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Water for a Healthy Country

Predicting Community Behaviour in Relation to Wastewater Reuse

What Drives Decisions to Accept or Reject?

Murni Po, Blair E. Nancarrow, Zoe Leviston, Natasha B. Porter, Geoffrey J. Syme and Juliane D. Kaercher

NATIONAL PROGRAM FOR Sustainable Irrigation

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SUMMARY

This reports the results of a three year investigation which aimed to develop a measurement of prediction of community intended behaviour in relation to the reuse of different wastewaters for different uses. It has been apparent that communities support the concept of water reuse as a means of responsible water resources management. However, many technically sound schemes internationally have failed because communities have rejected them. Little has been known of how people make their decisions to accept or reject schemes. Public acceptance, therefore, has been viewed as an "obstacle" to implementing reuse schemes and so the emphasis has been principally on persuasion. However, it is now generally accepted that social marketing and persuasion are ineffective. Until now, it has been difficult to know what to replace them with as there have been no systematic programs of social investigation to identify the different factors that might influence public perceptions or mediate their decision making. International literature reviews found little that specifically related to the recycling of water, however, a number of parallel literatures (eg. food technology) provided some insights.

Therefore, a research program was designed to systematically investigate, identify, measure and test the major factors that govern people's decisions about whether to use recycled water for different uses or whether to reject the schemes. It was decided to use Ajzen's Theory of Planned Behaviour (1985) as a basis on which to build the theory and methodology. This would allow an holistic analysis of prediction of actual behaviour rather than just individual attitudes and perceptions at particular points in time. Knowing what predicts behaviour would then allow water planners and utilities to systematically target these variables and address the actual concerns held by particular communities.

Using Ajzen's behavioural model as a basis, a hypothesised model was developed which incorporated the additional factors from comparable literatures. These needed to be tested for validity in circumstances that were as realistic as possible for community participants. Therefore, a social experiment was conducted with a random sample of community members where they were asked to drink "recycled water" and eat the horticultural products grown with "recycled water". Through a series of questionnaires (before, during and after the experiment), the measurement scales were tested.

The outcomes of the experiment confirmed both the choice of the additional variables and the validity and reliability of the measures. The findings confirmed previous work in water recycling research in that the closer the personal contact, the less acceptable the use. However, it also appeared that being exposed to the experiment also reduced acceptance. Both trust and emotions were shown to be involved in people's decisions to accept or reject the reuse situations, but surprisingly health risks were not significant in these decisions.

Having developed the measures, two case studies in two Australian cities were used to test the hypothesised model through a survey methodology. It was important that the case studies be immediate and applicable to the relevant communities so that they could clearly visualise their intended behaviours. Therefore an indirect potable scheme that was being considered for Perth and a horticultural irrigation scheme which had been launched in Melbourne (Werribee) were chosen.

Similar survey questionnaires were developed for each of the case studies and differed only in the details of the reuse schemes. A sample of 400 stratified random community were surveyed in each city. The results were remarkably similar in each city and provided confidence in both the selection and the measurement of the principal variables involved in people's behavioural decisions in relation to recycling schemes.

The final models showed the relationship of the variables and their strength of contribution to the decision making to either buy the horticultural produce or drink water from the aquifer replenished with treated wastewater. Most of the hypothesised variables emerged in the final analysis.

The two case studies provided a quantitative understanding of the role of emotions in people's behavioural decisions, both in the ability to measure them and also in terms of the degree of influence on the decisions. While these emotions are often discounted as "irrational" they constantly prove to be difficult to deal with and frequently constitute the major reasons for the failure of past schemes to gain public acceptance. However, the results of the statistical analyses show how other variables could be used to temper them, such as by increasing trust in the authorities and increasing the influence of "others".

Of considerable interest was that knowledge did not emerge as a factor in people's decisions to buy the produce. Anyone considering using communication and education as the main feature of a program to obtain community acceptance of a recycling scheme should take note of this finding. However, the provision of comprehensive and open information is a factor in engendering trust, so the role of knowledge should not be totally discounted.

As in the social experiment, the surprising finding that risk perceptions were not more dominant in influencing behavioural intentions occurred in both case studies. While risk was quite strongly influenced by trust, it had only a weak contribution to behavioural intention. Given that it is assumed that technological and health risks are important to address with the community, this is a significant finding. The model also suggests that by increasing trust in the authorities, people's concerns about risk will also reduce.

One finding that emerged in the Melbourne horticultural model that was different from the Perth case study, was the greater contribution to the decision making of environmental obligation. That is, the more people felt an obligation to protect the environment, the more positive were their attitudes to buying vegetables grown with recycled wastewater.

There were a number of outcomes of comparisons between the major variables in the models and the participants' demographic details that were of interest. It was evident that, in both case studies, people with lower levels of education were less trusting of the authorities than those with higher levels of education. Also females were more inclined to hold more negative emotions about the schemes than were men. There were also a number of other useful comparisons pertinent to the particular schemes that would be of great assistance for planning authorities.

Perhaps one of the most interesting findings here was that the indirect potable and the horticultural irrigation schemes were apparently seen by the communities to be similar. That is, "nature" acted as a filter for both schemes: the aquifer in the case of the indirect potable scheme and the plants in the case of the Werribee scheme. This may explain why the resulting models were so similar, except in the case of environmental obligation. It is expected that the contribution to the model of the different variables would be different for different recycling schemes. It therefore should be tested on a very different case study from these.

This research has provided an extremely promising start and the replication of the model provides considerable confidence in the variables and their measures. However, as with any new work, there remain a number of issues that have been identified by the researchers that need further refinement. This will occur over the next year or so, with opportunities for the further testing on different case studies being sought. The final product will be a tool that will allow planners and water utilities to predict potential behaviour in relation to their proposed reuse schemes and understand their local communities.

1.0 INTRODUCTION

In recent years, different States in Australia have established targets to increase their use of treated wastewater. For example, in Perth the State government aims to reuse 20% of its wastewater by 2012. In Melbourne, the target is set at 20% by 2010. Reusing wastewater that would otherwise be discharged to an outfall has now become an integral part of policy for Australia's water resource management.

Recycled water can be used for different water services ranging from landscape and agricultural irrigation to industrial and domestic household uses. The possible implementation of any reuse scheme, however, hinges on public acceptance of the scheme.

As a concept for responsible water resource management, water reuse is widely promoted by the Australian community. Focus groups held separately in different States have generally found people to be accepting of water reuse (Melbourne Water, 1998; Sydney Water, 1999; Water Corporation of WA, 2003; Kaercher, Po and Nancarrow, 2003). However, reactions from people when it comes to actually using the water are frequently quite different. Water recycling is seen to be a logical and necessary inclusion in the range of water resource management options, but communities frequently feel a reluctance to personally use the water. Little is known of how people make their decisions to accept different water recycling schemes for a range of different uses. What is apparent is that many technically sound reuse schemes around the world have failed because communities have rejected them, often at the eleventh hour.

In the past, public acceptance has been viewed as an "obstacle" to implementing reuse schemes and so the emphasis has been principally on persuasion. However, it is now generally accepted that social marketing and persuasion are ineffective. But it is difficult to know what to replace them with as there have been no systematic programs of social investigation to identify the different factors that might influence public perceptions or mediate their decision making. There have been only limited studies to date and these have mostly been conducted by water utilities.

International literature reviews (Po, Kaercher and Nancarrow, 2004; Po and Nancarrow, 2004) were recently conducted to try to identify factors that might have significant influence on people's acceptance of recycling schemes for a variety of uses. Little was found specifically relating to recycling of water, however, a number of parallel literatures (eg. the food technology literature) provided some insights. These factors included:

- perceived risks and benefits of the schemes
- perceived control over the quality of water
- trust in authorities, experts and technology
- knowledge about the schemes
- personal feelings & emotions associated with the schemes
- nature of the scheme

Therefore, a research program was designed to systematically investigate, identify, measure and test the major factors that govern people's decisions about whether to use recycled water for different uses or whether to reject the schemes. It was decided to use Ajzen's Theory of Planned Behaviour (1985) as a basis on which to build the theory and methodology. This would allow an holistic analysis of prediction of actual behaviour rather than just individual attitudes and perceptions at particular points in time. Knowing what predicts behaviour would then allow water planners and utilities to systematically target these variables and address the actual concerns held by particular communities.

Ajzen's Theory of Planned Behaviour has been used successfully to predict a range of human behaviours (eg. East, 1997) as well as providing empirical predictive evidence specifically in relation to pro-environmental behaviours (eg. Lynn et al., 1995; Harland et al., 1999). It has also been the subject of many positive reviews (eg. Manstead and Parker, 1995; Armitage and Connor, 2000). The theory itself develops on the seminal work in attitudinal theory by Fishbein and Ajzen (1975), and Ajzen and Fishbein (1980). It thus provides a highly reliable theoretical basis on which to build.

This report describes the various stages in that research program: the development of the model; the preliminary testing of the hypothesised variables and the validity of the measures through a social experiment; and the testing of the model through surveys about two reuse schemes in Australia. The schemes chosen were the newly established use of recycled wastewater for horticultural production at Werribee in Melbourne, and the proposed indirect potable reuse scheme through managed aquifer recharge in Perth.

2.0 RESEARCH PROGRAM METHODOLOGY

2.1 Ajzen's Theory of Planned Behaviour

Ajzen's (1985) Theory of Planned Behaviour (see Figure 1 below) proposes that a person's behaviour can be predicted from their behavioural intention. This intention is in turn determined by attitudes (towards the particular behaviour), subjective norm (what others think and personal motivation to comply), and perceived behavioural control (ease or difficulty of performing an action).

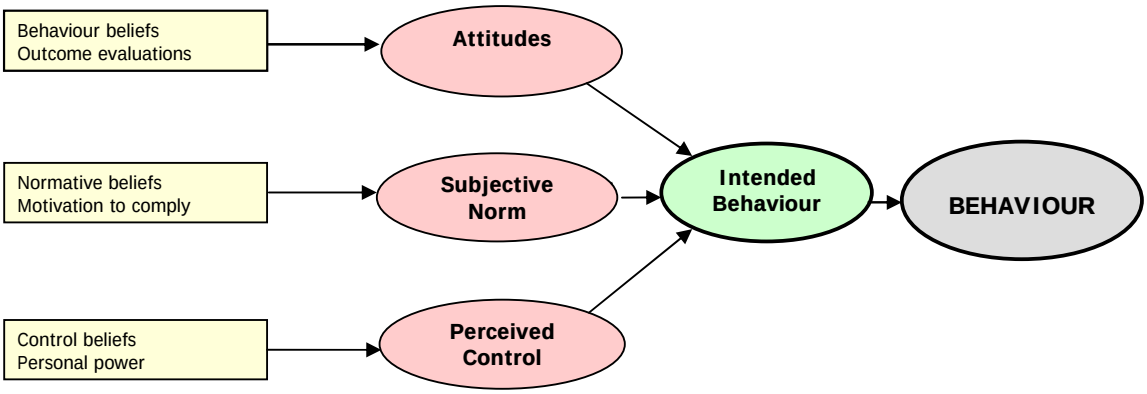


Figure 1. Ajzen's Theory of Planned Behaviour

Using Ajzen's behavioural model as a basis, a hypothesised model was developed which incorporated the additional factors from comparable literatures. This is shown in Figure 2.

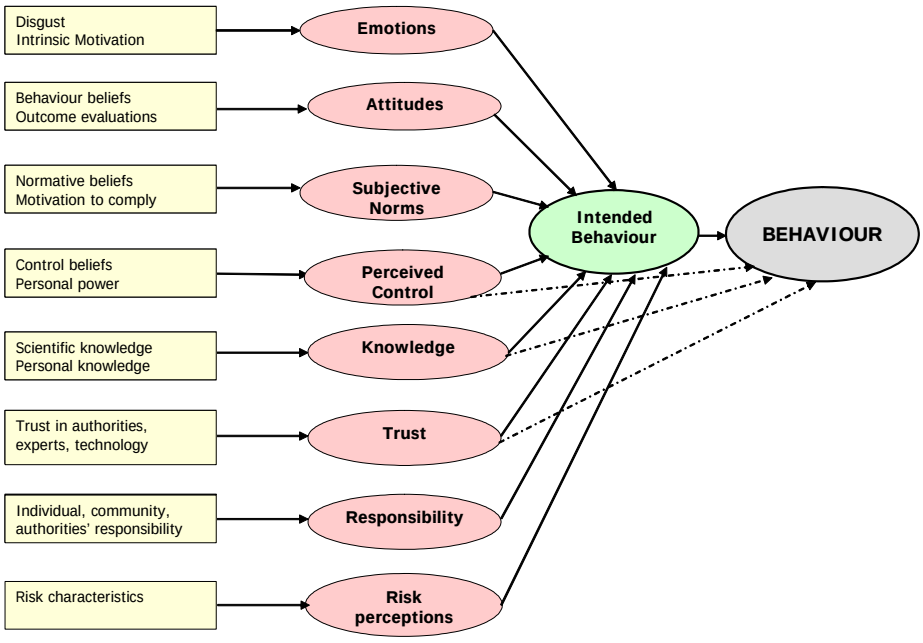


Figure 2. The hypothesised model

2.2 Developing the Measures

A range of measures were developed for each of the variables in the hypothesised model. These needed to be tested for validity in circumstances that were as realistic as possible for community participants. It was therefore decided to conduct a social experiment with a random sample of community members whereby they would be asked to drink "recycled water" and eat the horticultural products grown with "recycled water". Through a series of questionnaires, the measurement scales could be tested. The details of this stage are reported in Section 3.

2.3 Testing the Model

Having developed the variable measures, two case studies in two Australian cities were used to test the hypothesised model. It was important that the case studies be immediate and applicable to the relevant communities so that they could clearly visualise their intended behaviours. Therefore an indirect potable scheme that was being considered for Perth and a horticultural irrigation scheme which had been launched in Melbourne were chosen.

Similar survey questionnaires were developed for each of the case studies and differed only in the details of the reuse schemes. It was planned to survey a sample of 400 stratified random community in each city.

2.3.1 Perth Indirect Potable Reuse

Perth, the capital of Western Australia, is facing the results of a long term water shortage which is believed to be the result of climate change. A stepped change in rainfall occurred in the mid 1970s and again in the mid 1990s. This has resulted in a need to quickly develop more water sources. However, an added management issue has been the overuse of the major drinking water aquifer to unsustainable levels.

Managed Aquifer Recharge (MAR) has been suggested as a means of addressing both the requirement for a new source of water and the restoration of the stressed aquifer. Treated wastewater could be injected into the aquifer, mixed with the natural groundwater and later retrieved as the drinking water source. Water source issues are constantly discussed by the community and were the focus of the recent State election campaign. The need for a range of new and unconventional water sources is understood by the community as well as water reuse being a community priority in responsible water resources management. The MAR case study was therefore highly relevant. The results of this survey can be found in Section 4.

2.3.2 Melbourne Horticultural Irrigation

Melbourne, the capital of Victoria, has recently launched a scheme whereby treated wastewater from the Werribee Wastewater Treatment Plant was piped to nearby irrigators of horticulture. This scheme assisted in the restoration of the stressed groundwater aquifer and the meeting of Victoria's water reuse target of 20% by 2010. Water shortages have been a feature of Melbourne's planning over the past few years with the community experiencing quite severe restrictions for garden irrigation. The Werribee scheme was publicly launched and the horticultural produce was being sold throughout Melbourne as well as being exported. This reuse scheme was therefore immediate and applicable to all Melbourne residents. The results of this survey can be found in Section 5.

