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An analysis of the social aspects of establishing agricultural recycled water schemes

Social perspectives on water

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Executive Summary

Purpose of the study

The purpose of this study is to develop a better understanding of the opportunities and constraints to recycled water investment in rural and regional areas of Australia for agricultural irrigation use.

How the study was approached

A review of literature on the social acceptance of recycled water was conducted. This was verified with case studies that involved profiling and assessing the establishment of three agricultural water recycling schemes in rural-regional Australia. Information was gathered using key informant interviews and published documentation. Key informants were individuals directly engaged in negotiating recycled water schemes, including stakeholder representatives from regional water authorities, local communities, farming groups and relevant state government departments.

Social acceptance of recycled water (literature review)

Research on the factors influencing social acceptance of recycled water suggests a number of issues are likely to influence the way recycled water schemes are received. The literature identifies that the public is generally supportive of water recycling but the closer the intended use is to personal contact (i.e. drinking, cooking or showering), the more the support declines. In addition, the closer the proposal comes to a reality (i.e. is salient), the more support declines. Other important factors governing social acceptance include the source of the reclaimed water, demographic factors, risk and trust and water quality issues.

Key features of successful recycled water investment in rural-regional agriculture (case study investigations)

A range of linked factors appear to be important to understanding the drivers and constraints to successful agricultural recycled water schemes in rural and regional Australia. While a 'blueprint' for success is unlikely, key features used in this study for profiling implemented schemes included the history of the scheme, local place factors, institutional champions, institutional structure and form, public and stakeholder involvement, environmental impact assessment, technology and economic aspects. Three case study sites located in the Shoalhaven (New South Wales), Wimmera Mallee (Victoria) and Coal River (Tasmania) were reviewed using these features.

Key drivers of successful schemes

The most important aspect to emerge from the study was the similarity of key drivers for the interest in and establishment of recycled water schemes. Pollution control was the compelling reason why the water authorities initiated the schemes in all three cases. There were several related drivers including community concerns about the impact of nutrients on local waterways and increasingly stringent pollution control regulations of the EPA.

There was less evidence that the recycled water functioned as an offset to freshwater or potable water use. Although not a key driver, the emphasis on replacing freshwater use is becoming more apparent in the context of acute water

shortage. In each case, the success of the schemes therefore depended on the *creation* of new water markets.

Institutional champions were important for scheme establishment

The role of institutional champions emerged as an important aspect of successful case studies. Institutional champions included senior officers within the water authority and influential political representatives. A less obvious finding was the important role played by leaders in the agricultural community. A common characteristic was for a 'visionary' farmer to emerge as a stalwart for the scheme, encouraging others to come on board. A mix of political and community support was thus a characteristic of success.

In each case, the changes introduced were significant. Recycled water was successfully integrated into existing and new agricultural practices. Institutional champions played a central part in generating the necessary commitment in the face of considerable change.

Community and stakeholder engagement as a key part of planning processes

Community and stakeholder engagement from the early stages of planning processes appears to be a key aspect of successful water recycling schemes. Having the necessary organisational processes to support this in the water authority also appears to be important to scheme establishment. Informal relationships, developed as part of stakeholder and community engagement, appeared to be necessary for underpinning the end user agreements for recycled water use. The findings also suggest that environmental, social and economic values were explicitly incorporated into standard assessment procedures used for recycled water options.

Economic aspects of schemes

Establishing recycled water schemes appeared to involve high transaction costs, especially since these were often innovations for the community and water authority involved. There were several economic aspects of schemes that appeared to be highly complex and potentially contentious. Success seemed to depend on the provision by government of much of the capital costs of establishment. Major funding in each case came from state governments and the Australian Government. In addition, there was significant risk for water authorities in securing long-term recycled water markets because of their legal obligation to find alternative mechanisms for disposal of the treated effluent. Institutional and legal arrangements were put in place specifically to address these concerns.

Legal arrangements to manage on-farm risks

A critical element in the three cases was the bedding down of legal arrangements to formalise agreements between the water authority and farmers for the access and use of the recycled water. These agreements were partly to manage the risks arising from the on-farm use of the recycled water. In all three cases, contractual arrangements with water users included strategies such as education about, and management protocols for the use of, the water. The need for relationship-building processes culminating in more formal arrangements is one of the reasons why the development phases of the schemes were lengthy.

1. Introduction

Australia has the second highest per capita consumption of water in the world, irrespective that the continent is characterised by generally low and variable rainfall. The recent drought has, through public and political debates, heightened an awareness of water shortages, access and availability and has placed significant pressure on agricultural industries and communities to develop innovative approaches to water use. Further, the potential impact of climate change on water availability will add additional impetus to the search for innovative solutions. As a consequence, there is growing interest in the potential for water recycling to assist in meeting Australia's pressing water needs (PMSEIC 2003).

Public support or opposition to a particular water recycling scheme, irrespective of environmental or engineering considerations, is a key determinant of these types of investment, and there has been considerable interest in the determinants of community attitudes to water recycling for a number of years. Much of this interest has been generated by the public rejection of some recycled water schemes. For example, the recent Toowoomba referendum on 29 July 2006, in which 60 per cent of the local population rejected a plan to source 25 per cent of the city's water from recycled effluent (ABC 2006), illustrates the contentious nature of these types of water infrastructure investments.

To better understand these issues, this study, the social component of the Integrated Water Sciences *'Application of recycled water'* project, examines community acceptance of the use of recycled or reused water for irrigated agriculture. The primary aim of this work is to identify the institutional and socio-cultural issues which influence the utilisation of recycled water in regional Australia. The study investigates institutional factors and socio-cultural attitudes to recycled water and its use including, but not limited to:

- social drivers and constraints to recycled water use,
- the limits of social acceptability,
- involvement of key stakeholders in planning processes, and
- institutional arrangements.

Water recycling is one of several ways to enhance water use efficiency, security of supply and create cleaner waterways. For the purpose of this study, water recycling is defined as a collection of practices that occur at varying scales ranging from the reuse of treated municipal effluent to the beneficial reuse of stormwater, greywater, and industrial wastewaters for a range of purposes (CSIRO 2002; Burkhard *et al.* 2000). The terminology is not standardised, and therefore the terms 'recycling', 'reusing' and 'reclaiming' water will be used interchangeably in this report to refer to all practices involving plans to reuse water for other purposes.

This report commences with an overview of the approach taken in this study. The two phases of the investigation included an initial review of literature followed by an assessment of three case studies of implemented schemes to validate these general findings. Section 3 provides a review of the literature about social acceptance of recycled water for both drinking and non-drinking applications. This highlights the wide range of features likely to influence social acceptance of recycled water, and notes a lack of consensus on what drives individual attitudes to particular recycled water initiatives.

Section 4 identifies specific 'likely' success features of recycled water schemes drawing on general findings from the literature review and explains what is meant by these features. Individual case study reports detailing the characteristics of three particular rural-regional water recycling schemes are contained in Section 5, focussing on institutional context, local conditions and planning processes. A comparative discussion of the similarities and differences between the cases and a comparison with findings from the literature review is discussed in Section 6. Finally, this report concludes with Section 7 drawing out the main findings from the whole study as to the kinds of drivers and constraints that influence recycled water investment in rural-regional areas of Australia.

2. Approach and methods

The approach to the research was organised into two phases:

- Phase 1: Review of issues and scoping (literature review)
- Phase 2: Investigation of features of existing case studies

Phase 1: Review of issues and scoping

Phase 1 involved a review of literature on the social acceptance of recycled water. This included a review of current literature on the social acceptance of recycled water from a range of sources, including published papers, surveys and reports. The findings of this phase have been synthesised into a short report identifying key social issues likely to be influential in the implementation of recycled water schemes.

This initial review of factors influencing social acceptance suggested that further investigation into specific existing case studies would help to verify general conclusions and enable gaps revealed in the literature to be explored. In particular, the diversity of the “public” and the unstable nature of attitudes in any situation led to the decision to include empirical case study work to test findings of Phase 1.

Phase 2: Investigation of existing case studies

The second phase involved assessments of case studies of implementation in order to identify specific features of operationalised water recycling schemes in rural or regional areas of Australia that may influence scheme success. Drawing on the review of issues completed in Phase 1, hypothesised features of successful recycling schemes included:

- history of the scheme
- local place factors
- institutional champions
- institutional structure and form
- public and stakeholder involvement
- environmental impact assessment
- technology
- economic aspects.

These generic characteristics of schemes were identified following the review of issues in Phase 1 of the project (literature review). It was not anticipated that all these features would be relevant in all the cases studies but rather that a unique set of features would emerge as being significant in each case.

Several of the features were less difficult to examine using information readily available from government and other published sources. However, in order to fully examine 'local place factors' that may drive any water recycling scheme, the role of institutional champions, and the nature of public involvement, semi-structured interviews were conducted with key informants[1], representing a range of stakeholder groups (Table 1) involved in the planning of the recycled water schemes.

This was done for a number of reasons. The first was to develop a comprehensive understanding of the factors at the local level that drive successful schemes. Second, recycled water schemes represent a relatively innovative way of managing water and each experience in establishing schemes was expected to be unique. Since there is little consensus on what circumstances promote or discourage the practice, exploratory case studies were deemed appropriate for this preliminary study (Yin 2003). Third, local contextual features such as the need for more secure water supplies, agricultural activities and local community characteristics were also likely to be important for understanding planning outcomes, and utilising a case study design allowed this to be explored. It should also be noted that three case studies were not expected to reveal definitive 'answers', but to raise issues for further investigation.

Selection of case studies

A cross section of operational water recycling schemes in different regions was short listed for assessment and three of these schemes representing a range of experiences in rural water recycling, were chosen as detailed case studies. The aim was to represent different types of water recycling configurations, while emphasising schemes involving agricultural (i.e. non-potable) irrigation.

It was important that various stakeholders had been involved as an integral part of the decision-making process. Cases with a significant amount of information already available about the decision-making process were also favoured, since a limited amount of primary research can be done in a study of this nature.

In summary, the three case study locations were chosen on the basis of several broad criteria:

- schemes had to be currently operational
- involve a range of recycled water practices (emphasis on agricultural, non-potable irrigation applications)
- had involved stakeholders and the public in the decision-making process
- existing information was readily available.

[1] Key informants are people directly involved in planning the schemes through their personal or professional capacities.

The three cases chosen for investigation in this study were the:

1. Shoalhaven Reclaimed Water Management Scheme (REMS), South Coast New South Wales

2. Grampians Wimmera Mallee Water recycled water schemes, North Western Victoria

3. Coal River Recycled Water Scheme (CRRWS), South Eastern Tasmania.

Data collection methods

For each case, documentation was collected using web-based resources. Web searches for information on social acceptance issues in relation to each case targeted information relevant to the features outlined above. Refereed journal papers published about the cases were also retrieved and reviewed.

To verify and refine our understanding of opportunities and constraints to rural recycled water investment in these cases, semi-structured interviews were conducted by phone with key informants directly involved in the planning and development of the three cases. Agency staff and end-users were the main stakeholder groups approached. Stakeholders are defined in this study as any concerned person or group (e.g. government agencies, elected representatives, consultants, environment groups, community members and user groups). While members of the general public were not approached due to the time constraints of the project, information on perceptions of recycled water use was available from some secondary documentation, including surveys undertaken in the planning of the schemes. These were incorporated into the case reports.

A snowball sampling technique was used to identify participants and obtain their contact details. This technique directs access to key informants beyond publicly available information. The process followed was that one participant would point out the importance of someone else to the case and they were then approached and so on (Heckathorn 1997).

Questions were similar for agency staff and end-users, although greater emphasis was placed on the organisational context in questions for organisational participants. Interview questions covered educational and training backgrounds, farm activities/crops (end-users only), views on the drivers of the scheme, personal role in the process, views on recycled water, what challenges or issues they faced, relationships between agency staff and end-users, any internal organisational issues (agencies only), what influence they had on the process and how they thought the planning process could have been improved. The interview questions guiding the discussions with participants are reprinted in Appendix 1.

Each interview was coded and generic position titles were assigned in order to maintain the confidentiality of participants (see Table 1). The participant codes are used in the case reports to indicate which type of key informant referred to a particular issue or statement.

