribution system balance out water quality variations from the WWTP (John Gransbury, pers.comm., 12 April 2001). In respect to supply reliability both John Gransbury (pers.comm., 12 April 2001) and Glen Templeman (pers.comm., 23 May 2001) said the system was
extremely reliable. The pipeline system was designed to supply the reclaimed water at pressure which means that growers are able to access the desired volume of water as needed (John Gransbury, pers.comm., 12 April 2001). A user of the reclaimed water reported that in the 20 months the property had been connected to the scheme there was only one occasion that supply was not available (Lincoln Rayner, pers.comm., 23 May 2001).

Barriers to the Use of Reclaimed Water in the Willunga Basin

The success of the Willunga Basin Water Company’s reclaimed water scheme has in fact created a barrier to further water reclamation in the Basin. The City of Onkaparinga urgently needs to upgrade the Willunga WWTP as its capacity is being exceeded (Phil Bickley, pers.comm., 10 April 2001). The council is currently negotiating with the Willunga Basin Water Company to have the reclaimed water from Willunga distributed via the pipeline (Phil Bickley, pers.comm., 10 April 2001). The difficulty with this situation is it appears that the Willunga Basin Water Company is currently only able to use 3000ML of its water from Christies Beach because of a lack of winter storage. Two thirds of the company’s water is still being discharged to the Gulf of St Vincent. The negotiations between the council and Willunga Basin Water Company is commercially sensitive, therefore, the water company’s Operations Manager was reluctant to discuss the matter. However, he did not rule out the inclusion of the Willunga WWTP in the overall scheme (Glen Templeman, pers.comm., 23 May 2001).

I believe this set of circumstances highlights a fundamental barrier to the use of reclaimed water. A region that has an underutilised, reliable water resource that is of reasonable quality has a very low incentive to use reclaimed water. A comment by John Gransbury regarding the irrigators of the Willunga Basin suggests that this is the case, “I would think if the groundwater resources were sustainable and good quality then there’s no way they would be using reclaimed water” (pers.comm., 12 April 2001). In the case of the Willunga Basin, the underutilised resource is the reclaimed water from the Christies Beach WWTP. This presents an interesting paradox. Essentially the wastewater treatment plant at Willunga is in competition with the plant at Christies Beach. At this time there is only one distributor, the Willunga Basin Water Company. The Willunga plant is trying to provide a product that is currently being oversupplied to the only distributor.

Conclusion

The adoption of the use of reclaimed water in the Willunga Basin has reinvigorated the primary industries of the region, particularly winegrape production. The case of the Willunga Basin demonstrates that a reclaimed water scheme can be a success in its own right as well as generating improved productivity for other industries.

The local council is interested in adding the Willunga WWTP to the overall reclaimed water scheme. This presents an interesting and somewhat paradoxical situation. Effectively the wastewater treatment plant in Willunga is competing with the plant at Christies Beach. However, the Christies Beach plant entered the market first and has an oversupply of reclaimed water.
This indicates that in the future wastewater treatment plants will be competing with each other to supply reclaimed water. The circumstances of the Willunga Basin suggests that this is a very likely scenario.

References


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1 The wastewater being treated by SA Water Corporation’s Wastewater Treatment Plants consists of water returned to sewers from household toilets, sinks, showers, washing machines, and has wastewater from industries added to it (SA Water Corporation 1999:URL).

2 Biochemical oxygen demand (BOD) is a measure of the oxygen demanding substances in wastewater – which indicates the level of pollution present. It is expressed as the number of milligrams of oxygen required by micro-organisms to oxidise the organics in a litre of the water over a period of time. It is expressed as milligrams per litre (mg/L) (Environment Protection Authority 1996:17)