3.0 THE SOCIAL EXPERIMENT

Our knowledge of factors that affect people's decisions to accept or reject a particular reuse scheme is limited at this stage. One concern with introducing a reuse scheme is the "yuck factor" or disgust. The role of this emotion in people's decision-making processes is poorly understood. In psychological terms, the disgust emotion is defined as *the emotional discomfort generated from close contact with certain unpleasant stimuli* (Angyal, 1941). A disgust emotion in using recycled water is likely to be generated from people's perceived 'dirtiness' of the water and their fear of contagions or personal contamination from using the water. The emotion quotient in reusing water is therefore likely to be important in gaining an understanding of how people make decisions about using the water.

This study has been conducted as part of the CSIRO flagship program, Water for a Healthy Country. The role of the "yuck factor" in people's decision making was of particular interest. In addition, the study aimed to determine ways of measuring other factors that have been hypothesised to influence people's decision to accept or reject a particular use of recycled water.

As a summary, the study aimed to test measures and influences of:

- the feelings people associate with using recycled water for different purposes, specifically the "yuck factor";
- the range of factors that may influence public perceptions of using recycled water for different purposes.

3.1 Methodology

3.1.1 Study Design and Sample

In order to examine participants' behavioural responses to recycled water directly, an experimental study involving taste tests was adopted. Participants in the study were asked to taste test three samples of water that were labelled treated greywater, stormwater or wastewater and twelve samples of fruit and vegetables labelled as being irrigated with these recycled water sources.

Although recycled water and produce irrigated with recycled water has been shown to be safe to consume, the study decided to use placebos to avoid any unnecessary risks to the participants. The samples of water consisted of filtered scheme water and the fruit and vegetables were purchased from local supermarkets. Concealment of the samples' origins was essential to the methodological design so that participants' responses to recycled water could be directly measured. When designing the study, consideration was given to all ethical principles required by the National Health and Medical Research Council regarding research that involves concealment. In addition, all the food preparation and services in the study were guided by the Australia New Zealand Food Standards code to ensure the safety of food presented to the participants.

As a summary, the fifteen samples that the participants were asked to taste were as shown in Table 1.

Table 1. Samples of water and produce

Sample No	Label
1.	Treated greywater
2.	Treated wastewater
3.	Treated stormwater
4.	Oranges irrigated with treated greywater
5.	Oranges irrigated with treated wastewater
6.	Oranges irrigated with treated stormwater
7.	Lettuce irrigated with treated greywater
8.	Lettuce irrigated with treated wastewater
9.	Lettuce irrigated with treated stormwater
10.	Grapes irrigated with treated greywater
11.	Grapes irrigated with treated wastewater
12.	Grapes irrigated with treated stormwater
13.	Carrots irrigated with treated greywater
14.	Carrots irrigated with treated wastewater
15.	Carrots irrigated with treated stormwater

3.1.2 Participants

Participants were randomly selected from a number of Perth suburbs. The selection of the suburbs was based on weekly family income figures obtained from the Australian Bureau of Statistics (2001) and the proximity of the suburbs to the study location, as the participants were not paid for their involvement.

Eight suburbs close to the study location were chosen: two from the lower income groups (Hilton & Osborne Park); four from medium income groups (Innaloo, Woodlands, Doubleview & Jolimont) and two from higher income groups (Churchlands & Shenton Park).

A minimum of eighty participants was required for the experiment. Taking into account the usual drop-out rate, a total of 161 people were recruited to ensure the required number attended. An attempt was made to ensure there was an equal number of males and females agreeing to participate in each suburb.

The following table shows the number of people who attended the experiment, those who agreed but did not participate, and those who refused. The details of those who refused to participate were divided into two categories: people who were simply not interested in the study (Absolute) and those who could not attend due to other commitments (Conditional).

Table 2. Study sample design

Socio-Economic Group	Suburb	Attended	Agreed but did not participate	Refused		Total Called
				Absolute	Conditional	
Lower	Hilton	14	7	51	155	235
	Osborne Park	11	9	102	180	306
Medium	Doubleview	11	9	25	60	106
	Innaloo	9	11	52	73	148
	Jolimont	11	9	36	36	93
	Woodlands	14	6	53	96	170
Higher	Churchlands	11	9	36	67	133
	Shenton Park	12	9	42	74	139
	Total	93	69*	397	741	1330

*15 people sent apologies prior to and during the experiment

3.1.3 Procedure

Telephone recruitment of participants was conducted during the second week of April 2004. Only one person was required to participate from each household. Before they attended the experiment, respondents who agreed to participate were asked to answer a preliminary telephone questionnaire. This preliminary survey questionnaire contained a number of attitudinal statements and socio-demographic information.

The experiment took place on 1st May 2004 at the CSIRO Centre for Environment and Life Sciences. It was estimated that each participant would take no more than two hours to complete the experiment. The first 20 participants were scheduled to arrive at 9.00am, followed by another group of 20 at each half hour until 12.30pm.

The following shows a schedule of the experiment and its estimated time.

1. Induction 15 mins
2. Taste tests 1 hr 15 mins
3. Questionnaire 15 mins
4. Debriefing 15 mins

3.1.3.1 Induction

Participants were first introduced to the physical layout of the experiment. They were then given a brief explanation of the study and the terms used in the experiment (e.g. treated wastewater; greywater and stormwater), followed by instructions on how to proceed. *They were advised that tasting and swallowing the samples were not compulsory.*

3.1.3.2 Taste tests

Participants were requested to complete taste tests of a total of fifteen samples of water, fruit and vegetables irrigated with treated wastewater, greywater, and stormwater. Each sample was presented on a separate table. The fifteen tables were arranged so that the similar food and drink types were not consecutive. This aimed to reduce potential experimental bias.

Each table was labelled from 1 to 15 with a description of the sample (e.g. oranges irrigated with treated wastewater). For tables with fruit and vegetable samples, an A4 sized picture of the relevant sample was also presented which illustrated the contact with the water in the irrigation process. Participants were also reminded that tasting was not compulsory.

Each participant was provided with a booklet containing questions for each table. The pages in each booklet had been organised in random order to decrease potential order bias. Efforts were also made to ensure that no participants began the experiment with any drink samples.

Upon tasting, participants were required to complete all questions for that table before moving to the next.

3.1.3.3 Questionnaire

After the taste tests, participants were asked to complete a separate survey questionnaire. Some of the items in this questionnaire were repeated from the pre-experiment telephone survey to examine any apparent attitudinal changes to recycled water after being exposed to the experiment.

3.1.3.4 Debriefing

Participants were debriefed in an isolated office before leaving the experiment. This included personally addressed written information which explained that the samples were not associated with recycled water and the scientific reasons for the deception. A staff member was also available to the participants at all times to ensure that all their queries and concerns were addressed.

3.2 Results

For practical reasons, the study results are reported in four main sections. Section 3.2.1 comprises the results of *only* the preliminary survey conducted on the phone *before* the participants attended the experiment (Survey 1). Section 3.2.2 details the results of additional questions asked of participants *after* they completed their taste tests (Survey 2). The same questions asked to participants in Surveys 1 and 2 are reported in Section 3.2.3. Section 3.2.4 presents the results from the taste test experiment.

3.2.1 Survey 1

3.2.1.1 Awareness of Perth's water issues

Participants were asked the extent to which they were aware of Perth's water issues on a five-point scale. The majority of participants (85.8%) considered they were *aware* or *very aware* of Perth's water issues. No respondents reported being *not at all aware*.

3.2.1.2 *Experience with recycling* water

Participants were asked whether they had visited or lived in a place where greywater, stormwater or wastewater has been reused. A similar percentage of participants reported they had (50.0%) as had not (46.7%). Those who had or might have experienced recycled water were asked to indicate the type of water. Up to three responses were allowed.

Table 3. The type of water experienced

Water reused	Frequency (N=49)	Percentage
Greywater	46	95.8
Stormwater	17	35.4
Treated wastewater	4	8.3
Desalinated water	2	4.2

Greywater was the most common source of water reused. This included water from a washing machine/laundry (54.2%), shower/bathroom (20.8%) and dishwasher/kitchen (8.3%). *Stormwater* was the second most common source of water reused and this included rainwater tanks (33.3%) and bore water (2.1%). Other sources of water used were treated *wastewater* and desalinated water.

The recycled water was mainly used for *garden irrigation only* (79.6%), followed by *drinking* (14.3%) and *everything around the house* (12.2%).

Participants were also asked to rate their experience with using recycled water. The majority of respondents (85.7%) rated their reuse experience as *positive* or *extremely positive*. Very few participants rated the experience to be *negative* (4.1%) and no participants rated it to be *extremely negative.* About ten percent of participants rated the experience to be *no different*.

Participants who rated the experience to be either *positive* or *negative* were asked to indicate why. The main positive responses were *making good use of water* (72.7%), *water is scarce* (27.3%), and *no issues with reuse* (11.4%). Very few negative responses were mentioned. Examples of the negative responses were *chemicals in the water affected plants* (4.5%), *got sick* (2.3%), *don't like the taste* (2.3%).

3.2.2 Survey 2

3.2.2.1 Preferred terms to use

Participants in Survey 2 were given eight alternative terms that could be used to describe treated wastewater. They were then asked to rank their top three preferences from the eight terms. They were also asked to rank one term that they like the least.

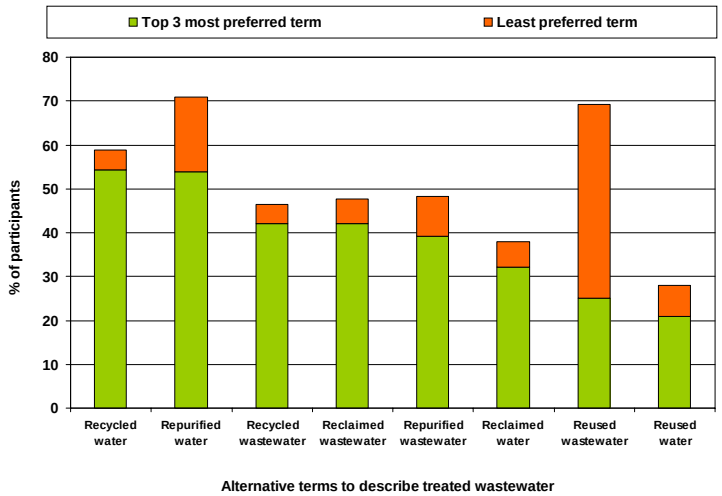


Figure 3. Preference ranking of alternative terms used to describe treated wastewater

Recycled water and *repurified water* were ranked by over half of the participants to be in their top three most preferred terms. The term *repurified water* was also ranked by nearly one fifth of participants (16.9%) as their least preferred term. *Reused wastewater* and *reused water* were also not favoured by participants with the term *reused wastewater* ranked the least preferred term by 44.3% of participants.

3.2.2.2 Cost of treated wastewater

Participants in Survey 2 were also asked about the potential influence of cost in their decisions to accept or reject reusing the water. The responses to this question are recorded in the table below.

Table 4. Would the cost of treated wastewater affect your decision to use the water?

	Frequency (N=93)	Percentage
Yes	38	40.9
Not sure	28	30.1
No	27	29.0

About forty percent of participants indicated that the cost of treated wastewater would affect their decision to use the water. Under one third (29.0%) said it would not affect their decision and 30% were unsure. Participants were further asked why they responded that way. Up to three answers were allowed for this question.

The main reasons for cost being an issue were *cost should not be too high*, *it should be cheaper*, c*ost is always a factor* and *other sources may be cheaper*.

Participants who thought the cost *would not* affect their decisions said that *cost should not be the main consideration*, *if the water situation is critical* and *water is precious*. The main reason given by participants who were *unsure* about the possible effects of cost on their decision was that *the cost should not be too high*.

3.2.2.3 Cost of produce irrigated with treated wastewater

Participants were also asked whether the cost of fruit and vegetables irrigated with treated wastewater would be a consideration in their acceptance or rejection of buying the products. A little more than one-third of participants (38.7%) said it would, with a similar percentage of participants (35.5%) saying it would not. The main responses for cost affecting their decisions to buy included *cost is important to me, would buy it if it was cheaper, cost should not be too high* and *more information needed on treatment process.*

For participants who thought cost would not affect their decisions, the main reasons given were *quality of produce is more important*, *cost should not be the major consideration*, *do not like the idea of using treated wastewater*, and *not concerned with quality of irrigation water*. Those who were unsure if cost would be a factor, the most frequent comment was that the *cost should not be too high*.

3.2.3 Surveys 1 & 2

3.2.3.1 Acceptability of different uses of treated wastewater

In both Surveys 1 and 2, participants were asked to rate on a five point scale how acceptable it would be to them if the government introduced the reuse of treated wastewater for a range of purposes. The question was repeated in Survey 2 to examine whether participating in the experiment could influence people's acceptance of reuse for any purposes.

The acceptability percentages and mean ratings of different uses of treated wastewater for Surveys 1 and 2 are shown in the table below.

Table 5. Acceptability of different uses of treated wastewater

Uses of treated wastewater	Survey 1			Survey 2		
	Acceptable or highly acceptable	Unacceptable or highly unacceptable	*Mean*	Acceptable or highly acceptable	Unacceptable or highly unacceptable	*Mean*
	%	%		%	%	
Watering public parks**	97.8	1.1	4.80	95.7	4.3	4.60
Home toilet flushing	98.9	1.1	4.80	93.5	3.3	4.71
Watering public playgrounds*	95.7	1.1	4.72	87.0	8.7	4.36
Watering home lawns/gardens*	95.6	2.2	4.70	89.2	6.5	4.41
Watering golf courses	96.7	2.2	4.77	95.6	4.3	4.71
Irrigating dairy pastures*	84.8	6.5	4.42	82.7	13.0	4.07
Irrigating fruit and vegetables*	88.0	8.7	4.34	67.4	26.1	3.63
Washing your clothes	78.5	12.0	4.02	72.8	19.6	3.95
Showering and bathing at home	57.6	27.2	3.45	53.3	33.7	3.28
Filling public swimming pools	52.1	27.2	3.34	47.8	35.9	3.20
Cooking at home*	43.5	30.4	3.09	33.0	46.2	2.69
Drinking**	31.5	45.7	2.68	23.1	57.1	2.36

*significantly different at $p < .01$ **significantly different at $p < .05$

Consistent with the previous research findings (eg. ARCWIS, 2002), the percentages of participants who found a specific use of treated wastewater *acceptable* or *highly acceptable* decreased as the use moved closer to human contact. About a third of participants in Survey 1 (31.5%) and a quarter of participants in Survey 2 (23.1%) found the reuse of treated wastewater for drinking purposes to be *acceptable* or *highly acceptable*. Using the treated wastewater for watering public parks, golf courses, public playgrounds, dairy pastures, home lawns and gardens, and home toilet flushing was generally seen to be *acceptable* or *highly acceptable* to most participants.

Overall, the mean acceptability ratings of the different uses in Survey 1 tended to be higher than those in Survey 2. In particular, the mean acceptability ratings of using treated wastewater to irrigate public playgrounds, home lawns or gardens, dairy pastures and fruits and vegetables were significantly higher in Survey 1 than Survey 2. Participants found these uses of treated wastewater to be more acceptable when they were asked in Survey 1 than Survey 2. This finding therefore suggested that exposure to the experiment may have influenced participants' perceptions of using recycled water. Participants seemed to have lowered acceptance of reuse after being faced with recycled water.

Participants in Survey 2 were further asked, on a 5-point scale, how fair it would be to ask people to use treated wastewater for the purposes described above.