Table 1: Participants interviewed for the study (with codes used in case reports)

Stakeholder category	Case 1 – Shoalhaven REMS, New South Wales	Case 2 – Grampians Wimmera Mallee Water recycling schemes, Victoria	Case 3 – Coal River Scheme, Tasmania
Water business / authority & local government	Manager [2] Project officer [1]	Manager [11, 12] Senior officer [13] Engineer [14, 15]	Senior manager [23] Project officer [24] Elected representative [22]
State government (i.e. regulators)	Manager [3] Engineer [4]		Manager [25]
Community representatives / end-users	Primary producer [5]	Primary producer [16, 17]	Primary producer [26]

Data analysis

Summaries of the interviews were written up as soon as the interviews were completed, based on interview recordings and hand-written notes. Descriptive summaries were sent back to participants by email to verify content and any further comments were incorporated. Qualitative analysis methods involved identifying themes related to opportunities and constraints to recycled water investment arising from the participant interviews and documentation. Similarities and differences between the accounts of the study participants were discussed among the study team and quotes were selected in order to illustrate particular themes or perspectives.

Ethics and consent

Each study participant was given a fact sheet containing background information about the project (Appendix 2). In accordance with requirements for informed consent, each participant was asked if they consented to being interviewed and if they were happy for the interview to be recorded. They were also advised that any information they provided would be used only for the purposes of research and that their names would not be used (unless they explicitly consented) in any publications arising from the research.

3. Social acceptance of recycled water and the role of 'the public' – literature review

Introduction

There is growing interest in the potential for water recycling to assist in meeting Australia's pressing water needs (PMSEIC 2003). Public support or opposition to a particular water recycling scheme, irrespective of environmental or engineering considerations, remains a key determinant of these types of investment.

Much of the available research on public involvement in water recycling initiatives seems to focus fairly narrowly on factors affecting personal attitudes. Commonly, this research is premised on the idea that 'the public' is an impediment to 'rational' water planning and if only support could be secured problems would be overcome. However, as will be highlighted in this literature review, a number of variables appear to influence public attitudes. In particular, institutional variables which provide structure and form to the initiation, development and on-going management of water schemes are important.

A complicating factor in this research is the nature of 'the public' and what this means for understanding social acceptance of recycled water. The public is made up of many heterogenous 'publics' - or groups - whose identities and attitudes are both place and time specific. This may explain the lack of predictability and consensus about what influences public acceptance of recycled water (Marks 2004; Marks 2006). For these reasons, significant value may lie in incorporating the local social and environmental context as well as institutional form into the analysis of acceptance (Russell and Lux 2006, p.4; Stenekes et al. 2006). This suggests that validation for some of the general findings of this study may be enhanced by local case studies of specific rural and regional experiences with recycled water for agriculture by providing the opportunity to identify both place and time specific variables that directly influence the local acceptability of water recycling proposals or schemes.

Variables influencing 'the public'

Broadly, the range of issues that may affect community response to water recycling are likely to include: public health, environmental health, economy and finance, technology and emotional factors (Khan and Gerrard 2006).

At a more individual level, variables which affect personal choice about the use of recycled water have been found to include, proximity, intended use of the water, the source of the water, demographic factors, risk and trust, and water quality issues. While there have been surveys of community attitudes to, and perceptions about, water recycling for over 30 years, there are

limitations as to the value of these surveys, largely because of the difficulty in generalising results across different contexts (space and time); and because attitudes are not stable and may be affected by any number of local and/or national factors (Russell and Hampton 2006).

This said, the only consistent factor to have been identified in the literature as a key driver for public acceptance of the use of recycled water is economic gain (Friedler *et al.* 2006; Marks 2003). However, the reality is that the cost of recycled water relative to alternative water sources was identified as a major impediment to its development by water industry stakeholders (ACIL Tasman 2005).

In undertaking this literature review, the following themes emerged as significant for understanding social acceptance of recycled water:

- proximity to recycled water and salience
- intended use of water
- source of reclaimed water
- demographic factors
- risk and trust
- water quality issues.

These are discussed below.

Proximity (personal contact) and salience

The literature identifies that the public is generally supportive of water recycling initiatives. However, the closer a proposal comes to a reality (i.e. becomes salient) the more the support declines (Bruvold 1998 cited in Hartley 2006). Furthermore, the closer the intended use of the recycled water comes to personal contact (e.g. drinking, cooking, bathing at home, etc.) the more the support declines. Research indicates the public is more supportive of recycled water for uses such as irrigation of pasture and much less supportive of uses that involve close human contact (e.g. drinking) (Marks 2006). However, later work by Bruvold (cited by Russell and Hampton 2006) indicated that in the face of a specific proposal the degree of contact may be less significant than views on its wider environmental, health and economic implications.

More work needs to be undertaken to explore reasons why people who feel positive about the benefits of recycling water are reluctant to use recycled water themselves (PWSEIC 2003).

Intended Use of water

Public support is generally higher for non-potable uses of recycled water (see Marks 2003). A 1996 Sydney Water survey found up to 99 per cent support for recreational park irrigation, while the same survey found only 23 per cent support for human consumption (SWC 1996).

Research by Hurlimann and McKay (2006) indicated that acceptance of recycled water was conditioned by the fit between the purpose for which it was intended and a variety of quality attributes. For example, the salinity of the water was considered to be important if the intended use was garden watering whereas colour and odour were more significant for clothes washing.

Evidence suggests considerable acceptance of the use of water for irrigation purposes. However, regardless of the degree of acceptance by water users for irrigation purposes, it still does not translate into a marketing advantage. Irrigators do not promote awareness of their use of recycled water and some have concerns about public perceptions about the use of recycled water for edible crops (e.g. Virginia Pipeline Scheme in Marks and Boon 2005; Crook 2003).

Source of reclaimed water – the YUCK Factor

The ‘yuck factor’ is the term used to discuss ‘the visceral reaction of displeasure and distain’ expressed by the public to water recycling particularly of sewage or black water (Hartley 2006, p.116). A UK survey in 2000 confirmed the existence of a source factor. People were more willing to use recycled water from their own wastewater than from second parties or the general public (Jeffrey and Jefferson 2001).

Po, Kaercher and Nancarrow (2004) suggested that acceptability may depend on the use history of the water as well as people’s perceived degree of control over the quality of the recycled water they receive. Marks (2003) draws out evidence on the influence of ‘disgust’ towards the use of recycled water for potable purposes. She suggests the disgust or the yuck factor is influential to attitudes on the use of recycled water for potable purposes. Certainly, the evocative slogan ‘toilet to tap’ has been effectively used to derail a number of recycled water proposals in California, United States (e.g. San Diego, San Gabriel, and East Valley). Closer to home the Toowoomba case illustrated how the yuck factor could be effectively deployed by campaigners against indirect potable recycling (Frew 2005; Anon. 2005).

Demographic factors

There is some evidence that a more educated and informed public is supportive of water recycling (Hartling 2001). The hypothesis underlying this is that the less informed public is vulnerable to the graphic demonisation of black water recycling, with catchy slogans such as ‘toilet to tap’.

Hurlimann and McKay (2003) found in their South Australian research that there was a correlation between acceptance of the use of recycled water and knowledge of the system.

Risk and Trust

The safety of recycled water is an issue identified as affecting the public willingness to accept its use. According to Hartley (2006) trust and confidence in both public agencies and technology are critical influences on the public perception of water recycling proposals. Khan and Gerrard (2006) emphasise that the credibility of the water reuse organisation and its personnel is as important as the quality of the project itself.

Researchers have identified factors that affect perceptions of risk, such as whether the risk is knowable (uncertainty), voluntary (can the individual control exposure?), and equitable (how fairly is the risk distributed?) (Beecher *et al.* 2005). In cases where projects are controversial the predominant concern should be on procedural justice (Khan and Gerrard 2006). This includes a society's values concerning procedural fairness in the way judgements and decisions are made and the fairness with which risks and benefits are distributed across different sectors of the community.

Water Quality Issues

The quality of the water that is produced through recycling is a key concern of the public. There is some evidence that the public trust their own impressions of water quality more than those of the experts (Hartley 2006; Hurlimann and McKay 2003).

It would appear that even with established horticultural uses of recycled water, such as in Monterey County, California there are on-going concerns from users about public perceptions of water quality and safety (Crook 2003; Rosenblum 1998). In this case continuing educational programs and food safety studies have been used to help maintain confidence in the use of recycled water for horticultural purposes. There are concerns not only about short-term biological contamination from recycled water use but also the unknown long-term effects of organics (Crook 2003).

Khan and Gerrard (2006) contend that public support for recycled water has remained static despite significant developments in water treatment technology, and this indicates that there is not a strong correlation between water quality and public acceptance. It is arguable however, that there could be a number of other potential explanations for this which include public resistance to the imposition of change or lack of trust in institutions or experts, to name just a few.

The importance of involving the public

Current risk communication theory emphasises: (i) two-way communications (dialogue); (ii) that the public has useful knowledge and concerns that need to be acknowledged; and (iii) that what

may matter most is the credibility of the purveyor of information and the levels of trustworthiness, fairness, and respect that he or she (or the organisation) demonstrates (Beecher *et al.* 2005).

Hartling (2001) contends that for the successful introduction of water recycling the public must be involved from the outset in the design of the scheme and that the key issues of trust in technology and institutions must be dealt with. Marks (2006) maintains that public involvement is integral to the success of alternative water resource supply proposals. The scope and scale of the public involvement will probably need to be more extensive for potable than non-potable proposals but is none-the-less essential. Marks' (2006) review of eight water recycling proposals in the United States and Australia found that public consultation was characterised by a lack of transparency in the planning phase and limited community outreach. Generally, the emphasis was found to be on marketing the proposal rather than keeping the public fully informed.

International research has identified significant community resistance to the use of recycled water which relates to a number of institutional factors and in particular how the community were prepared and consulted (Hurlimann and McKay 2006). The way in which a recycling scheme is introduced to the public may well influence its acceptability. Hartling (2001) for example argued that the public should be involved from the earliest possible stage. For Khan and Gerrard (2006), effective communication is an ongoing process which begins with the decision to consider a water reuse scheme and continues through the life of the scheme. Dimitriadis (2005) concluded that consultation with water users is vital to ensure that people really want recycled water and that they are prepared to pay for and use it. She suggests stakeholder preferences should play a role in establishing priorities and practices relating to recycled water. There is increasing support for the idea that communities should be involved in the planning of total water management from the earliest stage (Russell and Lux 2006; Russell and Hampton 2006). This gives the community the opportunity to be involved in designing solutions, potentially including the recycling of water, rather than having solutions imposed from above.

Predicting community attitudes

There would appear to be an assumption that once the public have had a positive experience with the use of recycled water they are more likely to find its use more acceptable in the future (see Marks 2003). Israel is well known for its long and successful agricultural water reuse. Agricultural uses such as crop and orchard irrigation and aquifer recharge with recycled water have been going on for 30 years without adverse effects to the public (Friedler *et al.* 2006). Despite this experience, a recent survey found low levels of public support for higher contact uses of recycled water. There were however, high levels of support for medium contact uses such as private gardening, toilet flushing and commercial car washing.

There is an inference that lack of acceptance by the public of recycled water is a consequence of misunderstanding of the risk associated with its use, lack of knowledge of treatment efficiency and other emotional factors (Gibson and Apostolidis 2001). Not nearly enough is known in general terms to predict likely community responses to water recycling in general, nor to specific proposals (Russell and Hampton 2005).

Po *et al.* (2004) developed a model for predicting community behaviour in relation to wastewater reuse. The research program aimed to systematically investigate, identify, measure and test the major factors that govern people's decisions about whether or not to use recycled water for different purposes. This research reinforced the findings of earlier work about the range of important variables influencing people's behaviour. However, it also illustrated that the task of prediction may be a significant challenge.

Discussion

Generally, research on the public in relation to water recycling is narrowly focused on trying to reveal public preferences. This research is premised on a snap shot of individual attitudes which assume not only that people's attitudes are stable and predictable but that future *behaviour* will follow current attitudes. According to Stenekes *et al.* (2006) the failure to establish water recycling as a viable option stems not only from a failure to gain public acceptance in any particular case, but is also the result of institutional frameworks constraining the definition of both the problem and an acceptable solution. What this means is that solutions to water problems are often influenced by the values and attitudes of those participating in the decision-making process as well as the incentives and constraints around different options. These institutional frameworks would need to be explored before fully understanding why innovations in water use are successful or otherwise.

What is missing is an understanding of the broader historical and cultural context of water management. For over 150 years Australians have been provided with abundant clean water as a matter of right. In addition, the removal of human waste has been facilitated in order to minimise householders contact with waste product. The whole system of engineering has been designed to deal with it as a priority public health concern arising from contamination of clean water by dirty water. This has been a highly efficient system, and has influenced the pattern and form of development and enabled the flourishing of a healthy population. Organisations, institutions and laws have evolved which facilitated the separation of clean and dirty water. The public has been educated to expect an abundance of clean water and fear contamination from their own waste.

In the next decades modern Australia will have to grapple with a whole new range of challenges. These include water scarcity, broader sustainability imperatives and changing attitudes to cost recovery. This means that traditional approaches to water supply and disposal are unlikely to

remain viable. In this context, recycling of water has been recognised as a potentially important element of a whole water cycle management.

There are a number of examples of highly successful recycling schemes in Australia and across the world, for example, Singapore (Anon. 2002; Paddock 2002) and Berlin (where drinking water aquifers have been enriched with treated wastewater for several years) (Fritz *et al.* 2003). Despite this, proposals to introduce specific recycled water schemes are often met with high levels of community resistance. One approach to grappling with this issue is to focus on individual attitudes and try to measure and predict the factors affecting them. However, there is evidence that a more viable approach is to develop a broader understanding of the historical and cultural factors which drive both the institutional approach to resolving issues as well as the attitudes and perceptions of individual end-users.

The way forward

It is apparent from the literature review that the public's expectations have a significant influence on the way that water recycling will be received. Research on the factors influencing public acceptance of recycled water show a high level of inconsistency and contradiction. This is likely to be due to the diverse nature of 'the public' and the particular issues in any one case. The public are made up of a range of people and groups with different interests and background levels of understanding. The implications of this are that it will probably be difficult to accurately predict public responses to specific water recycling proposals. Local environmental and social concerns appear to be a significant factor for the success of any particular water recycling initiative.

With this in mind, the next part of this study explores the implementation of particular rural-regional water recycling schemes focussing on institutional context, local context and planning processes in an effort to better identify specific 'likely' success factors. Insights raised by this work will inform understanding of the opportunities and constraints to future agricultural water recycling projects.

4. Profiling characteristics of successful water recycling cases

This section describes eight key characteristics of water recycling case studies that may be important for understanding success. A profiling approach was taken to identify specific features based on a review of previous papers, case studies and reports. These features were considered to be socio-cultural factors that influence the uptake and social acceptability of water recycling.

An analysis of literature on successful and unsuccessful documented case studies suggested that features key to implementing water recycling schemes may include:

- the history of the scheme
- local place factors
- institutional champions
- institutional structure and form
- public involvement
- environmental impact assessment
- technology
- economic aspects.

These features help to characterise the ability to build trust among stakeholders and to enhance the potential for implementing innovative or sustainable uses of water, including water recycling. This may be because they operate in different ways to either enable or constrain alternative approaches to the use of water. Given the complexity of social processes, it is important to note that they are likely to be highly interdependent and responsive to local conditions. Indeed, the way the features interact in any particular recycled water planning or policy initiative may be critical. Bearing these complexities in mind, the features were used in the analysis as a broad guide as to the potential factors that could influence successful recycled water investments in Australia.

The following sections explain what we mean by these features and why we think they are likely to be important for understanding successful implementation of water recycling schemes. Brief examples are used to illustrate how these factors were important in reported experiences of water recycling investment.

History of the scheme

A brief history of the scheme may provide important contextual information that helps in understanding the present situation in the locality, particularly what led to the initiation of the

scheme. Indeed this point about learning from the past is emphasised in some of the recent literature on the mechanisms that encourage institutional change (Scott 1995, p.74; Goodin 1996, p.4; Bressers and Kuks 2003)[2]. The recent history of the scheme shows how the idea of water recycling became a plausible one amongst the stakeholders concerned[3]. It would also take into account past interaction and the nature of the relationships between key stakeholder groups in the community, such as the level of trust, shared understanding of the problem and local practices (e.g. agriculture and water use).

Marks (2006) maintains that local historical context is important as it influences acceptance of water recycling schemes. An example is provided of Singapore's 'NewWater' potable water recycling scheme. In this case, a long-standing dependence by the Singaporean government on Malaysia's water exports and a concern for water supply security led to a commitment by the government to recycle water for drinking and investment in other projects aimed at securing water independence.

Local place factors

Local issues relevant to the community or agricultural sector may be drivers of water recycling investments. The recent drought declared across much of south eastern Australia and consequent town and farm water shortages are an example of local problems that investment in water recycling may potentially address. Any number of reasons may drive the initiation of a water strategy. Apart from the need to obtain a more reliable source of water, local authorities may be responding to other drivers such as the changes to pollution control legislation, the need to conserve potable water supplies, availability of other options, and other public policy drivers (Crook 2003).

In addition, the biophysical characteristics of the area may offer drivers or constraints to investment in water recycling. Some relevant examples include the local hydrological cycle and water catchment characteristics, including existing water and wastewater systems, water cycle interactions, landuses and the climate.

The agricultural industry profile may also drive recycled water investment, such as crops grown or animals raised in the area, the presence of other intensive water use industries and the current demand for, and availability, of water associated with these activities.

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[2] The role of the institutional context, made up of informal and formal rules of interaction, is discussed further under feature 4 'Institutional structure and form'. Recent directions in institutional thinking note the importance of historical patterns of institutional development in explaining the shape of present social institutions.

[3] The term 'stakeholder' will be used to refer to any concerned person or group, e.g. government agencies, elected representatives, consultants, environment groups and community members, business representatives, the media etc., including the general public unless otherwise stated.

We can extend local factors to include local social and cultural norms, such as local knowledge about water, community structure and networks, and key community figures.

Institutional champions

The role that particular people play in encouraging innovations has been recognised as important (DiMaggio 1988; Beckert 1999; Gilmour *et al.* 1999). Institutional champions are people who, for whatever reason, are willing and able to inspire commitment to change, either through facilitating interaction between people or obtaining adequate resources[4]. Strategic actions of institutional champions have been identified as important factors in initiating and enabling innovative water recycling schemes in the past (Stenekes et al. 2006; Livingston 2008). This is particularly the case in relation to community involvement in decision-making and in purveying new ways of thinking (e.g. integrated or water cycle approaches). Institutional champions are likely to be found in positions of responsibility, such as government officials or community representatives.

A high level of individual motivation and commitment of other key stakeholders and groups within the proponent organisation have also been found to be important features of successful water recycling schemes (Hartley 2006).

Institutional structure/form

Institutions provide the conditions that enable or constrain the implementation of innovative approaches to water use, such as water recycling. Social institutions[5] are broadly defined as habitual patterns of behaviour associated with enduring systems of social meaning and beliefs (Scott 1987). It is useful to think of these as encompassing both the formal and informal institutional arrangements that guide social life (Giddens 1984). These may range from informal co-operative arrangements between two farmers through to more formal arrangements for water use by irrigation corporations.

There are several aspects of institutional structures that might influence the ability to take up alternative uses of water (Colebatch 2005). This includes the organisational framework for managing water functions (who has responsibility for water?) and the legal context guiding water recycling practice (e.g. health regulations, pollution licences). Analysis should be extended to include any local customs or cultural belief systems influencing water use in the case study area.

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[4] Pettigrew (1979) describes these as 'institutional entrepreneurs'; those who take responsibility for mobilising people and resources to initiate, give purpose to, or manage change.

[5] Alternative definition: a stable pattern of social behaviour embodying particular knowledge bases, understandings and/or interpretations (cognitive) guided by shared values, routines or procedures (normative) and constrained or enabled by sets of rules or laws (regulative) (March and Olsen 1989; Scott 1995).

Public and stakeholder involvement

Public and stakeholder involvement in planning water recycling initiatives has been identified as an important feature due to difficulties that have arisen in the past between governments, expert groups and the public over proposals to recycle water (e.g. Uhlmann and Luxford 1999, p.A10; for U.S. cases see PIEOW 2003; WEF/AWWA 1998; Ryan 2003). The review of literature suggested the way the public and stakeholders[6] are approached is likely to be a key factor in whether water initiatives are successful. Opportunities for public and stakeholder interaction from the early stages of initiation are likely to be a key issue for generating commitment and support (Russell and Lux 2006; Stenekes 2007). Indeed recent national guidelines for water recycling acknowledge that establishing partnerships with stakeholders and engaging the community is a vital means of encouraging ownership of plans to invest in water recycling (NEPC 2006, p.22).

Public involvement encompasses the spectrum of interactions between project proponents and third parties. A complicating issue is that 'the public' is really made up of a range of different groups with different knowledge, experiences and interests and a mix of involvement techniques are likely to be appropriate. Broad principles of engagement include a transparent process, open discussion of issues and options, and provision of credible information (Carson and Gelber 2001; Russell and Lux 2006). While the need for public involvement is widely acknowledged in the water sector, Russell and Lux (2006) comment that the record on engaging the community in the water sector in Australia has not always reflected these principles. There has been less consideration of the potential positive role of the public in enabling sustainable water recycling.

There are generally three points at which the public might become involved in the planning and management of water recycling schemes; 1) as initiators of the schemes, 2) in formal decision-making procedures as part of statutory processes, and 3) in formal on-going management of the completed scheme. Each of these phases represents important features for any analysis of successful case studies.

Environmental impact assessment

Recycled water schemes are often major works and therefore may require some form of environmental assessment. This involves identifying and assessing the environmental consequences of a proposed project or plan. In Australia, environmental impact assessment is a legislated requirement under state laws for projects likely to affect the environment.

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[6] The term 'stakeholder' (Mitroff and Mason 1981) is often used to denote the more organised interests, ranging from those potentially influencing a decision or the beneficiaries of projects, e.g. government representatives, non-government organizations, industry associations, community groups.

Stakeholder and public consultation is often required as a part of the environmental impact assessment process, and proponents of schemes are required to take public submissions into account in revising the scheme (e.g. *Environmental Planning and Assessment Act* NSW). Water authorities generally exceed these requirements for public and stakeholder consultation processes in regards to sewerage or water recycling schemes.

While recognising the potential overlap with other features, environmental impact assessment processes are important when looking for opportunities and constraints involved in balancing environmental, social and economic objectives of schemes.

Technology

The available technology and the systems for recycling water, matched with opportunities for implementing these in practice are relevant to the potential for successful recycled water projects. This is weighed up against the existing water and irrigation technology and infrastructure in use. Current and proposed technology will be briefly discussed in relation to each case study in this investigation.

Economic aspects

Economic aspects of water management may shape opportunities for recycled water by providing incentives or discouragements for change. Such structures may include subsidies, rewards and pricing arrangements since these provide important motivations for particular actions or responses. The structure of incentives around water management can have a bearing on whether water cycle approaches, such as recycled water, are attractive or not to participants. Incentive structures describe the overall system of rewards that structure these responses. For example, the current price of irrigation or mains water, tax relief for water infrastructure (such as efficient irrigation), the availability of capital investment funds, any other issue affecting opportunities for recycled water systems to compete on their own merits.

5. Empirical case studies

The features discussed above will be used as the means of profiling the three case studies and validating the findings in the literature.

Case report 1 – Shoalhaven Reclaimed Water Management Scheme (REMS), New South Wales

History of the scheme and local place factors

The Northern Shoalhaven Reclaimed Water Management Scheme (REMS) on the south coast of New South Wales is the largest dairy water recycling scheme in Australia. The scheme, which began operation in December 2001, provides recycled water to 14 dairy farms on the Shoalhaven River floodplain (SCC 2004; 2006, p.6). The recycled water is used to irrigate 400 hectares of dairy pastures in addition to golf courses and other public open spaces.

Shoalhaven REMS was a joint venture between the Shoalhaven City Council and the then New South Wales (NSW) Department of Land and Water Conservation and took more than ten years to plan and implement. The Scheme is developing in two stages with Stage 1(a) providing 1800 mega litres a year of recycled water from four sewage treatment plants and Stage 1(b), connecting two further plants and doubling the supply of recycled water. The total cost of the completed project is expected to be $64.5 million (2005/06 figures). Stage 1(a) was completed in 2001.

A primary driver of the initiation of the scheme was concern for managing increasing amounts of sewage effluent generated by local population increases. Most of the key informants interviewed in relation to this case study, pointed to community concerns about preventing effluent discharges into Jervis Bay, an area which is widely recognised for its significant conservation value[7] as the main reason for the scheme. This indicates that a regulatory driver, that is, increasingly stringent Environmental Protection Authority (EPA) discharge requirements, was a primary 'catalyst' for initiating this scheme.