Table 6. Fairness judgement of different uses of treated wastewater

Uses of treated wastewater	*N*	Unfair or extremely unfair	Neither	Fair or extremely fair	*Mean*
		%	%	%	
Watering golf courses	90	3.3	3.3	93.4	4.63
Home toilet flushing	90	4.4	5.6	90.0	4.59
Watering public parks	90	2.2	4.4	93.4	4.54
Watering home lawns/gardens	90	6.6	7.8	85.5	4.38
Watering public playgrounds	90	10.0	5.6	84.4	4.22
Irrigating dairy pastures	90	16.7	8.9	74.5	3.97
Washing your clothes	90	22.2	13.3	64.4	3.63
Irrigating fruit and vegetables	90	24.4	14.4	61.1	3.50
Filling public swimming pools	90	37.8	15.6	46.7	3.08
Showering and bathing at home	90	42.2	16.7	41.1	2.93
Cooking at home	90	48.4	23.1	28.6	2.53
Drinking	91	62.7	16.5	20.9	2.20

The majority of participants (>80.0%) considered that asking people to use treated wastewater for watering golf courses, public parks, home lawns and gardens and public playgrounds to be *fair* or *extremely fair*. Almost two thirds of participants (62.7%) thought it was *unfair* or *extremely unfair* to ask people to use treated wastewater for drinking. Nearly half of the participants (48.4%) also felt this way about using treated wastewater for cooking.

Overall, the results indicated that it becomes less fair to ask people to use treated wastewater as the use moves closer to human contact. This was similar to decisions of acceptance of the different uses of treated wastewater. Correlation analyses were therefore conducted to examine the relationships between ratings of acceptance and fairness in relation to the uses of treated wastewater. Strong positive relationships were found between the ratings of acceptance and perceived fairness across all uses of treated wastewater ($r > .64$, $p < .01$). This suggested that people might make their fairness judgements based on how acceptable a particular use of treated wastewater was to them.

3.2.3.2 Managing treated wastewater programs in WA

Participants in Surveys 1 and 2 were asked to rate on a five-point scale the extent to which they would trust five nominated agencies to manage treated wastewater reuse programs in Western Australia.

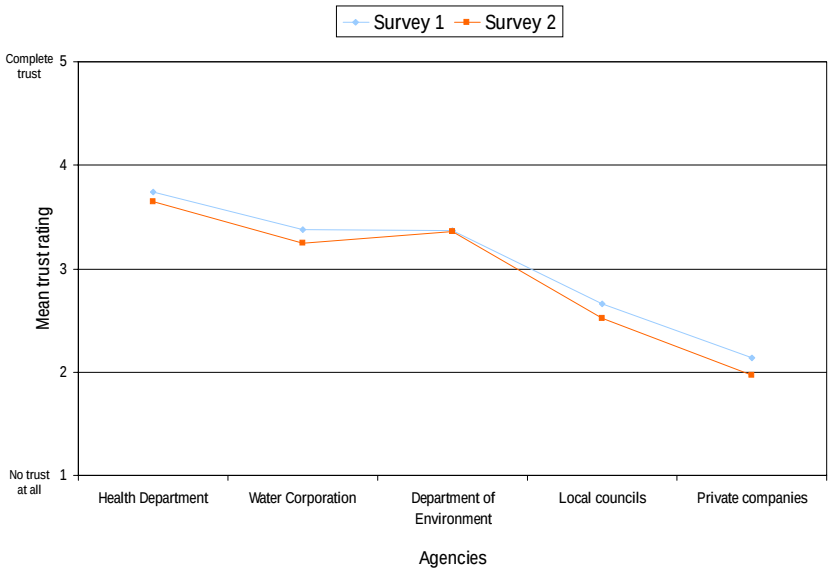


Figure 4. Mean trust rating of different agencies across Surveys 1 and 2

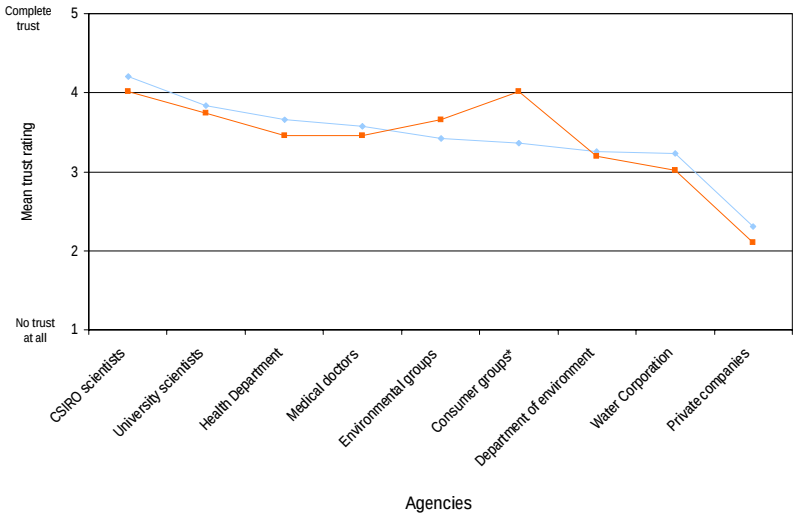
In Surveys 1 and 2, the Health Department was most trusted by participants to manage wastewater reuse programs in WA, followed by Water Corporation of WA and the Department of Environment. The mean trust rating for the Health Department was significantly higher in comparison to other agencies across the two surveys. The difference in the mean trust rating for Water Corporation and Department of Environment was found to be statistically not significant, indicating that participants trusted both agencies similarly to manage treated wastewater programs. The mean trust ratings for both private companies and local councils were significantly lower across the two surveys. Participants consistently felt less trusting of the private companies and local councils to manage treated wastewater programs in WA.

Participants were given a chance to nominate any other agencies that they would trust to manage reuse programs. In Survey 1, only thirteen responses were obtained and of these, CSIRO was the main agency being nominated (n=4) with a mean rating of 4.25. In Survey 2, thirty-four responses were recorded and again, the main agency nominated was CSIRO (n=15) with a mean rating of 4.07.

No statistically significant differences were found in the mean trust ratings across the five agencies between Surveys 1 and 2, indicating that participants' trust in agencies to manage reuse programs was stable across the two surveys.

3.2.3.3 Information provision on reuse issues

Participants were also asked to rate on a five-point scale how much they trusted the nine nominated agencies below to provide full information in a timely manner about any issues on the use of treated wastewater.



* significantly different between Surveys 1 and 2 at $p < .01$

Figure 5. Mean trust ratings of different agencies across Surveys 1 and 2

CSIRO scientists were consistently rated highly in terms of trust to provide full information in regards to any issues with the use of treated wastewater in both surveys. The mean trust rating for CSIRO was significantly higher than other agencies in Survey 1. In Survey 2, both CSIRO and the consumer groups were rated higher than other agencies. Private companies were rated significantly lower than the other groups across both surveys. Participants generally trusted agencies such as the Health Department, medical doctors, environmental groups, the Department of Environment and the Water Corporation to provide information.

As previously, participants were also given the opportunity to nominate any other agencies and rate it on the scale. However, no prominent group was nominated by participants in either survey.

No statistical differences were found in the mean trust ratings across different agencies between Surveys 1 and 2 except for Consumer groups, which were rated more favourably in Survey 2 than Survey 1.

3.2.3.4 Attitudes to reuse

A series of attitudinal statements were created to measure people's attitudes towards the environment and water reuse in general. The statements were asked first in Survey 1 and later repeated in Survey 2. Participants were required to rate how much they agreed or disagreed with each statement on a five-point scale.

The following table shows the mean agreement/disagreement for each statement. Results for Survey 1 are shown separately for the whole sample who accepted the invitation to participate and those who actually did attend and participated. This is to allow a direct comparison of attitudes before and after the experiment of those who attended.

Table 7. Mean agreement/disagreement with each statement across different respondent groups (1=strongly disagree to 5=strongly agree)

	Survey 1 All respondents (N=161)	Survey 1 Attending participants only (N=93)	Survey 2 Attending participants (N=93)
I think it is too hard to get most people to use recycled water	2.81	2.66	2.56
Water experts should have control over the kind of water the community is supplied with	3.55	3.43	3.41
I would rather "go without" than do something that wastes water	3.55	3.50	3.24
All water should cost the same, even if it comes from different sources	3.08	3.20	3.24
I believe water recycling is essential to help manage future water shortages	4.50	4.52	4.67
I have the responsibility to help with Perth's water future**	4.47	4.42	4.69
I would never use recycled water even in times of water shortages	1.58	1.61	1.45
It would be too difficult for me to use recycled water at home	1.89	1.85	1.85
I contribute to any water shortages in Perth	3.40	3.27	3.14
Water recycling is not appropriate for managing Perth's water future	1.71	1.71	1.55
I feel personally obligated to do whatever I can to save water	4.38	4.40	4.42
The Government is partly responsible for any water shortages in Perth	4.02	4.11	4.01
I feel good when I do things to help the environment	4.39	4.42	4.38
Water is a valuable resource that should be re-used	4.63	4.62	4.68
It is my right to have fresh water supplied to my home	3.94	3.97	4.01
It would be very easy for me to use recycled water in my home	3.78	3.76	3.84
People have a right to unlimited use of water*	1.81	1.63	1.61
I intend to use recycled water in the future	4.10	4.20	4.12
People should take responsibility for the environment around them**	4.50	4.51	4.73
Consumers have the right to know fruits and vegetables they are buying have been irrigated with treated wastewater**	3.41	3.41	3.91
The community as a whole has the responsibility to help with Perth's water future**	4.52	4.53	4.84
I could never use recycled water	1.55	1.51	1.32
I feel a moral obligation to protect the natural environment	4.42	4.45	4.63
I would only be prepared to use recycled water in times of water shortages	2.01	1.86	1.91
Every household should be free to choose their source of water supply (e.g. groundwater, surface water, recycled water)	2.75	2.71	2.77
The Government as a whole has the responsibility to help with Perth's water future	4.53	4.60	4.67
I believe the protection of the natural environment is vital for future generations**	4.65	4.68	4.87
Fruits and vegetables irrigated with recycled water should be labelled in the supermarket	3.17	3.15	3.45
Technology will always find a way to provide the water we need	2.82	2.74	2.53
Most people who are close to me support the use of recycled water	3.70	3.74	3.82

* Significantly different between those who did and did not attend the experiment

** Significantly different in the way attending participants responded to the statement in Surveys 1 and 2

T-test analyses were conducted for each statement to examine whether there were any significant differences in the agreement/disagreement ratings between participants who did and did not attend the experiment. Only one significant difference was found at $p < .01$. Participants who attended the experiment disagreed more with the statement *people have a right to unlimited use of water* (mean=1.63) than people who did not attend (mean=2.04). It is important to note that this difference is merely in terms of degree of agreement rather than being opposing views.

Paired t-test analyses were also conducted to examine whether participants who attended the experiment changed the way they responded to each statement from Surveys 1 to 2. The findings suggested that attending the experiment might have magnified the sense of responsibility participants felt towards Perth's future water supply and the environment in general. Participants expressed stronger agreement with the following statements when asked in Survey 2 than in Survey 1.

- *I have the responsibility to help with Perth's water future*
- *People should take responsibility for the environment around them*
- *The community as a whole has a responsibility to help with Perth's water future*
- *I believe the protection of the natural environment is vital for future generations*

Participants also expressed significantly higher agreement with the statement *consumers have the right to know fruits and vegetables they are buying have been irrigated with treated wastewater* after the experiment.

3.2.3.5 Factor structures

To examine the validity of the statements, analyses were conducted, firstly for Survey 1 results using all respondents who were invited to the experiment and secondly for Survey 2 with participants who actually attended the experiment. The underlying structures of people's responses to the attitudinal statements in Survey 1 would then be used to compare with those in Survey 2 results.

Survey 1

Four factors were extracted in Survey 1 and explained 45% of the variance. When tested for reliability, three factors emerged as being suitable for use as scales in later analyses.

- Factor 1. Environmental obligation (α= .84)
- Factor 2. Reuse intention (α = .70)
- Factor 3. Perceived control over the use of recycled water (α = .52)

Survey 2

An exploratory factor analysis was again performed on the 23 statements in Survey 2. Five factors were extracted and explained 50.4% of the variance. When the reliability analyses were formed, four factors were considered to be reliable to form a scale.

- Factor 1. Environmental obligation (α = .76)
- Factor 2. Reuse intention (α = .67)
- Factor 3. Perceived control over the use of recycled water (α = .68)
- Factor 4. Reuse beliefs (α = .69)

To validate the resultant scales, a confirmatory factor analysis using structural equation modelling (SEM) was used to determine the unidimensionality of scales across Surveys 1 and 2. A unidimensionality test was conducted to ensure that items of a particular scale are only measuring one dimension or concept at a time. The results are presented in the sections below.

- *Environmental obligation scale*

Through the SEM analysis, the items in the environmental obligation scales were refined and were found to be a good fit to the data across Surveys 1 and 2, measuring only one dimension of environmental obligation. The fit indexes across Surveys 1 and 2 are shown in the table below.

Table 8. Fit measures for *environmental obligation* scale across Surveys 1 and 2

Fit Statistics	Survey 1	Survey 2
Degrees of Freedom	2	2
Chi-square	6.76	0.46
Probability level	0.034	0.78
CFI	.98	1.00
NFI	.97	1.00
RMSEA	.12	0.00

The mean scores on this scale were compared across Surveys 1 and 2. They indicated that participants on average displayed a strong obligation to environmental protection. For participants who attended the experiment, their responses to the scale did not differ significantly between Surveys 1 and 2. Also, no significant difference was found in the mean scores between respondents who did and did not attend the experiment.

- *Reuse intention scale*

This reuse intention scale was found to be a good fit of data obtained in Surveys 1 and 2, indicating the scale's unidimensionality. The fit indexes for the scale across Surveys 1 and 2 are shown in the table below.

Table 9. Fit measures for *reuse intention* scale across Surveys 1 and 2

Fit Statistics	Survey 1	Survey 2
Degrees of Freedom	1	1
Chi-square	0.04	0.33
Probability level	0.84	0.56
CFI	1.00	1.00
NFI	0.99	0.99
RMSEA	0.00	0.00

Mean scores on the reuse intention scale was compared across Surveys 1 and 2. Participants on average indicated a fairly strong intention to use recycled water. For participants who attended the experiment, their intention to use recycled water did not significantly differ across Surveys 1 and 2. No significant difference was found in the intention to use recycled water between participants who did and did not come to the experiment.

- *Perceived control scale*

The perceived control scale was found to be a good fit of data across Surveys 1 and 2, supporting the unidimensionality of the scale. The fit indexes for the scale across Surveys 1 and 2 are shown in the table below.

Table 10. Fit measures for *perceived control* scale across Surveys 1 and 2

Fit Statistics	Survey 1	Survey 2
Degree of Freedom	4	4
Chi-square	8.75	3.73
Probability level	0.07	0.44
CFI	0.95	0.95
NFI	0.92	1.00
RMSEA	0.08	0.00

Again the mean scores for the scale were compared across Surveys 1 and 2. On average, participants reported a relatively strong perceived control over the use of recycled water. For participants who attended the experiment, their perceived control did not significantly differ across Surveys 1 and 2. No significant difference was found between respondents who did and did not attend the experiment.

3.2.3.6 Responsibility to help with Perth's water future

In the attitudinal statements, participants in Surveys 1 and 2 were asked to rate the extent to which they agreed or disagreed with three statements regarding personal, community and government responsibility for Perth's water future.

In Surveys 1 and 2, respondents on average agreed that the government, the community and they themselves all had the responsibility to help with Perth's water future. In each survey, there was no statistically significant difference between attitudes to the three responsibilities. However, findings indicated that participating in the experiment may have promoted greater feelings of personal and community responsibilities to help with Perth's water future, there being statistically significant differences between the surveys. No such differences occurred for government responsibility.

3.2.3.7 Responsible for Perth's water shortage issues

Participants were also asked to rate how much they agreed or disagreed with two statements regarding Perth's water shortages. In both Surveys 1 and 2, respondents on average agreed that the government was partly responsible for any water shortages in Perth, while they neither agreed nor disagreed that they themselves had partly contributed. Statistical results showed that the government was generally seen as being more responsible for the water shortage in Perth. Responses to both statements seemed to be stable across the two surveys.

3.2.3.8 Consumer right to know and Labelling of produce

Participants were also asked their agreement or disagreement with two statements regarding the consumer right to know about produce irrigated with recycled water and labelling of such produce.