Although the scheme 'began as a local solution to a local problem' (Tomkinson 2002; Gould *et al.* 2003), there were a range of strategic drivers that were also important. For example, widespread community protests against ocean outfalls in the Sydney region in 1989 encouraged more favourable attitudes within government agencies towards environmental protection and reclaimed water use (Gould *et al.* 2003).

[7] Jervis Bay was declared a National Heritage Area in 1988 following a series of 'Save the Bay' protests against development of naval facilities. Later the waters of the Bay were declared a state marine national park (1998) (Lady Denman Museum c2006; Gould *et al.* 2003).

It is telling that an interviewee noted that "timing" is very important when referring to the convergence of strategic and local issues that drove the project. Local issues included: the need to upgrade local sewage treatment facilities to cope with population growth in the Shoalhaven area; and a second issue was the quest for alternative options to outmoded effluent disposal (driven by public protests against outfalls) and the further circumstance of deregulation of the dairy industry in 2000. Tomkinson (2002) argued that dairy deregulation may have actually encouraged some farmers to invest in their businesses by intensifying production through irrigation with recycled water, in order to survive in the newly deregulated dairy industry.

In addition, there were positive spin-offs anticipated for rural development in the form of new farming opportunities. Studies had identified opportunities on the Shoalhaven floodplain for irrigation and predicted 80 additional jobs could be generated by 2015 if 1000 hectares of land went under irrigation (Tomkinson 2002). The availability of a reliable supply of water and higher incomes from milk processing activities were also identified.

Climate appears to be less of a factor in the initiation of the project because the Shoalhaven area has relatively high and consistent rainfall. Prior to commissioning the water recycling scheme, local dairy farmers relied on dryland farming and natural rainfall for pasture growth. It was a question as to whether dairy farmers would agree to invest in on-farm infrastructure that was needed to buy water in the long term, and ensuring farmer participation in the scheme was an anxiety for the water authority which had legal obligations to manage the wastewater (Tomkinson 2002). This suggests that drivers were both local and regional, originating from both 'top down' (regulatory driven) and 'bottom up' forces (from the community).

Institutional champions

An individual identified by almost all interviewees of this study as key to making the scheme happen was the then General Manager of Shoalhaven Water. He is widely seen as having an important role in guiding the community through the planning process. He is *'a very astute person, he's not pushy'* [5]. The qualities suggested by such comments include patience, persistence and respect – he *'presented the benefits, but didn't ram it down people's throats… he gave farmers time to get used to it'* [5].

There is also the interesting question of a champion on the 'end user' side. Several key informants pointed to a farmer representative who was critical in generating commitment among the wider farming community to the project. *'It took one very progressive dairy farmer to provide leadership and decide to participate… he convinced the majority by putting up his money'* [2]. Through the influence of this 'visionary farmer', many realised the value of recycled water for irrigation.

Institutional structure/form

Recycling water for dairy farming was an innovation for both the farmers and the water agency. There were some changes that had to occur in the institutional forms at both formal and informal levels to accommodate water recycling practices.

Responsibility for water supply, wastewater management and stormwater services in the Shoalhaven lies with Shoalhaven Water, a division of Shoalhaven City Council, traditionally handled mainly by engineers in the technical/services division of the council. Initiating water recycling to manage effluent required much greater co-ordination of a range of issues and groups - *'it was groundbreaking for our organisation'* [3]. Co-ordination was seen as pivotal in enabling implementation of the scheme (Tomkinson 2002). Interviewee accounts suggest that this required a greater degree of flexibility internally as well as with external stakeholders, that is, it required significant change in the culture of the organisation.

These changes are more significant when one considers the considerable institutional complexity inherent in managing the water cycle and particularly, increasing involvement being demanded by non-officials (e.g. community, environmental groups) in decision-making. Institutional change is demonstrated in the more frequent inclusion of community and user groups in meetings, for example, the Technical Advisory Group included a farmer representative. Cultural and structural change within the water business was also evident in the creation of the 'REMS project co-ordinator', dedicated to managing various internal and external stakeholders' input to the scheme – *'employed to develop relationships with end-users'* [1].

One of the more significant institutional factors was a structural separation between local and state government, reflecting the split of responsibility for water. In this case, it was a matter for the local government with responsibility for water management, while state government held funding and regulatory approval roles (e.g. EPA, NSW Health). Interviewees suggested that the degree of trust existing between officials in the Shoalhaven Council and state government was better than average because Shoalhaven was a larger council (with more resources) with a history of co-operation with state government on previous public works projects.

Legal arrangements were also entered into which helped to generate trust across organisational boundaries. An agreement between the local and state government called the *REMS Memorandum of Understanding* reduced the uncertainty about capital funding. The *MoU* set out the roles and responsibilities of each party, and in particular, bound the state government (and all future state governments) to continue funding the capital works through the two stages of the scheme.

In addition, new institutional forms were made to negotiate from the users' side. A collective 'farmer's group' emerged which enabled farmers to effectively co-ordinate their involvement in the scheme. Reflecting upon this, one interviewee commented, *'there were a lot of collective decisions*

to be made as to who gets the water, where the pipes go, where the allocations are… we knew we had to work together collectively to make it work' [5]. This took time but was aided by the emergence of the 'farming advocate' described above whose representation was important in generating and maintaining the commitment of the other farmers to the process.

The water authority also embarked on a series of user agreements to get farmers involved in the scheme. It was challenging to get them on board; it was *'a big leap for them, they weren't irrigators', 'they're in a naturally high rainfall area,'* [5] and this would have taken a lot of capital investment. The purpose of user agreements was to set out the responsibilities and rights as to the use of the water. For the water authority, the user agreements were necessary to ensure that end-users would continue to purchase the water in the long-term. There were three stages in the development of user agreements:

1. Expressions of interest were called to allow the project team to identify viable and non-viable properties

2. Heads of agreement were signed with a $5000 deposit from the end user to enable the water authority to lay pipes and build storages with certainty, and

3. Contract or deed of agreement including an extensive Farm Management Plan that set out compliance for on-farm practices as part of the long-term supply arrangement.

The user agreements built in the compliance arrangements that addressed nervousness about environmental and health risks associated with the use of the recycled water. Risks discussed by interviewees included potential impacts of recycled water quality on milk, herd health, worker health and the local environment (e.g. water table, soil condition). An extensive on-going monitoring program was undertaken to underpin confidence in the project, which incorporated controlled comparisons of health and environmental effects on irrigated farms compared with non-irrigated farms. On-farm compliance arrangements include a withholding period where stock are barred from grazing pastures recently watered with recycled water allowing natural ultraviolet rays to kill off pathogens.

Public and stakeholder involvement

Public and stakeholder involvement from the early stages was seen as an important success factor for the scheme (Tomkinson 2002). The planning process involved a diverse range of stakeholders, including user groups, government officers, consultants and members of the community. The proponents of the scheme seem to have emphasised combining community preferences with expert technical advice as a key principle of the process (Tomkinson 2002). Determination of the preferred option for effluent management was enabled through an extensive community consultation and information program.

Initial discussions contemplating the development of the scheme began in 1989 between staff in the water authority and members of the local community (Gould *et al.* 2003). However, the formal co-ordination of a reclaimed water option began around 1993 with the development of an Options Report. The Options Report was overseen by a Community Liaison Group (CLG) made up of local members of the Parliaments of NSW and Australia, Australian Government departments, Local Government Council, the Australian Conservation Foundation and local community groups (SCC 2002). This group was established by the Shoalhaven Council in order to ensure the inclusion of community views into the development of options.

Several strategies were considered by the stakeholders on the CLG but three were shortlisted for broader community consideration. These included ocean release at three different locations, land-based reuse on forestry plots and river release via constructed wetlands with local reuse (Tomkinson 2002). Gould *et al.* (2003) point out that all of these approaches were technically feasible, but each was more expensive than the original option of conventional ocean disposal. Therefore, it was necessary for the broader community to understand the cost implications and make an informed decision as to the best approach (Ibid.). A community survey was conducted in 1993 to find out people's preferences and how much they were prepared to pay for them. The results gave the water authority much more impetus to go ahead with recycled water ('land-based') options since 55 per cent of first preference responses supported land application of the reclaimed water. In addition, 80 per cent of respondents were willing to pay more for their sewerage charges to implement their preferred option (Falk *et al.* 1994).

There are two issues that emerge as important in understanding the outcomes in this case study. The first is the strategic involvement of key stakeholders from the early stages, that is, those representing key agencies and user groups, but also, opinion-makers in the community. The second is the importance of involving the wider community in the meaningful selection of a preferred option. This wider process combined informing and educating the public about water recycling opportunities and enabling them to trade-off complex sets of values (i.e. different options versus cost increase to the ratepayer) in a plebiscite. The transparency in this decision-making process was important in generating trust between officials and the public about reusing water on land.

Several interviewees commented that involvement by senior organisational figures and key political figures was also important to the success of the scheme. Reference was made to the support of the Minister of the day, State Member of Parliament Richard Amery, who held the twin portfolios of Agriculture and Land and Water Conservation (1997-2001). He reportedly saw that REMS offered the advantage of a win-win outcome: minimising ocean outfall effluent while also sustaining the dairy industry east of Nowra.

Environmental impact assessment / process

Some of the case study material suggests that there was considerable conflict in the community over an original proposal of a new ocean outfall for effluent disposal at Governor's Head. Prior to 1989, an environmental impact statement (EIS) had been commissioned (for the original proposal) but was never completed (Gould *et al.* 2003). Significantly, Gould *et al.* write that the level of conflict in the community over the issue was so high that the water authority waited 18 months before putting any options to public plebiscite. During this time, a significant amount of 'careful and structured dialogue' was undertaken between 'independent facilitators and key community opinion makers' to reduce levels of conflict (in Gould *et al.* 2003).

This suggests that the formal environmental impact assessment process was only meaningful and acceptable insofar as it was underpinned by adequate community and stakeholder engagement. The type of engagement occurring in this case evidently went well beyond legislated requirements for public consultation in environmental decision-making (i.e. inviting written public submissions on the EIS).

Technology

The availability of technology for recycling water seemed to pose less of a constraint or driver to the development of the scheme in this case compared with the ability to obtain a secure market and finance. The technological opportunities were all there and it was a matter of matching the level of treatment with the intended water uses, that is, irrigation. The greatest issues seemed to be both social and institutional.

Although not a key driver, some interviewees suggested a technical challenge lay in the optimisation of the complex water transportation system used for irrigation (i.e. pipes and pumps) with the length of pipes coming to about 90 kilometres. Optimisation in the engineering design of the system (e.g. reduced pipe diameters) meant the capital cost of the project was reduced by many millions.

Economic aspects

Resolving economic issues were critical to the success of this scheme, including securing a recycled water market, obtaining capital finance and devising public-private cost sharing arrangements. These are discussed below.

Securing and creating a recycled water market

A significant issue for the water authority was to secure a market for the recycled water. This involved obtaining a long-term (25 year) commitment on the part of farmers to accept (buy) the

water. Indeed, a farming representative described how the council went out of its way to bring farmers into the scheme by funding as much of the infrastructure as it could. Incentives for connecting into the scheme were given by council that encouraged irrigators to participate, including a 15-year period of free supply of the recycled water, subsidies for the cost of constructing farm irrigation storages and irrigation electricity supply upgrades (Tomkinson 2002).

Capital financing

The availability of most of the capital funding to build the scheme was a key issue that was only resolved with the assistance of government. Funding was obtained from a variety of public and private sources. Public financing came from the New South Wales (NSW) Government through the Country Towns Water Supply and Sewerage Program (i.e. Country Water Program), while Australian Government support was provided through an Australian Government natural resource management program National Heritage Trust. The Shoalhaven City Council also contributed through their ratepayers.

Eligibility for the public portion of funding was a critical issue if the scheme was to go ahead. For example, under the rules of the Country Water Program administered by the NSW Department of Energy and Utilities, funding was only available for upgrades to existing (i.e. conventional) water and sewerage infrastructure. In order to remain eligible, any alternative scheme involving recycled water for agriculture had to be undertaken in conjunction with the upgrade of existing facilities.