In both surveys, participants indicated a high level of agreement with the right of consumers to know if the fruit and vegetables they were buying had been irrigated with recycled water. In particular, their agreement rating with that statement was significantly higher in Survey 2, indicating that attendance at the experiment may have caused participants to feel more strongly towards this right.

On average, they neither agreed nor disagreed with the need to label fruit and vegetables in supermarkets if they had been irrigated with recycled water. Their responses towards the statement were not significantly different in Surveys 1 and 2.

3.2.4 Taste tests experiment

The presentation of results in the taste tests experiment does not necessarily follow the order of samples tried by participants in the experiment. For ease of interpretation, samples relating to a specific recycled water source are discussed simultaneously. As a summary, samples tested in the experiment were as follows.

1. Five different samples of treated stormwater: treated stormwater for drinking; lettuce, carrots, grapes and oranges all irrigated with treated stormwater;

2. Five different samples of treated greywater: treated greywater for drinking; lettuce, carrots, grapes and oranges all irrigated with treated greywater;

3. Five different samples of treated wastewater: treated wastewater for drinking; lettuce, carrots, grapes and oranges all irrigated with treated wastewater.

For any open-ended questions, the participants were allowed to provide up to three responses.

3.2.4.1 Samples of treated stormwater and produce irrigated with treated stormwater

Tasting and Swallowing

For each sample of stormwater, participants were asked whether they had either tasted or swallowed it. The percentages of participants who tasted and swallowed the five treated stormwater samples are shown in the figure below.

The majority of participants (>80%) had tasted and swallowed the five samples of treated stormwater. Of all samples, the percentages of participants who tasted and swallowed grapes and oranges irrigated with treated stormwater were slightly higher (97.8% and 95.6% respectively) than for the other samples.

Participants were asked to state their reasons for deciding whether to taste or not taste each of the samples. The same question was also asked regarding their decision to swallow or not swallow. Three responses were allowed for each question. The main responses are shown in the tables below.

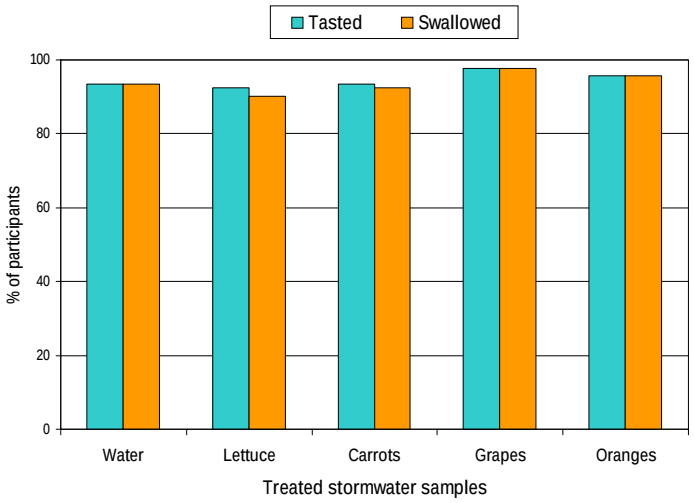


Figure 6. Percentages of participants who had either tasted or swallowed the five treated stormwater samples

Table 11. Reasons for tasting the treated stormwater samples

Response	Water N=69		Lettuce N=66		Carrots N=65		Grapes N=66		Oranges N=66	
	n	%	n	%	n	%	n	%	n	%
Felt safe with stormwater	34	49.2	31	47	35	53.8	41	62.1	27	40.9
Curiosity	20	29	25	37.9	25	38.4	16	24.2	17	25.8
Tasted/looked/smelled okay	8	11.6	12	18	10	15.4	9	13.5	5	7.6
Trusted the treatment	6	8.7	-	-	-	-	-	-	-	-

Only two thirds of participants who tasted the five samples provided reasons. The most common reason given for swallowing samples of treated stormwater or produce irrigated with treated stormwater was *felt safe with stormwater* followed by *curiosity* and *tasted/looked/smelled okay*.

For participants who chose not to taste the treated stormwater or produce irrigated with treated stormwater, the main reasons given were *unsure what is in the water* and *more information about the treatment process needed*. The table below presents the responses given by people who did not taste a particular stormwater sample.

Table 12. Reasons for *not* tasting the treated stormwater sample

Response	Water N=5	Lettuce N=5	Carrots N=6	Grapes N=2	Oranges N=4
	n	n	n	n	n
Unsure what is in the water	2	1	2	2	2
More information about the treatment process needed	2	-	2	1	2
Don't like the idea of using treated stormwater	-	4	1	-	-

Similar responses were obtained from participants who chose to either swallow or not swallow the samples. The most frequent reasons stated for swallowing treated stormwater or produce irrigated with treated stormwater were *not concerned with stormwater*, *felt it was safe* and *looked/tasted/smelled okay*. Other common reasons were *curiosity* and *trusted the treatment process*.

Table 13. Reasons for swallowing the treated stormwater sample

Response	Water N=67		Lettuce N=66		Carrots N=65		Grapes N=61		Oranges N=65	
	n	%	n	%	n	%	n	%	n	%
Not concerned with stormwater	5	7.5	22	33.3	-	-	46	75.4	36	55.4
Felt it was safe	13	19.4	-	-	48	73.8	8	13.1	24	36.9
Looked/tasted/smelled okay	29	43.3	27	40.9	-	-	6	9.8	18	27.7
Curiosity	16	23.9	8	12.1	10	15.4	5	8.2	7	10.8
Trusted the treatment	11	16.4	12	18.2	6	9.2	-	-	-	-

The most common responses given by participants for not swallowing treated stormwater or produce irrigated with treated stormwater were *concerned with the quality of the stormwater* and *more information about the treatment process needed*.

Table 14. Reasons for *not* swallowing the treated stormwater sample

Response	Water N=5	Lettuce N=7	Carrots N=5	Grapes N=2	Oranges N=4
	n	n	n	n	n
Concerned with quality of the stormwater	1	4	1	2	2
More information about the treatment process needed	4	-	1	1	1
Don't like orange/carrots/lettuce/grapes	-	2	-	-	1

Perceived health risks

Participants were also asked whether they considered the possible health risks to them when they consumed the treated stormwater samples. Their responses to this question are denoted in the figure below.

For treated stormwater and lettuce irrigated with treated stormwater, more than half of participants reported that they considered the possible health risks to them before consuming the samples (57.6% and 53.8% respectively). In contrast, the percentages of participants who considered the possible risks before consuming carrots and oranges irrigated with treated stormwater were lower (42.4% and 37.8% respectively). The percentages of participants who either had (48.9%) or had not (51.1%) considered the possible health risk of consuming grapes irrigated with treated stormwater were similar.

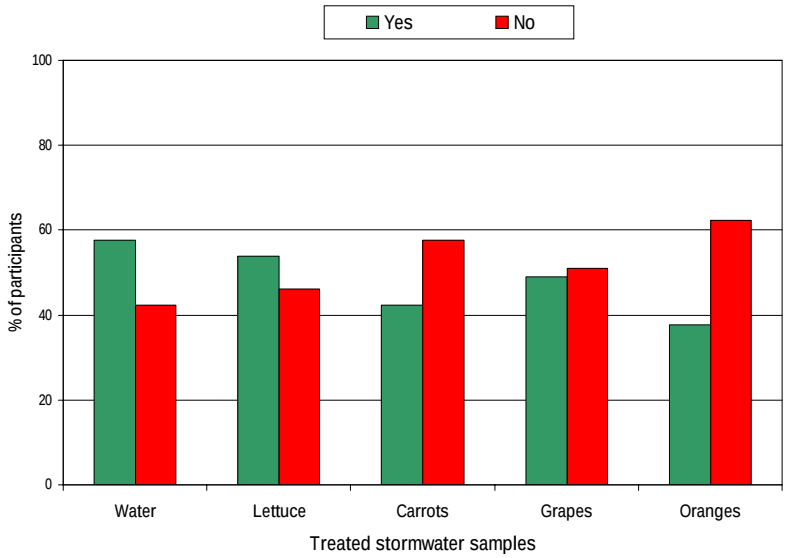


Figure 7. Percentages of participants who considered possible health risks in consuming the treated stormwater samples

Participants who considered the possible health risk were further asked to rate the risk on a five-point scale. Figure 8 shows the average mean ratings given by participants for the different samples of treated stormwater.

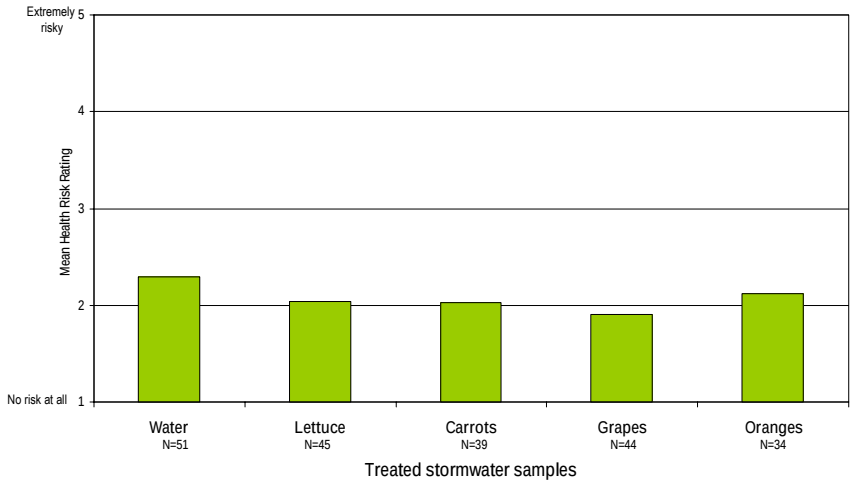


Figure 8. Mean health risk rating for different samples of treated stormwater

The mean risk rating for the treated stormwater sample for drinking was slightly higher (2.29) than the other samples. The difference in the mean rating was however not significantly different.

Feelings of disgust

Participants were also asked whether they felt disgusted when consuming the treated stormwater samples.

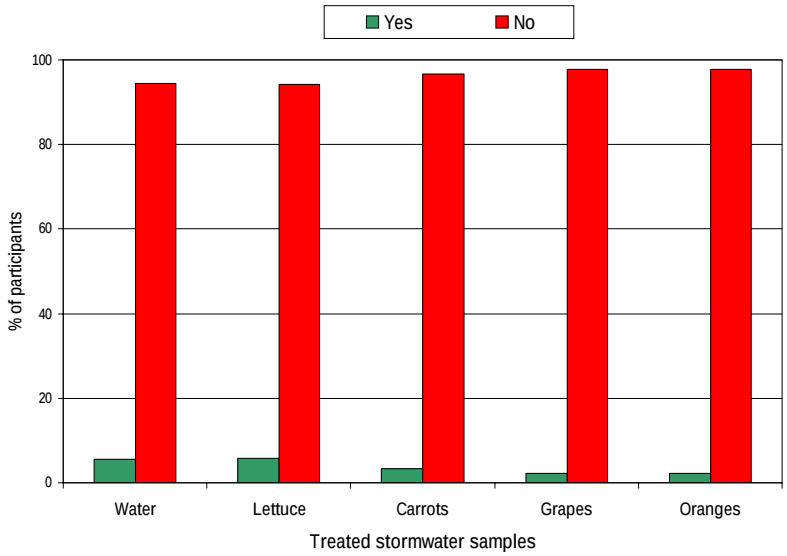


Figure 9. Feelings of disgust with the five samples of treated stormwater

The majority of participants did not feel disgusted with consuming the five samples. The percentages of participants who stated feeling disgusted were slightly higher for treated stormwater (5.5%) and lettuce irrigated with treated stormwater (5.7%).

Participants were asked to provide details about their feelings of disgust in relation to each of the treated stormwater samples. The main responses are shown in the tables below.

Table 15. Reasons for feeling disgusted with the treated stormwater samples

Response	Water N=4	Lettuce N=4	Carrots N=3	Grapes N=2	Oranges N=2
	n	n	n	n	n
Unknown content in stormwater a concern (eg petrol, oil, grease)	1	5	2	2	-
Depends who is treating the water	-	-	1	-	-
More information about treatment process/health impacts needed	-	-	-	-	1

The most common response recorded for those who felt disgusted was *unknown content in stormwater a concern*.

Table 16. Reasons for *not* feeling disgusted with the treated stormwater samples

Response	Water N=46		Lettuce N=40		Carrots N=44		Grapes N=42		Oranges N=47	
	n	%	n	%	n	%	n	%	n	%
Not concerned with treated stormwater	25	54.3	22	55.0	21	47.7	27	64.3	29	51.7
Tasted/looked/smelled okay	4	8.7	8	20.0	10	22.7	5	11.9	7	14.9
Trust the treatment process	5	10.9	-	-	4	9.1	-	-	3	6.4
Water is filtered naturally by the plants	-	-	-	-	-	-	3	7.1	-	-
Some concerns	3	6.5	-	-	-	-	-	-	-	-

The most common responses recorded for those who did not feel disgusted were *not concerned with treated stormwater*, *tasted/looked/smelled okay* and *trust in the treatment process*. Other responses included *water is filtered naturally by the plants* and *some concerns*.

Trust in the treatment process

Participants were also asked whether they trusted the treatment process when they chose to consume the five samples of treated stormwater.

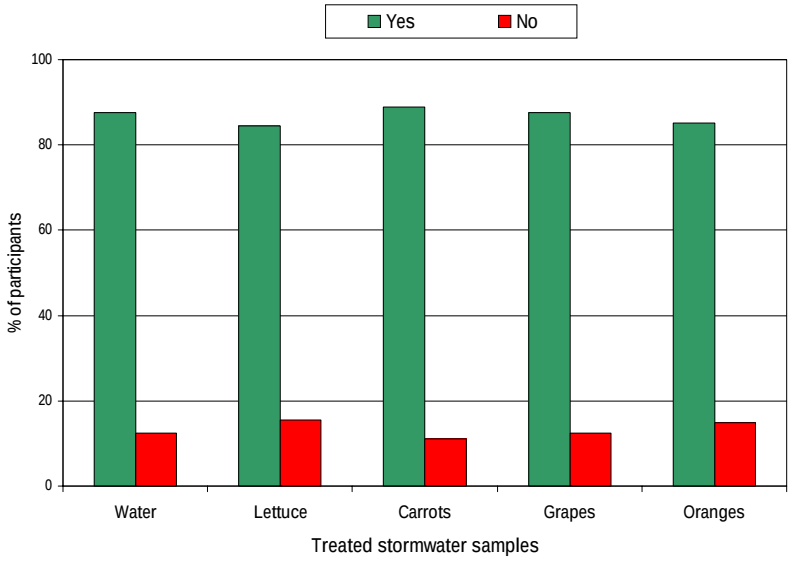


Figure 10. Percentages of participants who trusted or did not trust the treatment process

The majority of participants (>80.0 %) trusted the treatment process when they decided to consume samples of treated stormwater. The percentages of participants who said they trusted the treatment

process were slightly higher for treated stormwater for drinking (87.5%), carrots (88.9%) and grapes (87.8%) irrigated with treated stormwater.

Participants who trusted the treatment process as well as those that did not were further asked to provide details. Their responses are captured in the tables below.

Table 17. Reasons for trusting the treatment process

Response	Water N=53		Lettuce N=48		Carrots N=47		Grapes N=49		Oranges N=49	
	n	%	n	%	n	%	n	%	n	%
Not concerned with reusing stormwater	22	41.5	17	35.4	21	44.7	18	36.7	15	30.6
Trust the treatment standards	14	26.4	19	39.6	14	29.8	14	28.6	31	63.2
Would like more information on the treatment process	8	15.1	6	12.5	6	12.8	9	18.4	11	22.4
Trust the system but felt reluctant	8	15.1	5	10.4	-	-	3	6.1	-	-
Standards and regulations have to be high	5	9.4	6	12.5	-	-	-	-	-	-
Depends on who treats the water	-	-	5	10.4	3	6.3	-	-	-	-
Plants act as biological filter	-	-	-	-	5	10.6	4	8.2	3	6.1
Look/taste good	-	-	-	-	-	-	3	6.1	-	-

The main comments given by participants who trusted the treatment process was *not concerned with reusing stormwater* followed by *trust the treatment standards.* Table 18 below outlines reasons given by participants who did not trust the treatment process.

Table 18. Reasons for *not* trusting the treatment process

Response	Water N=10	Lettuce N=13	Carrots N=9	Grapes N=10	Oranges N=10
	n	n	n	n	n
More information needed about the treatment process	6	9	5	6	9
Concern with treatment system (unknown risks, possible failure in mechanical process and human errors)	3	3	5	4	4

3.2.4.2 Samples of treated greywater and produce irrigated with treated greywater

Tasting and swallowing

For each sample of treated greywater, participants were asked whether they had either tasted or swallowed it.

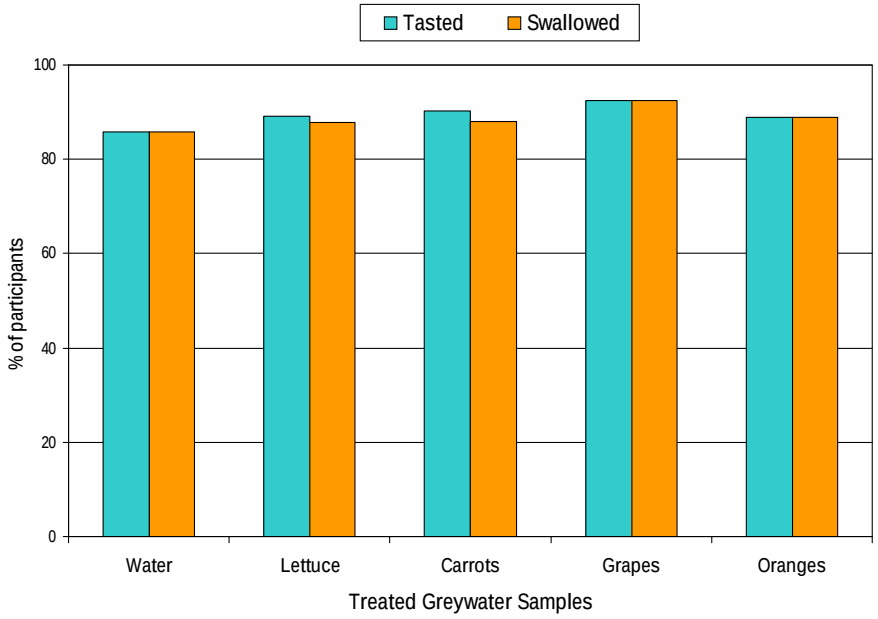


Figure 11. Percentages of participants who had either tasted or swallowed the five treated greywater samples

Most participants (>85%) had tasted and swallowed the five samples of treated greywater. The number of participants who had either tasted (85.9%) or swallowed (85.9%) treated greywater was slightly lower than the remaining samples.

Participants were further asked to state their reasons for deciding whether to taste or not taste each of the samples. The same question was also asked regarding their decision to swallow or not swallow. Responses are listed in the tables below.

Table 19. Reasons for tasting treated greywater and produce irrigated with treated greywater

Response	Water N=60		Lettuce N=62		Carrots N=62		Grapes N=63		Oranges N=62	
	n	%	n	%	n	%	n	%	n	%
Felt safe with greywater	12	20.0	26	40.4	40	64.5	22	34.9	13	21.0
Curiosity	31	51.7	18	25.7	18	29.0	20	31.7	24	38.7
Tasted/looked/smelled okay	15	25.0	14	20.0	4	6.5	14	22.3	11	17.7
Trust the treatment process	8	13.3	-	-	-	-	5	7.9	22	35.5

The most common reasons stated for tasting treated greywater or produce irrigated with treated greywater were *felt safe with greywater* and *curiosity*. Other common responses were *tasted/looked/smelled okay* and *trust the treatment process*.

Table 20. Reasons for *not* tasting treated greywater and produce irrigated with treated greywater

Response	Water N=12	Lettuce N=8	Carrots N=9	Grapes N=7	Oranges N=10
	n	n	n	n	n
Don't like the idea of using treated greywater	8	1	5	4	7
More information needed about treatment process/health impacts	2	5	2	2	2
Don't like/allergic to oranges/carrots/lettuce/grapes	-	1	-	-	2

Common responses for not tasting treated greywater or produce irrigated with treated greywater included *don't like the idea of using treated greywater* and *more information needed about the treatment process/health impacts*.

Table 21. Reasons for swallowing treated greywater and produce irrigated with treated greywater

Response	Water N=60		Lettuce N=56		Carrots N=55		Grapes N=56		Oranges N=58	
	n	%	n	%	n	%	n	%	n	%
Looked/tasted/smelled okay	20	33.3	23	41.1	20	36.4	9	26.8	9	15.5
Curiosity	19	31.7	7	12.5	13	23.6	6	10.7	24	41.4
Not concerned with using greywater	14	21.2	21	37.5	10	18.2	19	33.9	13	22.4
Felt it was safe	-	-	-	-	13	23.6	10	17.9	11	19.0
Trust the treatment process	9	15.0	3	5.4	1	1.8	9	16.1	1	1.7

The most frequent reasons stated for swallowing treated greywater or produce irrigated with treated greywater were *looked/tasted/smelled okay*, *curiosity* and *not concerned with greywater*. Other common responses included *felt it was safe* and *trust the treatment process.*

Table 22. Reasons for *not* swallowing treated greywater and produce irrigated with treated greywater

Response	Water N=9	Lettuce N=6	Carrots N=8	Grapes N=6	Oranges N=7
	n	n	n	n	n
Don't like the idea of using greywater	3	-	5	3	4
More information needed about the treatment process	2	3	2	2	2
Harmful substances in water	1	2	-	-	-

The most common reasons given for not swallowing treated greywater or produce irrigated with treated greywater were *don't like the idea of using greywater*, and *more information needed about the treatment process*.

Perceived health risks

Participants were asked whether they thought about the health risks when they consumed the treated greywater samples.

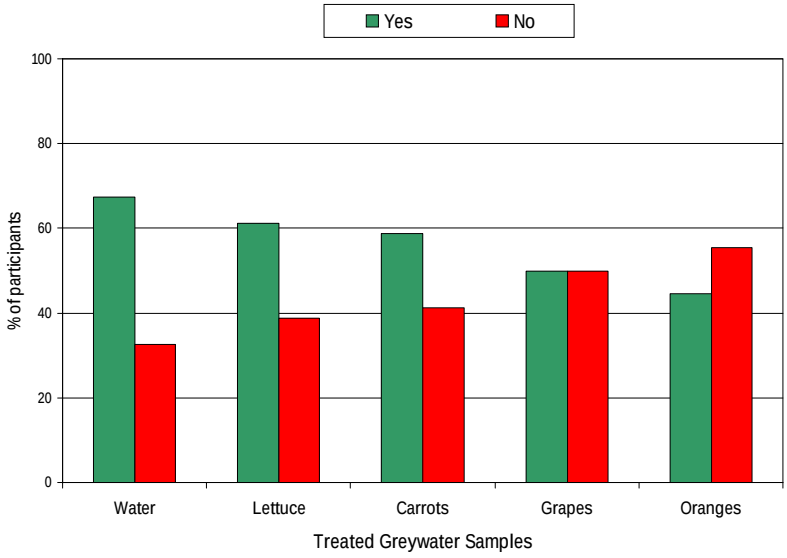


Figure 12. Percentages of participants who considered possible health risks in consuming the treated greywater samples

Over two-thirds of participants (67.4%) considered the possible health risks when they drank the treated greywater. About 60% of participants considered health risks when consuming lettuce and carrots irrigated with treated greywater. Less than half of the participants (44.6%) considered health risks when consuming oranges irrigated with treated greywater.

The mean health risk ratings indicated that participants perceived health risks in consuming all five samples of treated greywater to be very similar. Statistical analyses revealed no significant differences in the mean health risk ratings across the five samples.

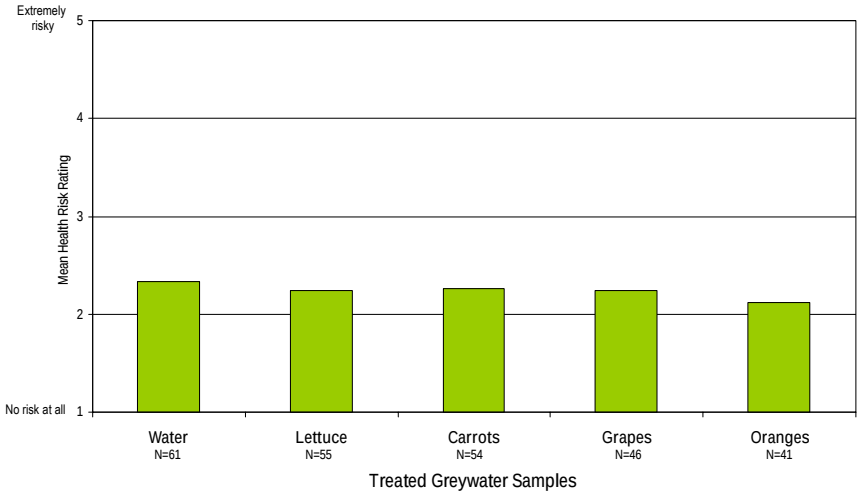


Figure 13. Mean health risk rating for the five samples of treated greywater

Feelings of disgust

Similarly, participants were asked whether they felt disgusted when they consumed the five samples of treated greywater. The following figure shows participants' responses to the question.

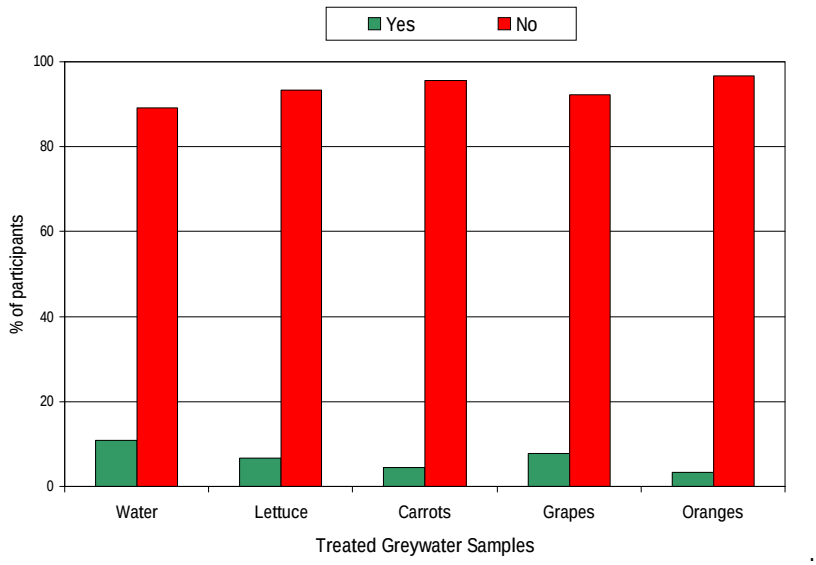


Figure 14: Feelings of disgust with the five samples of treated stormwater

The majority of participants did not feel disgusted when they consumed the five treated greywater samples. The percentages of participants who stated they felt disgusted were slightly higher for drinking treated greywater (10.9%) and consuming grapes irrigated with treated greywater (7.7%).

Participants were asked to provide details about their feelings of disgust in relation to each of the treated greywater samples. The main responses are shown in the tables below.

Table 23. Reasons for feeling disgusted with the treated greywater samples

Response	Water N=9	Lettuce N=5	Carrots N=4	Grapes N=7	Oranges N=3
	n	n	n	n	n
Don't like the idea / not comfortable	6	-	-	3	-
More information needed about treatment process/health impacts	-	4	3	-	-
Greywater not for drinking	3	-	-	-	-
Thought of wastewater in greywater	-	-	-	-	2
Did not taste right	-	-	-	-	1

The most common responses for those who reported feeling disgusted were *don't like the idea / not comfortable* and *I want more information*. Other responses included *greywater not for drinking*, *thought of wastewater in greywater* and *did not taste right*.

Table 24. Reasons for *not* feeling disgusted with the treated greywater sample

Response	Water N=39		Lettuce N=43		Carrots N=43		Grapes N=39		Oranges N=40	
	n	%	n	%	n	%	n	%	n	%
Tasted/looked/smelled okay	12	30.8	13	30.2	16	37.2	15	38.5	5	12.5
No problem with treated greywater	4	10.3	11	25.6	15	34.9	9	23.1	12	32.5
Trust the treatment process	12	30.8	9	20.9	5	6.0	11	28.2	6	15.0
Okay for irrigation only	8	20.5	-	-	-	-	-	-	4	10.0
Some concerns	-	-	4	9.3	-	-	-	-	3	7.5
Fewer problems with greywater than with wastewater	-	-	4	9.3	-	-	-	-	-	-
Produce did not taste nice	-	-	-	-	4	9.3	-	-	-	-
Provided treatment regulations are followed	3	7.7	-	-	-	-	-	-	-	-
Not at this stage	-	-	-	-	-	-	-	-	3	7.5

The most frequent responses given by respondents who did not feel disgusted were *tasted/looked/smelled okay*, *no problem with treated greywater*, *trust the treatment process*, *okay for irrigation only* and *some concerns*. Other common responses were *fewer problems with greywater than with wastewater*, *produce did not taste nice*, *provided treatment regulations are followed* and *not at this stage*.

Trust in the treatment process

The percentages of participants who trusted the treatment process were similar across the different samples of treated greywater. Most participants trusted the treatment process for the different samples of treated greywater.

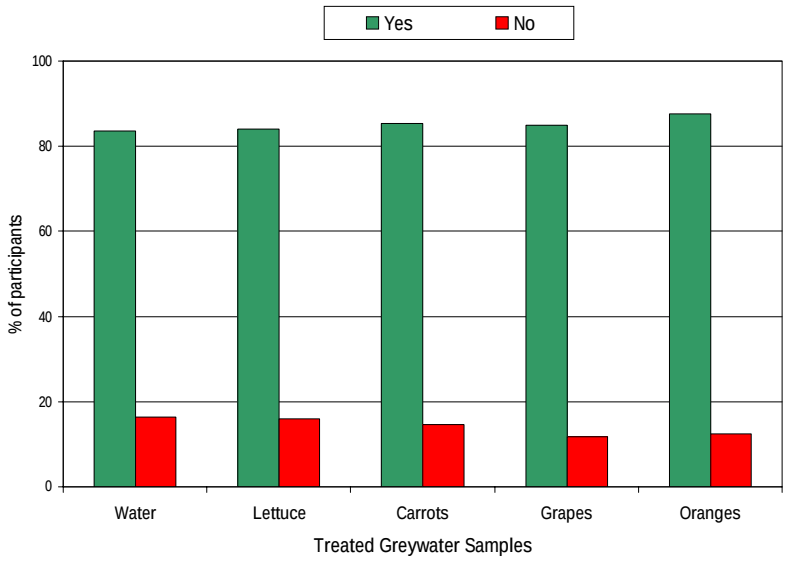


Figure 145. Percentages of participants who trusted or did not trust the treatment process

Participants were further asked to provide details about their trust in the treatment process. The tables below present the main responses given by the participants.