Land-based applications as implemented in the Shoalhaven were more expensive than conventional effluent disposal options since they involve more complex water management regimes and infrastructure. Experiences in this project suggest that the existing framework for water pricing, and subsidies reflecting these differences, tended to discourage alternative and/or recycled water use options.

Cost sharing arrangements

The source of funding (i.e. public money) brought particular constraints to the cost sharing arrangements devised between the government and water users. In this case, it was significant that taxpayer sourced funding could not be used on private land. Farmers were therefore required to invest significant sums on their own farms to benefit from the scheme. On-farm infrastructure costs were considered significant from the farmer's perspective - in the order of $200 000 per farm - including water pumps, pipes, small holding dams and spray irrigation equipment.

There was reportedly a lack of enthusiasm among farmers and lack of recognition of the value of the scheme and there was a significant amount of encouragement needed from Council – they *'were ready to accommodate any issues or problems that arose, never created friction… but it wasn't just an open cheque book, we had to negotiate'* [5]. Cost sharing arrangements were made

as part of detailed negotiations with end-users. Led by the farming ‘champion’, farmers formed a ‘collective buying group’ through which they negotiated and arranged collective purchase of some of the on-farm infrastructure from a single supplier.

Ironically, farmers who had connected to the scheme recouped their financial investment within the first two years of operation in the drought period that followed. The council website reports that the average irrigated farm in 2004 was between $50000 and $70000 better off due to the scheme. They also saved about $5000 in town water charges by switching to recycled water for washing down pens and yards and $5000 from fertiliser content in reclaimed water (SCC c2004). While many farmers across NSW were buying expensive stock feed, the Illawarra-Mercury newspaper reported that dairy farms in the Shoalhaven were essentially ‘drought-proofed’ through REMS by a reliable supply of recycled water (Anon. 2003; O'Connor 2002).

Summary

The key finding from this case study is that public and stakeholder involvement from the early stages was an important feature driving the initiation and establishment of the recycled water scheme. Another driver of investment was increasingly stringent effluent discharge requirements of the EPA, reflected in community concerns about the impact of effluent on waterways that compelled the water authority to find alternative mechanisms for disposal of the treated effluent. An important feature of success was the emergence of institutional champions for the cause on both sides of the negotiating table, that is, the general manager of the water authority and the ‘visionary’ farmer, who saw the benefits of irrigation for drought-proofing the local dairy industry. Economic aspects were also critical, such as creating a secure recycled water market and ensuring the support and financial commitment of the state government to the project.

Case report 2 – Grampians Wimmera Mallee Water recycled water schemes, North Western Victoria

History of the scheme and local place factors

Grampians Wimmera Mallee Water (GWMWater) has a series of recycled water schemes in its area of operation, which covers a large part of the north western region of Victoria. The Authority operates urban water and wastewater services for a population of about 52 000 people providing urban water to 74 towns and wastewater services to 24 of the towns. It also operates an extensive rural water supply system. Most rural customers are supplied by a network of open channels bringing water from the Grampians Ranges and Murray River to 22,000 farm dams (www.gwmwater.org.au). The Authority has supplied recycled water since 1972 to a range of customers for an extensive range of uses including vineyards, golf clubs, racetracks, public gardens, pastures and woodlots (Friend and Coutts 2006). About 93 per cent of the wastewater produced in the region is currently recycled, although the authority is aiming for 100 per cent (GWMWater 2005, p.3).

This case report focuses on the factors influencing initiation and establishment of the 1) Ararat Great Western pipeline scheme for vineyard irrigation, and 2) the Horsham water reuse for the 'Grains Innovation Park'[8] and other open spaces, for which interview and secondary information was collected.

1) The Ararat Great Western Pipeline scheme:

The Authority commissioned the Ararat Great Western pipeline water recycling project in 2001. This scheme involved construction of a 16 kilometre pipeline supplying recycled water from the Ararat wastewater treatment plant to a winery, two golf courses, municipal gardens, tennis courts, several ovals and a dozen vineyards in the Pomonal/Great Western Region of Victoria.

2) Horsham 'Grains Innovation Park' recycling scheme:

Recycled water from the Horsham City wastewater treatment plant is supplied via a pipeline to Department of Primary Industries (DPI) Victoria's 'Grains Innovation Park' in Horsham for plant breeding and research. The scheme provides irrigation water to another leasehold farm near the wastewater treatment plant, greens and fairways of Horsham Golf Club and the Horsham rifle range (Grampians Water c2004). Before the scheme came into operation, treated effluent from the town was discharged directly into the Hopkins River (Grampians Water c2004).

[8] Previously known as the Victorian Institute of Dryland Agriculture (VIDA).

We focus on these two projects in this discussion because they underpin commercial agricultural production.

The climate of north west Victoria offers increasingly compelling reasons for reclaiming wastewater for beneficial uses in the region. Characteristically it is a water scarce region with rainfall averages ranging from just 310 millimetres in the Northern Mallee to 890 millimetres over the Grampians area (www.gmwater.org.au). GWMWater states in a Sustainability Report (2005, p.17) that below average rainfall since 1997 has led to water use restrictions for most of the customer base and the lack of water has limited development in the region. In such circumstances, an increasingly strong driver for initiating new water recycling schemes is the need to obtain more reliable water supplies.

According to the interviewees however, the Ararat and Horsham schemes seem to have been instigated as a means of providing alternatives to river effluent disposal whereas augmenting freshwater supplies appears to be a more recent driver. Furthermore, the introduction of more stringent license requirements for the discharge of wastewater by the Environmental Protection Agency (EPA) in the 1980s was the key catalyst for the authority to invest in many of the recycled water schemes in the region.

As with the Shoalhaven example in New South Wales (NSW), timing was an important factor in opportunities for recycling. Several interviewees mentioned that these schemes were born out of the convergence of local needs. For example, in Ararat, the water authority was under pressure from the Victorian EPA to look for land based disposal options in the 1980s. At the same time, local vineyard operators saw an opportunity to secure more water. A key motivation to participate was that the growers '*…mainly cared about keeping their vines alive through drought*'[14]. Similarly, new EPA license regulations meant the Horsham City Council needed an alternative to effluent disposal into the Wimmera River from the Horsham sewage treatment plant. DPI Victoria saw this as an opportunity for establishing a new 'plant breeding' base where irrigation facilities would be a great advantage [17]. These examples also illustrate how water recycling schemes have traditionally depended on *creating demand* for expanded water use rather than offsetting existing freshwater uses.

Another related factor in establishing these recycled water schemes was the regional development opportunities they bring (Hansard 1998, 28 April). Local vineyard managers in Great Western near Ararat saw the scheme as a means of providing long-term security of supply that could facilitate rural development and generate flow-on benefits for the community in terms of employment and tourism. A spokesperson from the Authority commented in 2000 in relation to this project, 'If the Grampians is going to survive in its own right it has to have economic development,' (Courtney 2000, ABC "Landline" program).

Institutional champions

Interviewees stated that particular people were important for encouraging these investments in water reuse and management in the region. Having learned from these experiences in developing reuse schemes, a senior environmental officer from the technical services division of GWMWater began to develop a 'Strategic Planning Framework for Reclaimed Water' in 2005 to institutionalise experience in reclaimed water projects in the region. The Framework defined a more active and effective role for the organisation in partnering with members of the community and end-users in pursuing new schemes (Coutts 2006). Thus it provided an opportunity for the organisation to learn from experience and streamline internal processes to enable new schemes. An ability to inspire new ways of thinking about the necessity of community engagement in planning processes is likely to have been the defining factor that made this officer an institutional champion. However, institutional champions rarely operate in a vacuum and many others contributed to and participated in the development of the Framework. For example, support of senior communications staff, engineers and the Board of Management was necessary.

According to the interviewees, support from political champions was important for resolving conflict between users and the Authority (e.g. the Ararat Great Western recycled water scheme). At one point, the negotiations for the scheme could not proceed due to issues of unfamiliarity with recycled water projects, lack of funding and entrenched positions about cost apportionment. The then local Member of Parliament for Benalla and Victorian National Party leader Pat McNamara[9] was approached and asked to be a mediator. This independent arbitrator played a key role in resolving differences between the parties, enabling an agreement necessary for progressing the scheme. An important outcome of this process was the offer of $1.7 million capital funding towards the scheme from Victoria's Department of Natural Resources and Environment (Hansard 1998, 28 April). A unique mix of political support with central government investment seemed a key ingredient for enabling the scheme.

If institutional champions are defined as people who inspire commitment to change through promoting new ways of thinking, facilitating interaction or redirecting organisational resources, mention also needs to be made about particular non-officials who were important enablers of change. In the Ararat scheme, for example, one or two of the vineyard operators in the Great Western wine district played a key role in maintaining open communication (conflict management) between water authority representatives and the growers.

[9] Victorian Minister for Agriculture and Resources from 1992-1996.

Institutional structure/form

These events need to be seen in light of major reforms that were being undertaken in the Victorian water industry in the 1990s. Grampians Wimmera Mallee Water is a government owned statutory authority established in 2004. Management of the organisation is overseen by a Board comprised of ten members. However, the present organisational form is a result of processes of amalgamation of many small water management organisations in rural Victoria[10]. As such, GWMWater is one of 14 regional water authorities now providing urban and rural water and wastewater services (Cooper *et al.* 2006).

The Ararat Great Western Pipeline recycled water scheme was initiated by Horsham City Council, which had responsibility for water before 1995. The negotiations for the scheme went on during the transfer of water functions to Grampians Water, which disrupted the informal negotiations with external stakeholders involved in establishing the scheme. One interviewee recalls how *'enquiries were made during the amalgamation - then everything went quiet'* [16]. The water authority was undergoing rapid internal refocus from a local to a regional perspective, and a public service provider to an organisation with a customer focus (Waddell et al. 2000). This suggests that such negotiations were not normal, or not highly institutionalised because they required significant effort to undertake.

Several interviewees explicitly mentioned co-ordination problems at the organisational level that made it difficult to progress reuse schemes. An officer in the water authority reflected that the approach was *'very ad hoc, there were a large number of agreements, contracts and systems… there weren't the internal processes to deal with this'* [13]. Issues of communication between technical and other departments and between the water authority and the community were raised as impediments to schemes by some interviewees. The senior officer 'champion' mentioned above brought about changes to the way the organisation worked by developing the 'Strategic Planning Framework for Reclaimed Water'. The Framework was an *'opportunity to standardise the way things were done'* [13]. It set out improved internal processes and procedures and importantly, signalled a cultural shift in the organisation towards recognising the importance of external stakeholder engagement. This enabled resolution of some co-ordination challenges described above and captured the idea that wastewater was a resource rather than a waste product.

[10] Non-metropolitan water and wastewater services were traditionally managed by many small organisations (i.e. 370 water trusts, sewerage authorities and local councils) which operated independently of each other (Cooper *et al.* 2006). In 1995, 21 of these small organizations were merged into Grampians Water (Waddell et al. 2000). In 2004, a further merger of urban and rural water businesses occurred in north west Victoria with the amalgamation of Grampians Water (urban services) and Wimmera Mallee Water (rural services) into the existing GWM Water.

Institutional changes were reflected in both formal and informal aspects of the way the organisation did business. In the formal sense, the creation of the Sustainable Development Division, under which reclaimed water co-ordination functions were subsumed, suggests the organisation increasingly saw recycled water schemes as playing a role in the sustainability of the region. Giving a dedicated senior officer the role of co-ordinating recycled water activities meant that *'someone has responsibility'* [13] for the internal process and for liaison with the community and external stakeholders in relation to water recycling. Today, this officer provides legal and regulatory advice related to water recycling, which, prior to this, project managers had to chase up on an *ad hoc* basis.

The Framework sets out guidelines for recycled water agreements with end users which are an important part of the institutional arrangements necessary for maintaining trust with stakeholders and making property rights explicit. Prior to the framework, many problems were experienced with negotiating supply contracts with users, for example, *'each user had slightly different needs or wants and legal contracts became messy'* [13]. This process was greatly assisted by the drafting of a more precise standard legal template for recycled water user agreements, which was assisted by the Victorian Water Industry Association.

The process follows a gradual locking in of commitment through a series of different agreements. For example, GWMWater initially entered into an Memorandum of Understanding with Great Western vineyard owners for the purchase of recycled water (Russell Kennedy 2004). An umbrella agreement was then made between the authority and all of the participating vineyards. In addition, the vineyard owners entered a separate agreement among themselves that explicitly set out their rights and obligations in relation to purchasing and using recycled water (Russell Kennedy 2004). This has been important for settling reallocations of the available recycled water necessary in drought conditions where stage four water restrictions and domestic grey water reuse has led to a significant reduction in the amount of treated effluent available.

According to the interviewees, user agreements required significant education and training because the water authority believed people sometimes had little knowledge of irrigation practice and/or issues relating to recycled water use. As part of the Ararat recycled water project, the agreements with end-users for the management of the water included site management plans involving certain controls on the use of the water. For example, the use of drip irrigation systems, withholding time for worker access, ensuring worker vaccinations in the event of a pipe burst, preventing water pooling, and the maintenance of certain records.

As with the previous case study, monitoring programs were an important part of ensuring confidence in the safety of the schemes. For example, an extensive monitoring program has been in place at the 'Grains Research Park' in Horsham for testing groundwater levels and salinity from recycled water for more than ten years. These institutional forms were important in maintaining and underpinning broader public confidence in the schemes.

Public and stakeholder involvement

Public and stakeholder involvement was identified by many of the interviewees as the key factor in generating community support for recycled water projects. The water authority now routinely makes efforts to incorporate social values into decision-making about recycled water. According to Friend and Coutts (2006) it has consciously challenged the 'we know what's best for you' culture. This contrasts with the approach to public consultation in the past where decisions about effluent disposal had been made without consulting and educating the community first, sometimes to the detriment of the organisation, and leading to public outcry.

Many lessons from experiences with communities in a number of recycled water schemes have been incorporated into practice. One interviewee commented that the current approach is about *"involving rather than directing"* the community [11]. The emphasis is on listening to ideas and concerns but also informing stakeholders of the potential uses and benefits of the reclaimed water (RMCG 2004). GWMWater is careful to provide as many opportunities for key stakeholders to have informed input during the decision-making process as possible. The Board's support and commitment to this principle is highlighted as a necessary ingredient.

The approach to community consultation set out in the Strategic Planning Framework begins with identifying early on local stakeholders who may be interested in recycled water. This is followed by assessing the potential benefits of projects for each stakeholder, preparing an information sheet, participating in individual/group meetings with authority representatives, having open meetings with the local community, and giving feedback to keep all stakeholders informed of changes. This approach has been rolled out successfully in several towns in the area of operation and helped to facilitate the establishment of recycled water projects (Coutts 2006).

The process of negotiation itself is very important because it enables the stakeholders to develop an understanding of each other's needs and to develop trusting relationships. Initially some concerns were expressed by communities about whether it was safe to use recycled water, they were a '*bit sceptical… a little bit afraid of it'* [11]. However, water has been reused in many communities now, so people increasingly accept recycled water. Study participants reported a real change over the last five years where people are '*seeing [recycled water] as a resource, and competing for the water'* [11]. Under severe water use restrictions, many are seeing the value of recycled water. There is a sense in a dry region that '*we must rely on what water resources we can get'* [11].

However, even if they don't agree with the outcomes of consultation, the process of negotiation is important for helping people to understand why the scheme is being undertaken.

Environmental impact assessment

Environmental values are one of several criteria against which recycled water options are weighed up during consultation with communities. GWMWater's Framework sets out how this might best be done.

Incorporating environmental values was essential in the initiation of both the Ararat and Horsham schemes described above, both of which were driven by environmental values for riverine protection. This was reflected in Victorian Environmental Protection Authority's preference for land based reuse (RMCG 2004). However, any new water reuse schemes also require preparation of an Environmental Improvement Plan (EIP) under Victorian legislation to demonstrate how it helps improve the environmental performance of the organisation. An EIP is an action plan with goals and a timeline for improvement, with ongoing monitoring and reporting of performance, and must be submitted to EPA Victoria for approval prior to commissioning. The aim is twofold: to demonstrate an organisation's commitment to environmental responsibility and to improve relations with the local community (EPA 2002). This process is consistent with that outlined in the Strategic Planning Framework for Reclaimed Water, which guides GWMWater's approach.

GWMWater engages the public more than its obligations require. The Strategic Planning Framework outlines how the organisation incorporates environmental, social and economic values into the decision-making process. What makes this interesting is that the community and end-users are closely involved in the assessment of alternative water use schemes based on a triple bottom line assessment. The process of engaging the community in developing criteria under these values and weightings ensures trade-offs by the stakeholders can be made between competing social, economic and environmental values. In this way, conflicting concerns are brought into the open and a more credible outcome is obtained (Coutts 2006).

Technology

Technology itself did not seem to be a limiting or enabling factor for the schemes. There were several comments about the respective knowledge of users and officials about the technology. Several interviewees commented that end-users knew a lot about their own businesses, including irrigation techniques and practices, while the officials knew a lot about finance, administration, regulation and bulk water supply methods. It appears these differences made it more difficult to negotiate shared agreements about recycled water in the initial stages of the Ararat Great Western and the Horsham recycling schemes.

Technological issues are now more explicitly incorporated into the stakeholder consultation processes in the recent Framework. The organisation calls this the 'technical sieve' – which is part of the option selection process, but only one aspect of a triple bottom line approach.

Economic aspects

Economic issues represented significant impediments to implementing the schemes. Similar to the Shoalhaven example, the main problems for the water authority were related to obtaining a secure recycled water market, finding capital funds and establishing cost sharing arrangements with users.

Securing or creating a recycled water market

Securing a recycled water market was a key concern for the water authority in the establishment of the recycled water projects. However, unlike the Shoalhaven where rain was more plentiful, there was a keen desire to obtain secure water for local farmers who were in drought. Although there was less of a need to convince end-users to participate in the scheme, the water authority was concerned to '*tie them up in the long term'* [14]. The authority had an obligation under the Planning and Environment Act 1987 to ensure alternatives to riverine effluent disposal in the long term, and was concerned to lock in permanent (contractual) arrangements. As one interviewee noted, they can't very well go back to the EPA and ask to dispose of the water if a buyer ceases to operate [14].

An innovation addressing this problem was illustrated in the Ararat Great Western Scheme. One of the largest vineyard owners (Seppelts, now owned by Foster's Group) agreed to act as a 'safety net' for the other smaller vineyards (Russell Kennedy 2004). This meant that the right of the water authority to discharge treated wastewater onto the relevant land was registered into the title to the land. Similarly, if other participants in the scheme ceased to participate or operate, the excess water could be discharged to the 'safety net' land (Russell Kennedy 2004). This arrangement enabled the scheme to go ahead.

Concern about securing a right to discharge meant that '*farmers knew they couldn't push the water authority too far…[the authority] could have bought their own land and would have had no people to negotiate with'* [16] (Ararat Great Western recycled water scheme). Lengthy interaction was required between the stakeholders for each side to understand their respective constraints.

Unlike the Shoalhaven, where recycled water was supplied to dairy farmers for free for the first 15 years, vineyard owners agreed to pay in the range of $125 per year on average for the first 15 years after which the price would be renegotiated. This perhaps reflects the critical need for water in the area when water storages are down to five to six per cent of capacity.

Capital financing

According to the interviewees, the ability to find capital investment was a significant issue for establishing most of the recycled water schemes in the region. Almost no projects have been implemented without some kind of external capital investment from state and/or federal governments. External funds are needed in order to fill the 'gap' between what end-users can pay (or are prepared to pay) and the actual capital cost of the project.

A general approach used by GWMWater was to evaluate the cost of using conventional methods to dispose the effluent to a river, in terms of approvals and works and so on, and then to put this towards constructing the recycled water scheme. However because users cannot afford large capital sums, any differences between this and the actual cost of the scheme need to be made up by external capital investment. Capital is currently sourced from public funds including the Natural Heritage Trust, National Water Commission (Smart Water Fund), Regional Development Victoria and Sport and Recreation Victoria.

Cost sharing arrangements

Similar to the Shoalhaven example, the capital cost of projects were typically covered by public funds up to the farm boundary, while on-farm costs (e.g. drip irrigation, pipes and pumps) are covered by the beneficiaries of the schemes.

In relation to on-going costs, the water authority is working towards setting prices on a cost recovery basis, however, as one interviewee commented, schemes are currently being run at a loss [13]. This is part of an attempt to treat recycled water as more of a business, but the Authority is constrained by an upper bound on water charges set by the Essential Services Commission of Victoria. Costs vary from scheme to scheme in northwest Victoria depending on local conditions. Among beneficiaries of schemes there is a sense of doing the water authority a favour by accepting a waste product that would normally have to be disposed of at significant inconvenience in the current regulatory framework. This perhaps reflects the situation where in some cases '…a *wastewater charge has already been paid for and customers think that GWMWater should pay for all of it'* [13]. Therefore, much time is spent negotiating the cost of water with end-users. One participant described water costs as a particular sticking point in the negotiations for recycled water schemes [13]. In the Horsham scheme, informal relationships ('the old boys network' [16]) were an important mechanism for breaking through these difficulties. These connections helped develop an understanding between the parties about the constraints on the others' financial capacity and business needs and necessity to underpin cost sharing agreements. Some interviewees stated that in some cases there are on-going disputes about the cost of water that remain unresolved [13, 14].

Summary

Pollution control appears to be the catalyst for initiating several of the existing recycled water projects in the Grampians Wimmera Mallee area. Key features critical to the establishment of the Ararat and the Horsham schemes appeared to be the development of informal relationships and trust between water authority representatives and local agriculturalists. These networks emerged as an important basis for more formal (legal) agreements for the use of the recycled water. Economic issues were also important, including the ability of the water authority to create and secure a long-term recycled water market and obtain adequate capital funding from state governments and the Australian Government for the construction of the schemes.

Case report 3 – Coal River Recycled Water Scheme (CRRWS), (Clarence Recycled Water) Tasmania

History of the scheme and local place factors

The Coal River Recycled Water Scheme (CRWRS) (which trades as Clarence Recycled Water) is in south-eastern Tasmania about 12 kilometres from Hobart. It has the capacity to recycle over 2.5 billion litres of treated effluent from the Rosny Treatment plant and redirect it through a system of pipelines for use on more than 100 farms and other businesses throughout the region.

Construction began in 2004 and involved installation of an effluent pump station, 6.7 kilometres of rising mains, a large storage tank and over 18 kilometres of reticulation mains in the Coal River Valley area. There are a diverse range of water users – from a couple of agricultural and amenity (turf) irrigators through to several small horticultural or viticultural users (less than ten megalitres per year). About seven megalitres per day of recycled water is currently available. It is anticipated that supply may be constrained at times of peak demand because of limits on the average instantaneous flow (Flow Allocation/Management Policy, Board of Management Clarence Recycled Water 2007).

The Coal River Recycled Water Scheme (CRWRS) had its origins in 1995 when the Clarence City Council undertook a review of its sewerage treatment and disposal options. At the time secondary treated effluent was released from the Rosny Wastewater Treatment Plant into the Derwent River. The key driver for the establishment of the scheme was pollution reduction. There was considerable concern about the impact of nutrients on the Derwent River. One of the key informants to the study indicated that it was only a matter of time before the Environment Authority 'came knocking at the door with a big stick'. Clarence City Council (CCC) came to the view that recycling the water was a more cost effective long term solution than upgrading the Rosny Plant to tertiary level treatment before disposal to the Derwent River.

A secondary driver for the establishment of the scheme was local development. There is historically inconsistent rainfall in the Coal River Valley, however the soil is of a good quality for agriculture. In the 1990s the South-East Irrigation Scheme had been established in the Valley and the potential for irrigated agriculture in the region had been established. The economic benefit of expanding irrigated agriculture in an area with limited employment opportunities was attractive to the community and local council.

As with both the Shoalhaven and Ararat Great Western Pipeline schemes the primary catalyst for the Coal River Recycled Water Scheme was pollution reduction. However, once the scheme was established, its value in its own right soon became apparent. This is evidenced in the plans by the Clarence City Council to expand the scheme in the near future.

Institutional champions

There would appear to have been several key players in the establishment of the Coal River Water Recycling Scheme. The long-term support and advocacy by a local member of parliament and former councillor was regarded by several interviewees as having been critical to the successful establishment of the scheme [22,25].

The role of innovator and adopter at the user end was also regarded as having been very important to the uptake of use of recycled water. One farmer is regarded as having been the *'lynch pin - once he was on board the rest followed'* [23]. It would appear that once one well-regarded and respected farmer took the risk to invest in the scheme others were prepared to come on board. In the end, the scheme was fully taken up within only one year of its establishment.