Table 25. Reasons for trusting the treatment process

Response	Water N=48		Lettuce N=45		Carrots N=46		Grapes N=46		Oranges N=47	
	n	%	n	%	n	%	n	%	n	%
Trust the treatment standards	26	54.1	18	40.0	15	32.6	15	32.6	22	46.8
More information about the treatment process and the potential health impacts	8	16.7	6	13.4	6	13.0	5	10.9	5	10.6
Not concerned with reusing greywater	5	10.4	15	33.4	7	15.2	12	26.1	10	21.3
Depends on who operates/monitors the system	-	-	-	-	9	19.6	-	-	5	10.6
Concern that treatment unable to remove all	8	16.7	5	11.1	4	8.7	5	10.9	3	6.4
Plants act as additional filter	-	-	4	8.8	-	-	6	13.0	-	-

A variety of comments were recorded from participants who trusted the treatment process. The main responses were *trust the treatment standards, more information about the treatment process and the potential health impacts,* and *not concerned with reusing greywater.* Some participants qualified their responses by stating that they were still concerned that the treatment might not be able to remove all possible harmful aspects of the water.

Table 26. Reasons for *not* trusting the treatment process

Response	Water N=11	Lettuce N=13	Carrots N=15	Grapes N=11	Oranges N=10
	n	n	n	n	n
More information needed about the treatment process and the long-term health impacts	10	11	11	7	7
Concern with treatment system: unknown risks and possible failure in mechanical process or human errors	-	5	-	3	-

Participants who did not trust the treatment process generally felt they needed more information about the treatment process and the long-term health impacts of using treated greywater.

3.2.4.3 Samples of treated wastewater and produce irrigated with treated wastewater

Tasting and swallowing

Participants were asked whether they had tasted or swallowed the five different samples of treated wastewater.

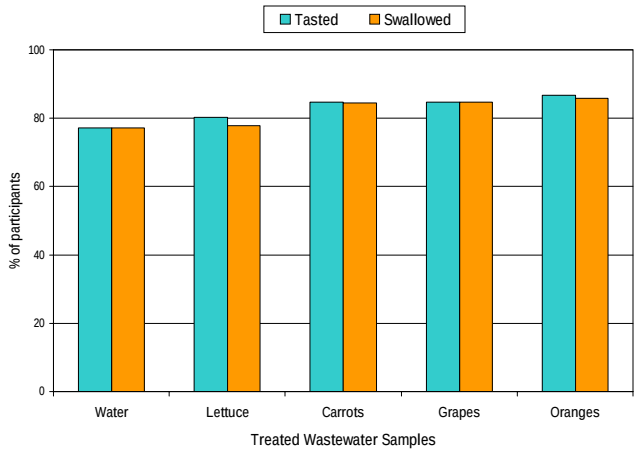


Figure 16. Percentages of participants who either tasted or swallowed the five samples of treated wastewater

The majority of participants (>80.0%) had tasted and swallowed carrots, grapes and oranges irrigated with treated wastewater. In comparison, the number of participants who tasted and swallowed the treated wastewater (77.2%) and lettuce (77.2%) irrigated with treated wastewater was lower.

Participants were also asked to state their reasons for deciding whether to taste or not taste each of the samples. The same question was also asked regarding their decision to swallow or not swallow. Responses are listed in the tables below.

Table 27. Reasons for tasting treated wastewater and produce irrigated with treated wastewater

Response	Water N=52		Lettuce N=51		Carrots N=57		Grapes N=61		Oranges N=58	
	n	%	n	%	n	%	n	%	n	%
Curiosity	28	53.8	23	45.1	22	38.6	27	44.3	22	37.9
Trust the treatment process	10	19.2	5	9.8	12	21.1	16	26.2	23	39.7
Tasted/looked/smelled okay	7	13.5	10	19.6	12	21.1	18	29.5	5	8.6
Not concerned with the water	8	15.4	14	27.4	8	14.1	-	-	-	-
Don't like the idea of using wastewater	3	5.8	-	-	-	-	-	-	-	-
Would like more information about the treatment process	-	-	4	7.8	-	-	-	-	-	-

The most frequent reasons cited for participants who tasted treated wastewater or produce irrigated with treated wastewater were *curiosity*, *trust the treatment process* and *tasted/looked/smelled okay*. Other reasons identified were *not concerned with the water*, *don't like the idea of using wastewater* and *would like more information about the treatment process*..

Table 28. Reasons for *not* tasting treated wastewater and produce irrigated with treated wastewater

Response	Water N=20	Lettuce N=14	Carrots N=13	Grapes N=11	Oranges N=12
	n	n	n	n	n
Don't like the idea of using wastewater	10	5	9	8	9
More information needed about the treatment process	8	4	2	3	2

The most common reasons given for not tasting treated wastewater or produce irrigated with treated wastewater were *don't like the idea of using wastewater* and *more information needed about the treatment process*.

Table 29. Reasons for swallowing treated wastewater and produce irrigated with treated wastewater

Response	Water N=49		Lettuce N=49		Carrots N=54		Grapes N=55		Oranges N=56	
	n	%	n	%	n	%	n	%	n	%
Looked/tasted/smelled okay	14	28.6	17	34.7	20	37.0	31	56.4	31	55.4
Felt it was safe	9	18.4	7	14.3	22	40.7	11	20.0	24	42.9
Curiosity	13	26.5	11	22.4	10	18.5	7	12.7	4	7.1
Trust the treatment process	13	26.5	6	12.2	6	11.1	2	3.6	1	1.8
Don't like the idea of using wastewater	4	8.2	2	4.1	-	-	-	-	-	-

The most common reasons given for swallowing treated wastewater or produce irrigated with treated wastewater were *looked/tasted/smelled okay* and *felt it was safe*. Other common reasons included *curiosity* and *trust the treatment process*.

The most frequent reasons cited for not swallowing treated wastewater or produce irrigated with treated wastewater were *don't like the idea of using wastewater* and *more information needed about the treatment process*.

Table 30. Reasons for *not* swallowing treated wastewater and produce irrigated with treated wastewater

Response	Water N=15		Lettuce N=10		Carrots N=11		Grapes N=10		Oranges N=9	
	n	%	n	%	n	%	n	%	n	%
Don't like the idea of using wastewater	-	-	5	50.0	7	63.6	7	70.0	6	66.7
More information needed about the treatment process	5	33.3	-	-	3	27.3	2	20.0	2	22.2
Not convinced it was adequately treated	6	40.0	6	60.0	-	-	1	10.0	-	-

Perceived health risks

Most participants thought about the possible health risks when drinking the treated wastewater sample (80.4%). About two thirds of participants thought about health risks when consuming lettuce (67.0%), carrots (68.5%) and grapes (66.3%) irrigated with treated wastewater.

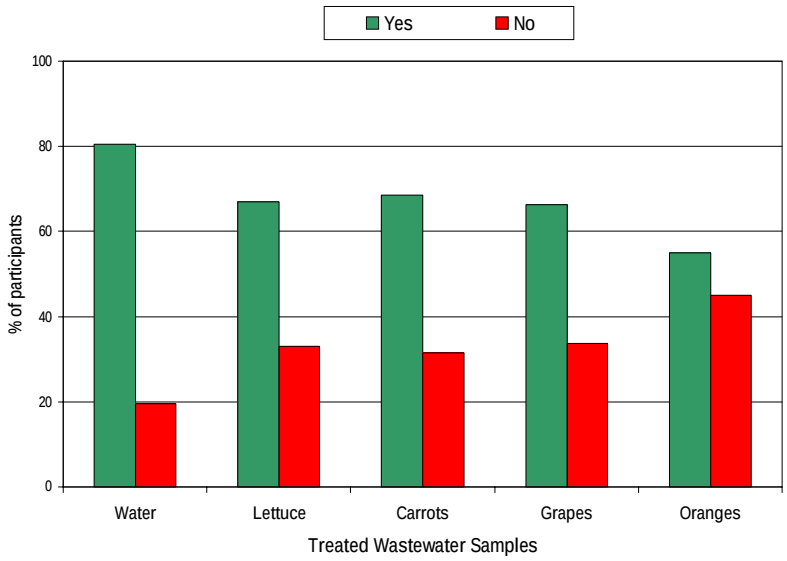


Figure 17. Percentages of participants who either thought about health risks or did not think about health risks when deciding to consume the five samples of treated wastewater

Participants who perceived health risks in consuming the treated wastewater samples were further asked to rate the risk on a five-point scale.

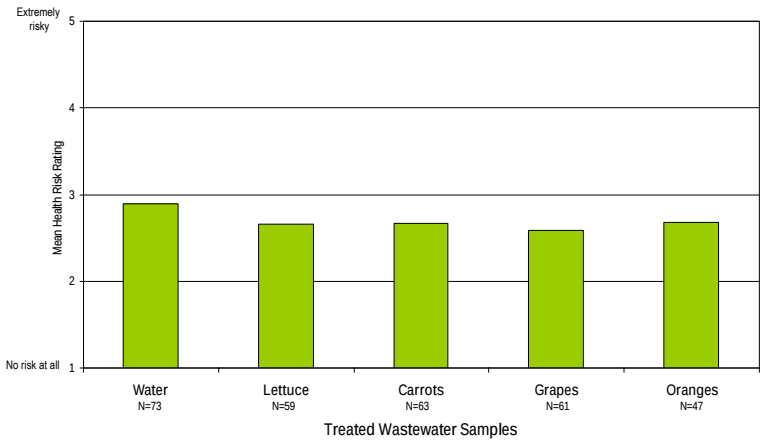


Figure 18. Mean health risk rating for the five samples of treated wastewater

Figure 18 shows the mean risk rating across the five samples of treated wastewater. Participants perceived statistically higher risk to their health in drinking treated wastewater rather than eating carrots, grapes and oranges irrigated with treated wastewater ($p<.05$)[1]. Participants did not seem to be different in their perceived health risks in drinking treated wastewater and eating lettuce irrigated with treated wastewater.

Feelings of disgust

About a fifth of participants reported feeling disgusted when drinking treated wastewater and eating lettuce and grapes irrigated with treated wastewater (22.8%, 21.6%, and 19.8% respectively). Fewer participants reported feeling disgusted when eating carrots (14.4%) and oranges (14.8%).

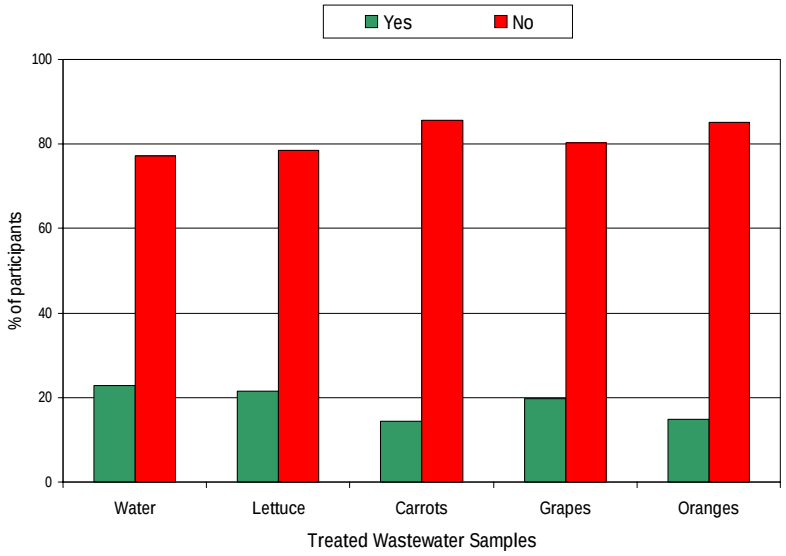


Figure 19. Percentages of participants who reported feeling disgusted with the five samples of treated wastewater

Participants were asked to provide details about their feelings of disgust in relation to each of the treated wastewater samples. The main responses are shown in the tables below.

[1] A significance level of .05 was used to increase the power of this study as the number of participants who responded across five samples were low (N=35).

Table 31. Reasons for feeling disgusted with the treated wastewater samples

Response	Water N=20	Lettuce N=16	Carrots N=11	Grapes N=15	Oranges N=10
	n	n	n	n	n
Uncomfortable with using wastewater	9	12	8.0	3	5
Thought of others' waste in water off-putting	6	-	-	5	-
Unknown health effects	-	-	-	6	-

The most frequent responses from participants who felt disgusted were *uncomfortable with using wastewater*, *thought of others waste in water off-putting*, and *unknown health effects*.

Table 32. Reasons for *not* feeling disgusted with the treated wastewater samples

Response	Water N=38		Lettuce N=33		Carrots N=39		Grapes N=33		Oranges N=36	
	n	%	n	%	n	%	n	%	n	%
Trust the treatment process	8	21.1	6	18.2	16	41.0	8	24.2	6	16.7
No problems with treated wastewater	4	10.5	9	27.4	8	20.6	12	36.4	8	27.8
Looked/smelled/tasted okay	9	23.7	10	30.3	-	-	7	21.2	5	13.9
Uncomfortable with using wastewater	9	23.7	-	-	5	12.8	-	-	5	13.9
Water is filtered naturally by the plants	-	-	-	-	-	-	3	9.1	5	13.9
Concentrated on end product only	-	-	-	-	-	-	-	-	4	11.1
Only a small amount of risk	3	7.9	-	-	-	-	-	-	-	-

The most frequent responses for those who did not feel disgusted were *trust the treatment process*, *no problems with treated wastewater*, *looked/smelled/tasted okay* and *uncomfortable with using wastewater*. Other common responses were *water is filtered naturally by the plants*, *concentrated on end product only* and *only a small amount of risk*.

Trust in the treatment process

The percentages of participants who trusted the treatment process for wastewater were similar across the five samples of wastewater: treated wastewater (74.2%), lettuce (74.4%), carrots (73.9%), grapes (73.9%) and oranges (76.7%) irrigated with treated wastewater.

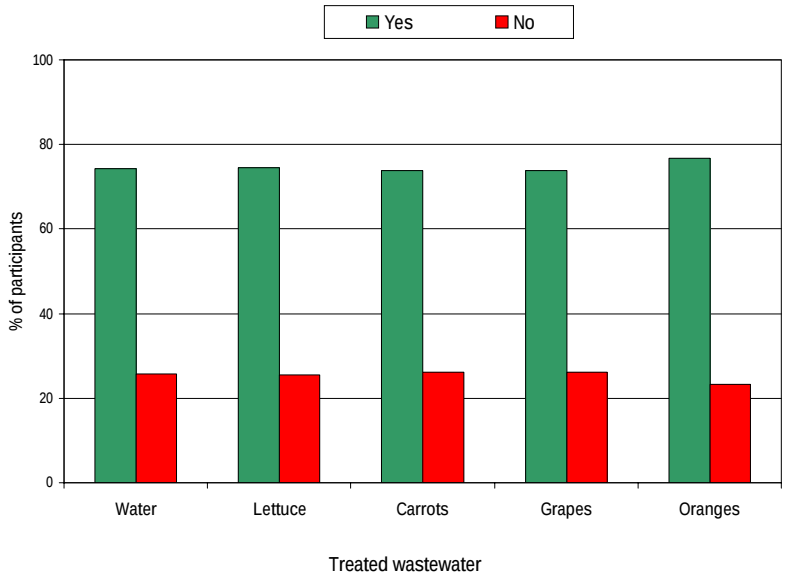


Figure 20. Percentages of participants who trusted or did not trust the treatment process

Participants who trusted the treatment system provided various comments about their trust. Their main responses included *trust the treatment standards*, *tried it but felt reluctant* and *more information needed about the treatment process and potential health impacts*.