Institutional structure/form

Recycling water for agricultural purposes was an innovation for both the water authority and the farming community. Responsibility for potable water supply and wastewater management rests with the Clarence City Council. This is an interesting difference in comparison to the cases in NSW and Victoria (prior to 1995) previously discussed, in which the different aspects of water management are managed by separate authorities. In fact in this case there was a common senior manager to both the water supply and wastewater sections of the council. It was suggested by one of the interviewees that this is an important factor in the relative ease with which the scheme passed through the internal processes of council.

As is the case in the other jurisdictions, responsibility for regulation of water quality and approval for large projects rests with the state government. In this case, both the Department of Tourism, Arts and the Environment and the Department of Primary Industry and Water were key players in the approval process for the Coal River Recycled Water Scheme.

A unique feature of the institutional arrangements in this case is that the Clarence City Council chose to set up a separate authority to manage and operate the water recycling scheme. The Coal River Water Recycling Authority which trades as Clarence Recycled Water was established as a single authority under s.30 of the *Local Government Act, 1993* (Tas.). The principal goals and objectives are set out in the Rules established for the Authority in 2004. The Chairman of the Authority is a local alderman, however, the Board is made up of non-elected professional people. There are four board members with expertise respectively in business, research and development, farming and community.

Another important feature of this arrangement is that responsibility for the regulation of the Scheme has been devolved to the local level with an annual reporting mechanism to the State Regulator. These arrangements were arrived at through the approval process for the scheme and are

formalised in the Development Proposal and Environmental Management Plan within the provisions of the *Environmental Management and Pollution Control Act 1994* (Tas). This clearly identifies the roles and responsibilities for the scheme between the different levels of government and the Authority.

In addition to the formal mechanisms established to set up and manage the Coal River Water Recycling Scheme there are also important requirements for recycled water users. In the first instance an applicant for recycled water is required to prepare an Irrigation and Environmental Management Plan (IEMP). The plan is paid for and prepared by the Authority consultant. These plans essentially detail how users will take and use water in a manner that is safe from both a public health and environmental perspective.

Secondly, after a satisfactory IEMP has been completed and approved a User Agreement is entered into. This agreement is legally binding on both parties and requires the Authority to supply water and the user to accept it and use in accordance with the conditions of the agreement. It is valid for a period of up to ten years subject to a review after five years.

Finally, a Part Five Agreement, also legally binding, is entered into by the parties. This effectively adheres a document outlining conditions (detailed in the IEMP and User Agreement) to a land title. Its primary purpose is to allow continued access arrangements for any ongoing environmental monitoring (such as groundwater testing and soil analysis) should the property be sold. It adds resource security to the users by clearly identifying the property title as an area where recycled water can be taken and used.

The user agreements build in a range of mechanisms which formally address concerns about the health and environmental risks associated with the use of recycled water. The risks identified by interviewees included concern about human health, animal health (Helminths) and environmental health (primarily soil salinity and water logging). Management measures have been adopted to deal with the issues around Helminths, which include withholding periods for stock and so on. An extensive on-going water and soil monitoring program is part of the approach to managing the risks associated with the scheme.

Clarence City Council has a 30 year wastewater management plan. It incorporates recycling as an option, which is an indication of normalisation or institutionalisation of recycled water practice.

Public and stakeholder involvement

According to one of the interviewees the biggest challenges were the ‘social and cultural’ issues. The task was to win the ‘hearts and minds’ of the community [23]. The Council chose to engage in a transparent and open process of engagement with the community. The first phase, in

2001,involved extensive discussions with stakeholders. This was followed by extensive public consultation in 2002-2003 during the formal Environmental Impact Assessment phase.

A key part of the process of trust building with the farming community was the establishment of the Operational Advisory Group. This group was made up of five farmers and the four Board members. This group worked through the concerns of the farmers, which included costing and management issues. The process took approximately one year and is regarded by several informants as having been critical to the success of the scheme.

The public consultation process is not a one-off event. The Authority maintains an on-going relationship with users and the broader community. User and community groups are regularly consulted and provided with information. The Authority has a communication strategy which includes regular newsletters and the posting of a wide range of information (including monthly water quality data) on the web. This transparency is regarded as being very important to the on-going relationship of trust with both users and the broader community.

Environmental impact assessment

The formal environmental impact assessment of the project seems not to have been overly problematic. The environmental concerns included the potential impact on soil salinity in the Coal River Valley. This was especially of concern given the risk of salt water intrusion which arises because of the topography of the land and the fact that some parts of the sewerage collection system are located under the high water mark. Around $650 000 was spent by Council to repair leaks in the system.

The Development Proposal and Environmental Management Plan (DPEMP) and Addendum were prepared by Gutteridge, Hastings and Davey (GHD) in April 2003. Approval was given by the Department of Primary Industry Water and Environment in 2003.

The public consultation process went beyond that formally required by legislation. It would seem that the progression of infrastructure projects such as these must be underpinned by a robust engagement of the community in the development of options and solutions.

Technology

The availability of technology seems not to have been either a driver or constraint on the establishment of this scheme. As one interviewee commented '*it was really just a lot of pipes and pumps – not rocket science'* [23]. In this case the only change to the treatment process was microfiltration after secondary treatment. The real capital investment was in transporting the water from the treatment plant to the Coal River Valley some 20 kilometres away. This suggests it was a significant project but not necessarily a technologically challenging one.

While the technology of the system does not seem to have been a constraint to its development, its design may in the longer term prove to be limiting. The need for on-farm storage to ensure reliability of supply would appear to be emerging as a constraint in the hotter months as the demand for water is seasonal [26]

Economic Aspects

The resolution of the economic aspects of the scheme was fundamental to its success. These issues included securing a market for recycled water, obtaining the capital for its establishment and resolving cost sharing arrangements.

Securing recycled water

A significant issue for the scheme was to secure a market for the water. This involved an extended process to encourage uptake by farmers and a formal commitment to accept water for a minimum ten-year period. Council paid for infrastructure up to the farm gate. This included connection, valve and metering points as well as the cost of the farm Irrigation and Environmental Management Plan. The water is provided at a subsidised rate which makes it very attractive to farmers.

The costs to farmers in this scheme are less than in other cases because the water is supplied under pressure. Therefore there is no need for farmers to purchase extra pumping equipment or pay for electricity to pump on an on-going basis. Some farmers have invested in centre pivot irrigation equipment and on farm storage dams.

Capital financing

The availability of capital finance to underpin the scheme was essential. The total cost of the recycling plant was $16 million. The Australian Government contributed $8.3 million to the scheme through an Australian Government natural resource management project. Council contributed $3 million of its own funds with a further $5 million in-kind. Even though there were significant capital outlays by Council it was suggested that a land based disposal option was a more cost effective long-term option than upgrading the existing plant to tertiary treatment.

Cost Sharing Arrangements

There is no doubt that users must undertake capital investment on-farm to utilise the recycled water. Initially, there was some resistance from farmers who argued that they '*should be paid to take someone else's wastewater'* and indeed concerns about the future costs of water remain [26]. Grappling with the issue of public and private benefit in this context is very complicated. The pricing regime adopted by the Authority does not cover costs. The price of water supplied ranged from $10-27 per megalitre in 2007. The water pricing policy provides that the price of water will

rise over the next five years to between $10-49 per megalitre. There is around a $400 000 deficit in the running of the scheme. Council considers the cost of running the scheme to be part of its community service objective. Cost sharing then comes about through the recovery of this deficit through the rate base. One possible reason people do not object to the cost of the water is because *'they feel good that their waste is being managed sustainably'* [22]. This suggests that public good values compete with those of a financial nature in the support for such schemes.

Summary

The catalyst for initiating this scheme was the need for better pollution control on the part of the local council. As in the other cases, this was driven by community concern about the impact of nutrients on local waterways and the anticipated strengthening of EPA requirements for effluent discharges. Key features emerging from this case for the establishment of the scheme is the importance of having a transparent and open process of community and stakeholder engagement. Institutional champions played an important role in recognising the value of the scheme, particularly a local member of parliament and the respected farmer, whose encouragement convinced other agriculturalists to come on board. This led to the creation of innovative institutional arrangements for the management of the scheme. Economic aspects of the scheme were also key features of success, particularly, securing the commitment of farmers to buy the recycled water and obtaining the necessary capital funding for the project.

6. Discussion

The three detailed case studies of recycled water schemes have provided considerable opportunity to examine the most salient factors in the success of recycled water schemes. In the first instance a number of characteristics believed to be most relevant to their success were examined. These included the history of the scheme, local place factors, institutional champions, institutional structure and form, public involvement, environmental impact assessment, technology and economic aspects.

Our case studies revealed that some of these aspects appear to have been of greater significance in the success of the schemes. For example, the choice of technology does not seem to be a major impediment or an incentive in any of the case studies. In fact, none of our informants mentioned water purification technology as being the subject of debate or concern in the establishment of the respective schemes.

The most important aspect to emerge from the case studies in both the history of the scheme and the local place factors was the similarity of the key drivers for the interest in and establishment of the respective recycled water schemes. In all the three examples the compelling driver was the need to deal with a pollution or waste management problem. In the Shoalhaven Scheme, the focus of concern was the impact on the environment of discharges into the ocean, particularly Jervis Bay. However, while the success of this scheme is widely acknowledged, it has not completely resulted in the outmoding of discharge to water source options. Recycling water for agriculture is however a very legitimate alternative that is now more readily considered in sewage treatment plant upgrades and expansions. In the Grampians case study, effluent discharges into the Hopkins River were the driver for an initial project - the Ararat Great Western Pipeline extension. However, later schemes built on the experience of the Ararat Scheme and these were driven more by the awareness of the potential availability of water for productive uses. In the Coal River case study, nutrient loading in the Derwent River, arising from sewage discharge, was the key driver for the establishment of the scheme.

Increasingly, the use of recycled water is considered because of its potential to reduce demand for freshwater. In these cases there can be considerable environmental benefit from a reduction in demand on freshwater sources for human consumption. Interestingly, in the three cases examined the anticipated environmental benefit was one of pollution reduction, and there was little evidence in these examples that the recycled water functioned as an offset to potable water use. In all three cases the establishment of the schemes actually resulted in an increase in the net demand for water. Although not a key driver, it is worth noting that emphasis on replacing potable water use has in each case driven interest in expanding existing recycled water projects in the context of acute water

shortage. This is evident in the push to extend recycled water use to include potable replacement, for example, for washing down dairy yards and stock consumption in the Shoalhaven. In considering such schemes, it should be kept in mind that the environmental benefits gained by pollution reduction need to be carefully weighed against other potential environmental impacts. The potential impacts include increased overall water use and potential elevated nutrient levels entering waterways. The extensive monitoring in place in all the cases shows that there is an awareness of these potential impacts.

The role of institutional champions emerged as an important aspect of the success of the case studies. It is quite apparent for example that the General Manager of Shoalhaven water during the establishment phase of the scheme is widely regarded has having been a critical player in its establishment. His role was linked by all informants to the success of the scheme and he is widely regarded as both a visionary and stalwart of the scheme. The support of the senior officer at GWMWater and the support of the Board was a vital part of the transition to sustainability. Equally, in the case of Coal River the local member of parliament and former councillor played a significant role in galvanising support for the scheme. Similar experiences in the Shoalhaven and Grampians Wimmera Mallee examples suggests that engaging the support of senior political representatives is a common feature of innovations in recycled water.

A less obvious finding of the case studies was the important role played by leaders in the agricultural community. One of the critical challenges in the establishment of the recycled water schemes was to find secure markets for the water and leadership in the farming community was very important in this regard. In the Shoalhaven, the role of the 'visionary farmer' in taking up the option for recycled water was vital to garner the support of other more reticent members of the farming community. This farmer was a vocal champion of the potential benefits of the scheme and had an important role in negotiating a favourable outcome for the dairy farmers. In the Grampians case, the leadership of Seppelts Vineyard in the Ararat Scheme was critical and this led to a number of smaller vineyards agreeing to sign on and ensured the viability of the recycled water scheme. In the Coal River case, the leadership of the vegetable growers was believed to be pivotal to the wider acceptance of the use of recycled water more broadly in the Coal River.