Table 33. Reasons for trusting the treatment process

Response	Water N=48		Lettuce N=45		Carrots N=36		Grapes N=42		Oranges N=40	
	n	%	n	%	n	%	n	%	n	%
Trust the treatment standards	20	41.7	22	48.8	14	38.9	21	50.0	19	47.5
Tried it but felt reluctant	13	27.1	9	20.0	7	19.4	10	23.8	-	-
More information needed about the treatment process and potential health impacts	6	12.5	7	15.6	8	22.2	7	16.7	5	12.5
Strict standards and regulations must be maintained	6	12.5	-	-	5	13.9	-	-	-	-
Plants act as additional filter	-	-	5	11.1	4	11.1	6	14.3	5	12.5
Not concern with using treated wastewater for irrigation of trees	-	-	-	-	-	-	-	-	7	17.5

For participants who said they did not trust the treatment process, the main responses given by them included *more information needed about the treatment process* and *concern with potential contaminants in water/food.*

Table 34. Reasons for *not* trusting the treatment process

Response	Water N=22		Lettuce N=19		Carrots N=20		Grapes N=21		Oranges N=20	
	n	%	n	%	n	%	n	%	n	%
More information needed about the treatment process	12	54.5	10	52.6	10	50.0	12	57.1	14	70.0
Concern with potential contaminants in water/food	6	27.3	3	15.8	4	20.0	10	47.6	-	-
Do not like the idea of using wastewater	4	18.1	-	-	-	-	-	-	-	-
Concern with treatment system: unknown risks and possible failure in mechanical process or human errors	-	-	3	15.8	3	15.0	-	-	4	20.0

3.2.4.4 An overview of all 15 samples

Tasting and swallowing of the 15 samples

The percentages of participants who tasted the fifteen samples are shown in the figure below.

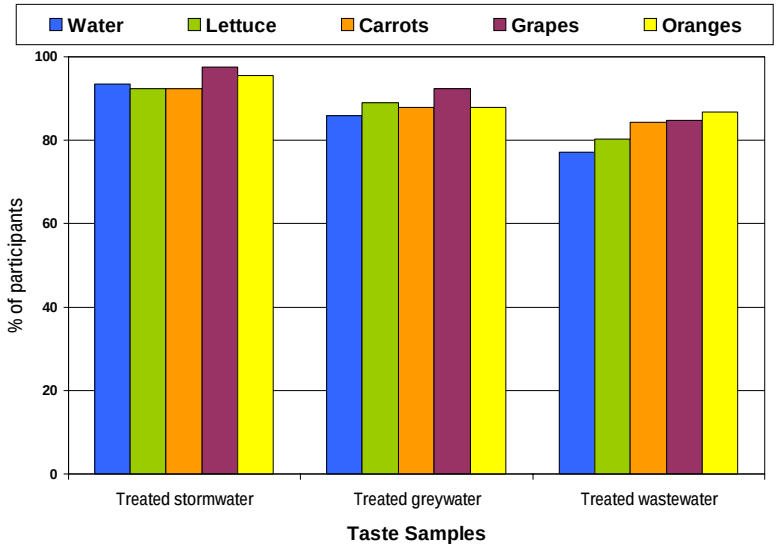


Figure 21. Percentages of participants who tasted the 15 samples

All fifteen samples were tasted by the majority of participants. The percentages of participants who had tasted the samples of treated wastewater and produce irrigated with wastewater were generally lower than treated greywater. In turn, treated greywater samples were generally lower than treated stormwater. While responses to fruit and vegetables irrigated with recycled water varied from one source of recycled water to another, oranges and grapes tended to be tasted the most by participants. Overall, as would have been expected, lettuce, having the greatest direct contact with the water, was tasted by a lower percentage of participants compared with other samples. This was particularly so when it was irrigated with treated wastewater.

Most participants who tasted the fifteen samples also swallowed them as well. The percentages of participants who swallowed the samples are shown in the figure below.

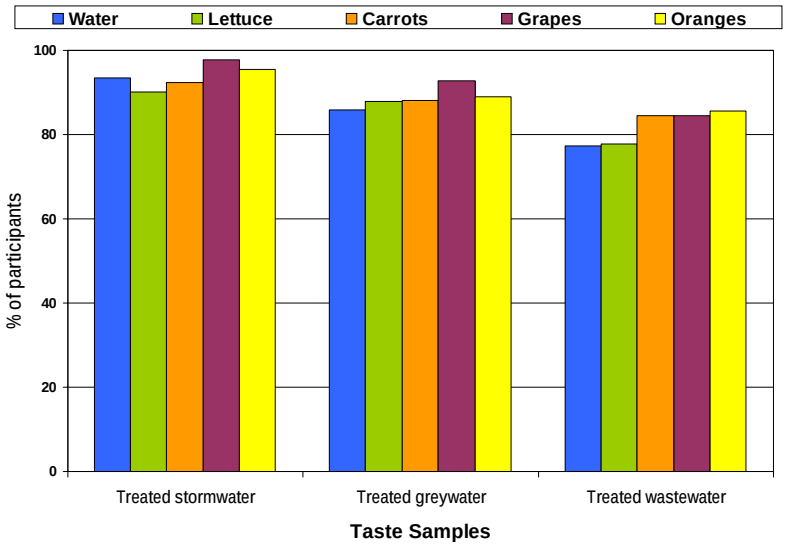


Figure 22. The percentages of participants who consumed the 15 samples

Again, the numbers of participants who swallowed the samples of treated wastewater and produce irrigated with treated wastewater were lower than those for treated greywater and stormwater. Of all the samples, the numbers of participants who swallowed the samples of treated wastewater and lettuce irrigated with wastewater were the lowest. Again, responses to different fruit and vegetables irrigated by recycled water varied from one source to another. Overall, the differences between the fruit and vegetables were generally consistent with the degree of personal contact with the recycled water.

Perceived health risks

For each sample, participants were also asked whether they considered any possible health risks when they chose to consume them. The percentages of participants who considered the possible health risks for the 15 samples are depicted in the figure below.

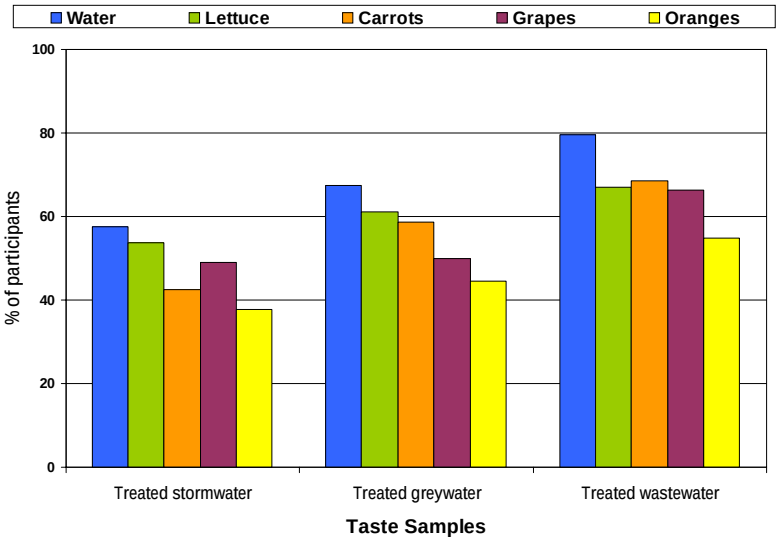


Figure 23. Percentages of participants who perceived health risks in consuming the samples

The percentages of participants who considered the possible health risks when faced with treated wastewater and produce irrigated with treated wastewater were higher than their greywater and stormwater counterparts. The percentages of participants who considered health risks associated with treated stormwater and produce irrigated with treated stormwater were lowest.

Relative ratings of the perceived risk are shown in the following figure.

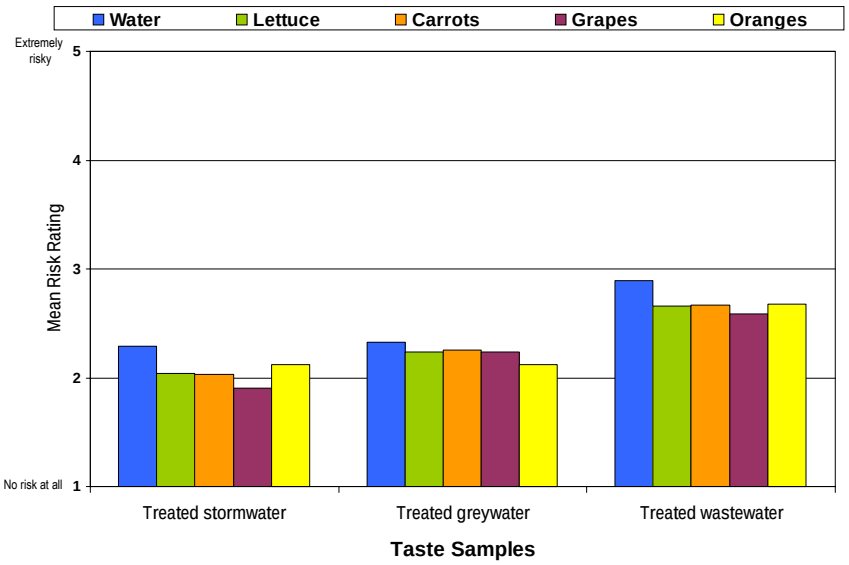


Figure 24. Mean health risk ratings associated with each sample

Figure 24 indicates that participants on average rated the treated wastewater for drinking and produce irrigated with treated wastewater samples to be more risky than either treated stormwater or greywater.

Statistical analyses showed that the differences in the mean risk ratings for samples within a recycled water source were not statistically significant. Specifically, the mean risk ratings for treated stormwater and different produce irrigated with treated stormwater were not significantly different. The same results were found for the mean ratings of treated wastewater and greywater samples.

For particular produce, the source of recycled water used for irrigation was found to influence its perceived risk rating significantly. Lettuce, carrots, grapes, and oranges irrigated with treated wastewater were perceived significantly more risky than those irrigated with either treated stormwater or greywater. The samples of treated wastewater for drinking were also rated significantly more risky than those of treated greywater or stormwater.

Feelings of Disgust

Participants were also asked about their feeling of disgust when they made their decision to consume the samples. The percentages of participants who felt the emotion of disgust for each water source are shown in the figure below.

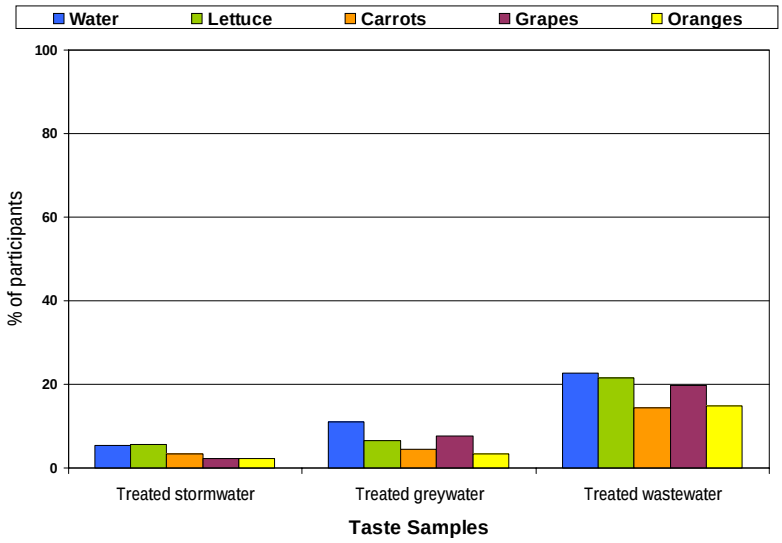


Figure 25. Percentages of participants who felt disgusted when consuming the samples

The majority of participants indicated that they did not feel disgusted when they considered consuming the samples. However, the percentage of participants who indicated feeling disgusted was higher when they were faced with treated wastewater and produce irrigated with treated wastewater. This though would indicate that people did not associate their "yuck" feelings with the term "disgust".

Trust in the treatment process

Participants were also asked about their trust in the treatment process when they made their decision to consume the samples. The following figure shows the percentages of participants who trusted in the treatment process for the range of samples.

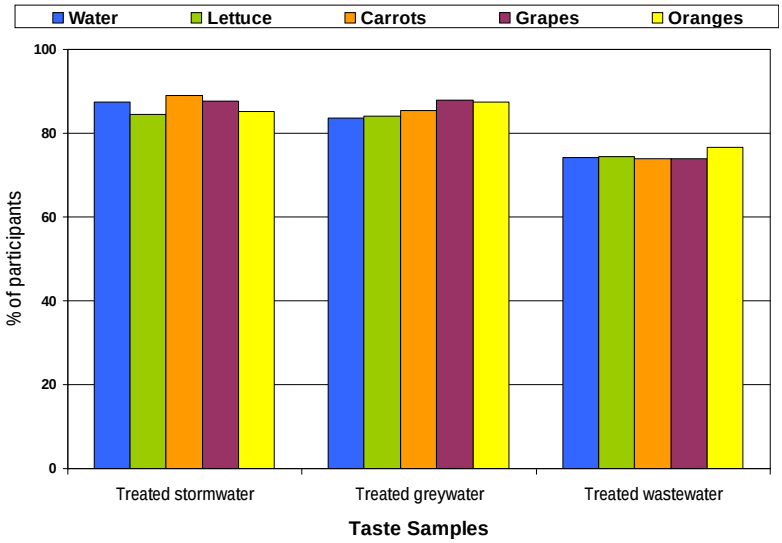


Figure 26. Percentages of participants who trusted in the treatment process

The percentages of participants who trusted in the treatment process were lower when they were faced with samples of treated wastewater and produce irrigated with treated wastewater. The percentages of participants who trusted the samples of treated stormwater and greywater and produce irrigated with treated stormwater and greywater were similar.

3.2.4.5 The way people make judgements about each sample

Participants were asked to rate each sample on ten semantic differential scales. Multi-dimensional scaling with individual differences was selected to examine how participants used the scales to make judgements about the fifteen samples.

Two through five-dimensional solutions were produced from the fifteen samples. Figure 27 below shows the plotting of stress value for the different dimensional solutions.

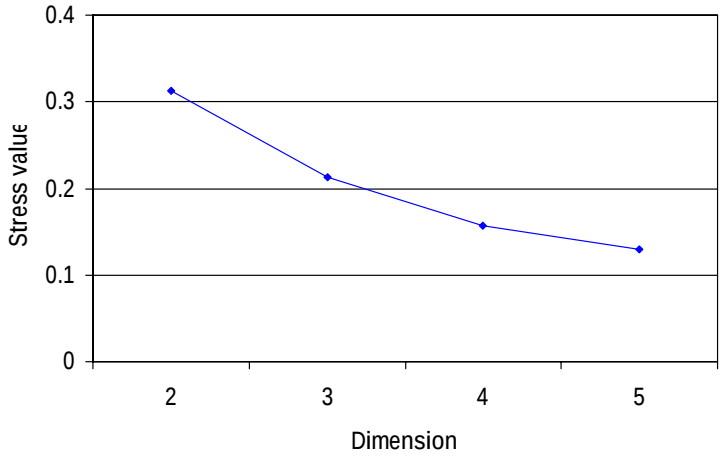


Figure 27. Plotting of stress value for each dimension solution

An elbow, the point where the slope of the line declined slowly was detected over the third dimension. Examination of the dimension stimulus coordinates further suggested that the four- and five-dimensional solution did not add meaningful structure to the data. Consequently, three dimensions with a stress level of .21 and R^2 of .70 were retained for interpretation.

The three dimensions were interpreted by examining the scales that had high positive or negative scores and provided with the following descriptive names.

- Dimension I: Appeal-Vs-Repulse
- Dimension II: Trust-Vs-Distrust
- Dimension III: Safe-Vs-Contaminated

The multi-dimensional scaling also examined how participants varied in the way they rated the fifteen samples. The results are reported in the table below. When reading the table, a weight of 0.0 for a sample on a dimension indicates that the dimension was not seen as relevant to that particular sample. A score of 1.0 indicates that the dimension was important in evaluating the sample.