There is some considerable complexity to any discussion of the role of institutional structure or form. We defined institutions as habitual patterns of behaviour that can enable or constrain the implementation of innovative approaches to water use. These can encompass more formal explicitly defined agreements and structures and also, more informal arrangements (i.e. implicit norms, beliefs) between those involved. This investigation suggests that informal connections between stakeholders negotiating these approaches were important for developing good communication and trust.

On the one hand there have been important formal institutional changes preceding or following the establishment of the schemes. For example, reclaimed water projects are co-ordinated by the 'sustainable development' section of the Technical Services division of the GWMWater business. In addition, the position of a recycled water coordinator is embedded into the organisational structure of both GWMWater and Shoalhaven Water. In the Coal River example, a new legal entity or formal organisation was created for the purpose of the on-going management and expansion of the scheme. The process of normalisation of recycled water practice is clearly illustrated in the adoption by GWMWater's *Strategic Planning Framework for Reclaimed Water*. This document detailed the approach adopted by the water authority to water planning and clearly identified the role of water recycling in the overall management of the system.

In addition to these, more formal and observable aspects of institutional structure or form are important informal changes that indicate an ongoing reform to standard methods of operating. An example is the cultural shift evidenced in both the organisations and end-users implied in the statement that recycled water is a beneficial resource and not a waste product. Other more subtle changes are evidenced in working practices that can serve over time to break down prejudice or ignorance about particular approaches. It has been well documented for example, that organisational structure and professional barriers can inhibit creative solutions to problems. In the water context the legal, professional and organisational structures have traditionally been separated into distinct silos to manage aspects of drinking water supply from wastewater management. Some of the evidence in our case studies suggests that these cultural and organisational divisions are now breaking down. Changes to working practices are also bringing these different groups closer together in the provision of input and are facilitating an improved ability to solve problems because of the incorporation of different types of knowledge. This is illustrated for example, in the incorporation of community and farming representatives into advisory groups and planning meetings. The creation of separate institutional structures at Coal River may be less beneficial in the long term for reforming institutional processes to facilitate the acceptance of recycled water more broadly.

A critical institutional element in all three cases was the bedding in of legal arrangements to formalise both relationships and agreements. There appeared to be three levels of agreement that were important to the success of the schemes through explicitly apportioning costs and risks assumed by each partner. In general terms, formal arrangements were put in place between the recycling entity and government for capital funding; intra-organisational agreements commonly in the form of Memoranda of Understanding (MOU) in relation to management of schemes and between the recycling entity and customers of the water. These agreements removed any potential ambiguity related to the legal and economic responsibility.

Another important aspect of the formal institutional arrangements involves the management of risks arising from the on-farm use of the recycled water. In all three cases the contractual arrangements with water users included strategies such as education about, and management protocols for the use of, the water. This approach helps to ensure that no adverse consequences arise from the use of the recycled water and also assists with the development of trust between the recycling entity and the broader community.

It could be argued that the establishment of a recycled water scheme has fairly high transaction costs. Certainly it would appear that formalising arrangements was an important part of the long-term risk management strategy for the recycling entity. The reason why formal arrangements were costly to negotiate was because of the need to secure a recycled water market and ensure on-going compliance with licensing conditions constraining disposal into waterways.

Engaging the public was a key element in the success of all three recycled water schemes examined. This research found that it is much more than a public consultation procedure, but is rather about developing and maintaining an on-going relationship. The interesting consequence of this from an organisational perspective is that the formal environmental impact assessment is significantly less painful and time consuming than might otherwise be the case. For example, in the Shoalhaven, the broader community was involved from the beginning in the options analysis. There was an on-going effort to involve the public through educational forums, referendum and community reference panels amongst others. Thus by the time the proposal was proceeding through the formal environmental approval process, the project design complied with relevant standards, and importantly had widespread community support with little opposition.

Analysis of the case studies indicates that community support is a potential institutional change agent enabling the establishment of innovative practices such as recycled water use. The literature review gave support to the idea that the early engagement of the community in problem solving about the wide range of water issues was likely to lead to not only creative solutions but also significant understanding of the issues (Russell and Hampton 2006; Russell and Lux 2006). The 20th century engineering solutions to water supply and wastewater management tended to centralise knowledge and power. The effect of this has been to exclude the broader public from a role in decision-making about these issues. The case study experiences suggest that communities are demanding a greater say in the way water is managed but also that this comes with greater responsibility in its use. One of the keys to achieving long-term change is the development of dynamic relationships between the community and water authorities.

There are several elements critical to the establishment of these relationships. Perhaps the most important of these are time and transparency. In the three case studies examined in this study the time from project conception to delivery was in the order of ten years. The reasons for this lengthy

development phase are complex not the least being the challenge in obtaining financial backing for the projects. However, it may also be a natural consequence of the lengthy relationship building process necessary to the success of the schemes. In all three cases the changes introduced were quite dramatic. Not only was a recycled water scheme established but in most cases water users had to move from dryland agriculture to irrigated agriculture. The shifts appear to have taken place at three levels. Firstly, within the water management agency a change was required from a traditional approach to water management to one that embraced water recycling and water cycle management. Secondly, the broader community needed to develop an understanding of and support for the new approach. Finally, the water users had to be brought up to speed, not just about the use of recycled water, but also about a whole new approach to their farming enterprise.

When described in these terms, the complexity of the agency-community relationships and multi-layered paradigm shifts required considerable time and effort to achieve. It can be seen that both the internal stakeholders as well as the external stakeholders are important. Internal stakeholders that were critical to the success of the schemes included not only the engineers and designers but also the financial and regulatory arms of the agencies. The external stakeholder group is made up of the community as well as other interested agencies that have responsibility for health, pollution control and agriculture.

These relationships are on-going because the success of the schemes depends on the maintenance of trust and confidence between the agency, community and users. The relationships are two way. For example, the integrity of the water authority depends on the compliance of the water users with the terms of their contacts to prevent public health and environmental impacts. At the same time, the water users must have confidence in the water authority to supply water at the quality essential to maintain the viability of their businesses as well as maintain the condition of their natural assets and water infrastructure.

The development and maintenance of trust would appear to depend on establishing both formal and informal arrangements. Transparency in these arrangements is an important underpinning principle. Formal arrangements for water quality monitoring needed to be supported by measures that make the results of monitoring broadly available to users and the community in an accessible form. In all our cases, water quality monitoring results are available on the agency web sites. Robust contingency measures in the event of system failure are important to the maintenance of trust in the water management system. In all cases, the agencies and communities have developed mechanisms to respond in these cases. Due diligence not only assists with the technical and legal liabilities but also is an important part of the process of maintaining trust in the system.

Finally the economic issues would appear to be some of the most complex and potentially controversial of the characteristics underpinning successful recycled water schemes for agriculture.

In these three studies, success of the schemes depended on the provision by government of much of the capital costs of establishment. In each case, funding for key aspects of infrastructure was sourced from either state governments or the Australian Government. For the Shoalhaven, the Country Sewerage Scheme administered by the then Department of Land and Water Conservation provided funding. For the Grampians Schemes capital investment came from a variety of external sources such as an Australian Government natural resource management program and the state government. In the case of the Coal River Scheme an Australian Government natural resource management program provided funding for the construction of the of the pipeline while some funding through the National Water Initiative was used in the recycled water plant construction. In each case, the source of the capital funding had an important influence on the nature of the scheme because of eligibility requirements for public funding.

There were also special arrangements in each case with the water users to assist in the set up of their on-farm operations. Generally, public funding was not available for on-farm (private) works, but was available to assist in bringing infrastructure to the farm gate. In all cases, a subsidised or nominal rate is charged for the use of recycled water as part of the contract arrangements.

In all this, there are complex arguments for and against these economic and financial arrangements. On the one hand, the polluter pays principle would support the idea that it is reasonable for the broader community to contribute to the cost of disposing of their waste since they generate the effluent. On the other hand, this disposal option through on-farm irrigation has the potential to generate significant private benefit. In this case the user pays principle would appear to be relevant. There was a need in the three cases studied to engage in a process which effectively created a demand for water to enable an alternative disposal option to replace a more harmful one. The critical challenge was to ensure an equitable apportionment of public and private benefit which is reflected in cost-sharing arrangements. While these considerations are negotiated on a case by case basis, it is clear that the need exists for capital to underpin the development of water recycling in rural areas.

Summary

In summary, the key features for understanding drivers and constraints to successful recycled water schemes in the three case-study areas investigated include:

- community engagement from the early stages of initiation (i.e. ‘bottom up’ elements)
- commitment by agency officials to engagement of community in the process
- this includes senior organisational and political support (i.e. role of institutional champions)

- users seeing value in recycled water and the role of the ‘visionary farmer’ in generating collective commitment
- informal partnerships underpinned by formal agreements and procedures for building understanding and trust
- organisational cultural shifts embracing water cycle approaches (i.e. ‘water cycle’ knowledge displacing conventional water supply/dispose knowledge; and knowing how to include non-officials in processes)
- interaction across organisational and professional boundaries
- secure capital funding.

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Appendix 1 – Interview questions

A. Organisational and agency representatives:

1. Could you outline your background briefly? [*professional / educational training*]
2. What is your present position and activities?
3. What was your role in relation to planning the [*name of recycled water scheme*]?
4. What were the reasons the scheme was initiated?
5. How did water recycling come up as the preferred option? Who was involved in that process? [*i.e. how were water use options generated, weighed up and selected in the decision-making process, who took part in that process*]
6. Were there any major challenges in relation to developing the scheme? [*i.e. organizational, social or economic issues (e.g. set-up costs, subsidies, delivery costs, risk apportionment)*]
7. What sort of involvement did you have with users and the public?
8. Water recycling isn't a traditional approach; did you have any issues as it went through your own organization? [*i.e. roles and responsibilities, internal processes, relationships, relevant to how scheme was progressed*]
9. Could you direct me to any other people involved in the process who I could speak to, or any other information?
10. Would you like a summary of the interview? (yes/no) [*Confirm email / postal address.*]

B. Farmers/water users and community members:

1. What is your background? (*education, training, professional life, occupation, type of farming*)
2. How and why did you become involved in the [*name of water recycling scheme*]?
3. What were the reasons the scheme was initiated?
4. What did you do in the planning process?
5. When and how did water recycling become an option or issue? Who was involved in that approach and what did they do?
6. Given that water recycling isn't a traditional approach, were there any issues for getting such a scheme running? [*economics, social, environmental*]
7. What was your impression of the relationships between the water agency staff and local users/farmers during the planning of the scheme? How did this affect the outcomes from the process?
8. What influence do you think the community/users/farmer's groups and you yourself had on the scheme and its outcomes?
9. From your point of view, in what ways could the planning process have been improved?
10. Could you direct me to any other people involved in the process who I could speak to, or other information?
11. Would you like a summary of the interview? (yes/no) [*Confirm email / postal address*]

Appendix 2 – Project Fact Sheet

Australian Government
Bureau of Rural Sciences





Recycled Water – Opportunities and Challenges

The Social Sciences Program of the Bureau of Rural Sciences is conducting a study on water recycling for agriculture. The project is looking at opportunities and constraints to the development of recycled water schemes as part of integrated water use strategies in rural and regional areas of Australia.

The primary aim of the project is to develop a better understanding of the institutional and socio-cultural issues which influence the utilisation of recycled water for agriculture.

The key questions are:

* **How are stakeholders, community representatives and water users involved in planning local water recycling investments?**
* **What are the drivers and constraints to investments in recycled water in rural and regional Australia?**

Approach

The prolonged drought in Australia has placed significant pressure on agricultural industries and communities to develop innovative approaches to water use. Water recycling is one of several ways of enhancing water efficiency, security of supply and cleaner waterways.

Three recycled water initiatives in rural and regional Australia – in the Shoalhaven (NSW), Wimmera-Mallee (Victoria) and Coal River (Tasmania) – are case studies for this research. Along with many other areas in Australia, these regions have undergone significant stresses due to the prolonged drought.

Interviews will be undertaken with stakeholders involved in water recycling schemes – including water authority staff, local/state governments, NGO/environment groups, community representatives and users – to learn more about local conditions. The interviews will give us an in-depth look at the range of views about water recycling in agriculture and the opportunities and challenges for investment.

Expected outcomes

* This research will contribute to our understanding of stakeholder involvement in planning processes related to recycled water schemes for agriculture in rural and regional Australia.
* The findings will inform government policy by providing a better understanding of the social, institutional and cultural issues that influence the uptake of recycled water in agricultural industries.

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