Table 35. Results produced from the multi-dimensional analysis

Samples	Dimension I (Appeal-Vs-Repulse)	Dimension II (Trust-Vs-Distrust)	Dimension III (Safe-Vs-Contaminated)
Treated Stormwater	.63	.46	.38
Lettuce irrigated with stormwater	.50	.45	.38
Carrots irrigated with stormwater	.57	.47	.46
Grapes irrigated with stormwater	.46	.49	.44
Oranges irrigated with stormwater	.49	.45	.40
Treated Greywater	.51	.53	.31
Lettuce irrigated with greywater	.61	.42	.41
Carrots irrigated with greywater	.56	.47	.41
Grapes irrigated with greywater	.72	.40	.31
Oranges irrigated with greywater	.62	.43	.40
Treated Wastewater	.52	.52	.41
Lettuce irrigated with wastewater	.55	.51	.43
Carrots irrigated with wastewater	.41	.51	.49
Grapes irrigated with wastewater	.55	.58	.35
Oranges irrigated with wastewater	.54	.51	.45
Overall importance of each dimension	.31	.23	.16

The overall importance weights indicate that the *Appeal-Vs-Repulse* dimension was more relevant to participants in their evaluation of samples compared with *Trust-Vs-Distrust* and *Safe-Vs-Contaminated* dimensions.

For samples related to treated wastewater except for carrots, participants generally used two predominant dimensions. Participants used *Appeal-Vs-Repulse* and *Trust-Vs-Distrust* dimensions in their evaluation. For carrots irrigated with treated wastewater, participants tended to use *Trust-Vs-Distrust* and *Safe-Vs-Contaminated* dimensions.

For samples related to treated greywater and stormwater, participants used only the *Appeal-Vs-Repulse* dimension to evaluate the samples with some exceptions. For treated greywater, participants used both *Appeal-Vs-Repulse* and *Trust-Vs-Distrust* dimensions. Participants used all three dimensions to evaluate samples of grapes and oranges irrigated with treated stormwater.

3.2.4.6 Predicting consumption

To maintain sampling adequacy, samples which had a small number of participants (<15%) who did not consume the samples were excluded from this sample. Consequently, only two samples – treated wastewater and lettuce irrigated with treated wastewater were retained for binary logistic regression analyses.

Statistical analyses by means of t-tests and cross tabs were initially conducted to omit variables that were not significant in their contribution to the consumption of the two samples. The variables examined were:

1. responsibility to help with Perth's water issues; [2]
2. responsibility for Perth's water shortage problems; [2]
3. prior experience with recycled water;
4. conservation attitudes; [2]
5. reuse behavioural intention; [2]
6. awareness of Perth's water issues;
7. age;
8. levels of education;
9. gross annual household income;
10. perception of health risks;
11. trust in the treatment system; and
12. feeling of disgust.

Results showed that the first 10 variables did not contribute significantly to the consumption of the two samples. They were therefore omitted from the modelling of sample consumption.

Forward stepwise (Ward) logistic regression analyses were conducted for each sample to examine factors that would increase the odds of consuming the sample.

Table 36. Logistic regression models of samples consumption

Samples	Trust Odds ratio	Disgust Odds ratio	Nagelkerke R Square
Wastewater	18.23	0.08	.52
Lettuce irrigated with wastewater	11.43	*ns*	.29

ns = not significant at p < .05

The odds ratio above represents the strength and direction of the relationship between two variables. The odds ratio for each of trust and disgust represents the strength and direction of relationships between both *trust in the treatment process* of a particular sample and *feeling of disgust* with the consumption of the sample.

[2] From Surveys 1 and 2

Looking at the odds ratio for trust and disgust, it appears that *trust in the treatment process* and *feelings of disgust* were two important factors predicting consumption of the treated wastewater sample. In particular, participants who consumed the sample were 18.23 times more likely to trust the treatment process and were .08 times less likely to feel disgusted than participants who had not consumed the sample.

For the consumption of lettuce irrigated with treated wastewater, only trust in the treatment process was the main predictor. Participants who consumed the lettuce irrigated with treated wastewater were 11.43 times more likely to trust the treatment process that those who did not consume the sample.

3.3 Follow-up Surveys

After the preliminary reporting of experiment results in May 2004, it was deemed necessary to conduct follow-up surveys with participants of the experiment and a random selection of Perth residents. Two follow-up studies were subsequently carried out about two months after the experiment.

The first follow-up survey was carried out with participants who attended the experiment. It aimed to further investigate the attitudes of the participants to the acceptability of using treated wastewater for different purposes. Results from Surveys 1 and 2 suggested that participants significantly lowered their acceptance of using treated wastewater for some purposes after being exposed to the experimental conditions. This survey examined the attending participants' attitudes two months after the experiment.

The second follow-up survey was conducted with a random selection of people living in the Perth metropolitan area. Participants who attended the experiment displayed strong obligations to environmental protection and intention to reuse water. This survey aimed to determine whether the same attitudes were shared by the general Perth community.

3.3.1 Results

3.3.3.1 Follow-up Survey 1

The mean acceptability ratings by the experiment participants for different uses of treated wastewater across three surveys are presented in the figure below. This format has been adopted for clarity.

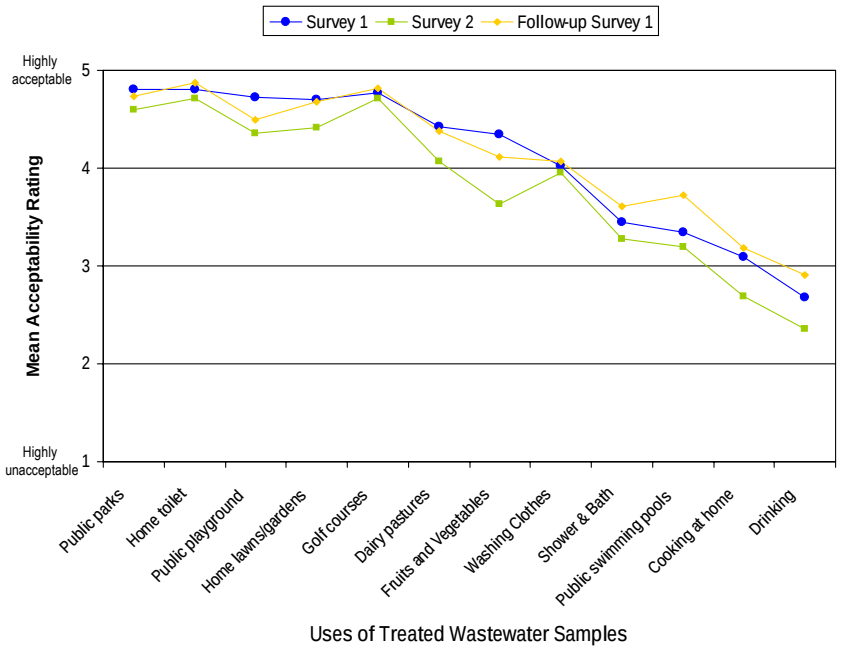


Figure 28. The mean acceptability ratings of uses of treated wastewater across different surveys

Figure 28 shows the consistent trend in general reuse findings, indicating that the acceptance of reuse decreases as the use moves closer to human contact. The figure also shows that participants lowered their acceptance of different uses of treated wastewater after their participation in the experiment. When asked the same question two months after the experiment (i.e. Follow-up Survey 1), participants' acceptance increased to levels similar to those found prior to attending the experiment. Participants perceived the uses of treated wastewater for cooking, irrigating home lawns/gardens, fruits and vegetables, and pastures to be significantly less acceptable in Survey 2 than in either Survey 1 or Follow-up Survey 1. The use of treated wastewater to fill up public swimming pools was perceived more favourably in Follow-up Survey 1 than Surveys 1 or 2.

3.3.3.2 Follow-up Survey 2

Awareness of Perth's water issues

Participants in the Follow-up Survey 2 were asked to rate their awareness of Perth's water issues on a five-point scale. Participants on average thought they were fairly aware of Perth's water issues. There were no significant differences in the mean awareness rating given by participants who attended the experiment and those in the Follow-up Survey 2. In other words, participants who attended the experiment did not consider themselves to be more aware of Perth's water issues than a random selection of Perth community.

Attitudes to reuse

A series of attitudinal statements as in Surveys 1 and 2 were asked to the general Perth community sample. Again they were required to rate the statements on a five-point scale. The responses to the statements were compared with those obtained in Survey 1 from participants who attended the experiment. The results are shown in Table 37.

In comparison with the participants who attended the experiment, the general Perth sample agreed more with the following statements:

- I think it is too hard to get most people to use recycled water
- It would be too difficult for me to use recycled water at home
- I would only be prepared to use recycled water in times of water shortages
- I could never use recycled water
- Water recycling is not appropriate for managing Perth's water future
- Water experts should have control over the kind of water the community is supplied with
- People have a right to unlimited use of water
- Every household should be free to choose their source of water supply (e.g. groundwater, surface water, recycled water)

The general Perth sample also indicated lower agreement with the following statements than did the attending participants.

- I believe water recycling is essential to help manage future water shortages
- I feel personally obligated to do whatever I can to save water
- I feel good when I do things to help the environment
- Water is a valuable resource that should be re-used
- It would be very easy for me to use recycled water in my home
- I intend to use recycled water in the future
- I believe the protection of the natural environment is vital for future generations.

It is important to note the difference expressed by the general Perth sample and the attending participants is only a matter of degree rather than opposing views. However, it does seem that the participants were more pro-reuse of water than Perth residents in general.

Table 37. Mean agreement/disagreement ratings for different attitudinal statements

	Attending participants	General Perth residents
	Survey 1 (N=93)	Follow-up Survey 2 (N=149)
I think it is too hard to get most people to use recycled water*	2.66	3.32
Water experts should have control over the kind of water the community is supplied with*	3.43	3.77
I would rather "go without" than do something that wastes water	3.50	3.39
I believe water recycling is essential to help manage future water shortages*	4.52	4.15
I would never use recycled water even in times of water shortages	1.61	1.82
It would be too difficult for me to use recycled water at home*	1.85	2.47
Water recycling is not appropriate for managing Perth's water future*	1.71	2.15
I feel personally obligated to do whatever I can to save water*	4.40	4.11
I feel good when I do things to help the environment**	4.42	4.27
Water is a valuable resource that should be re-used*	4.62	4.31
It is my right to have fresh water supplied to my home	3.97	3.85
It would be very easy for me to use recycled water in my home*	3.76	3.39
People have a right to unlimited use of water*	1.63	2.07
I intend to use recycled water in the future*	4.20	3.66
People should take responsibility for the environment around them-	4.51	4.42
I could never use recycled water*	1.51	1.91
I feel a moral obligation to protect the natural environment	4.45	4.23
I would only be prepared to use recycled water in times of water shortages**	1.86	2.58
Every household should be free to choose their source of water supply (e.g. groundwater, surface water, recycled water)*	2.71	3.27
I believe the protection of the natural environment is vital for future generations**	4.68	4.53

*Statistical significant different at P< .01

**Statistical significant different at P < .05

Environmental obligation scale

An exploratory factor analysis was conducted with the items which measured the participants' attitudes towards environmental protection and again formed a highly reliable scale with standardised item alpha of 0.78.

An environmental obligation score was therefore calculated for the general Perth community sample. An independent t-test analysis revealed that participants who attended the experiment displayed significantly stronger attitudes towards environmental protection than did the general Perth sample. Again, the difference was merely in terms of degree rather than opposing views.

Reuse intention scale

An exploratory factor analysis was also conducted on the items which measured participants' intention to use recycled water. However, the items were found to have a low standardised item alpha of .44. An SEM analysis was conducted and indicated that the three-items were a good fit to the data. The scale was therefore retained.

T-test analysis indicated that participants who attended the experiment displayed significantly stronger intention to reuse in comparison with general Perth residents.

Perceived control scale

An exploratory factor analysis was conducted on the items measuring the participants' perceived control and formed a scale with a standardised alpha of 0.47. Again, the SEM analysis found that the model fit well to the data and therefore the scale was retained. Perth residents in general felt a significantly lower personal control in the use of recycled water than did participants who attended the experiment.

3.4 Summary and Conclusions

The findings here in relation to recycled water for different uses were in line with past reuse studies which suggested that acceptability decreases as the use moves closer to human contact. The present study also found that perceptions of fairness of a reuse scheme was closely related to the participants' acceptance of the scheme. Participants did not think it was fair to ask people to use recycled water for purposes that they themselves found difficult to accept.

Being exposed to the experiment seemed to reduce participants' acceptance of treated wastewater. Participants were more willing to accept different uses of treated wastewater prior to attending the experiment than they were when asked immediately *after* the taste experiment. However, their acceptance of treated wastewater reverted back to original levels when they were again asked two months later. It is difficult to draw any firm conclusions however, without a control group.

The acceptability of water reuse was also found in the study to be dependent upon the type of water being reused. Participants were often more accepting of reusing the treated stormwater and greywater than they were wastewater. Also, the nature of the sample influenced acceptability, with treated water samples being less acceptable than those consisting of produce simply irrigated by treated water. Of the produce, the order of acceptability was generally, from lowest to highest, lettuce, carrots, grapes and oranges. This is again consistent with the acceptability of treated water tending to wane with greater personal contact.

Public agencies such as the Health Department and Water Corporation were trusted by the participants to manage recycled water programs in WA. CSIRO and university scientists were most trusted to provide information on recycled water. Private companies were generally not trusted by people to manage or provide information about reuse.

The importance of trust and emotions associated with reuse in people's decisions to accept or reject a particular reuse scheme was shown in the results of multi-dimensional scaling and logistic regression. Surprisingly, perceived health risks did not seem to affect people's decisions significantly. However, health risks may be involved in people's trust decisions.

It was considered possible that participants who attended the experiment may have represented the more pro-reuse and pro-environmental sector of the Perth population. This proved to be the case. The follow-up study with a random selection of Perth residents indicated that the general Perth residents did not display the same strength attitudes in environmental protection, reuse intention, and perceived

control as the participants who attended the experiment. Therefore, the results achieved here in this experiment will represent a 'best case scenario' in terms of ingestion of the samples. It could also be assumed that the emotions and principle aspects of decision-making would be further amplified in the wider Perth community.

In general, the experiment provided confidence in the applicability of the variables in the hypothesised model in relation to behavioural decisions. It provided confidence in both the validity and reliability of the measurements of most of the variables, especially in the case of the repeated measures. It would also seem that the term "disgust" may not be an appropriate way to measure the "yuck" emotion that is evident, but rather the use of the semantic scales that produced the Appeal-Vs-Repulse dimension.

4.0 TESTING THE MODEL: INDIRECT POTABLE IN PERTH

This research marked the second stage of Water for a Healthy Country flagship – Water Futures project. It was designed to explore factors that influence people's decisions to use recycled water for different household purposes. For the purpose of this study, a reuse scheme which involves infiltrating highly treated wastewater into a Perth drinking water aquifer was presented as a case study. This reuse method, commonly known as Managed Aquifer Recharge (MAR), was chosen as it is considered by the Water Corporation of Western Australia to have major potential to provide water supplies for the future of Perth. Additionally, it could assist in maintaining the environmental sustainability of the aquifer. The technical viability of using MAR in Perth is still currently being explored and discussed with the community. A variety of trials of MAR reuse are expected to commence in Perth in the next few years for both non-potable and indirect potable uses.

4.1 Methodology

A survey questionnaire suitable for a telephone interview was developed as a result of the outcomes of the social experiment reported in the previous section. It was administered during November 2004. The survey aimed to interview a minimum sample number of 400 people in the Perth metropolitan area. Respondents were provided with a brief explanation of the reuse scheme that covered all the pertinent points (see Section 4.1.5). Interviewers were provided with additional detailed information to assist with any questions. They were also advised to forward the call to a more knowledgeable research team member should questions venture into more specialised areas.

4.1.1 Study Locations

All suburbs in the Perth metropolitan area were stratified into 3 groups (higher, medium and lower) based on their weekly family income figures obtained from the Australian Bureau of Statistics (2001). Ten suburbs were then selected from each of lower and higher socio-economic groups and twenty suburbs were chosen for the medium group. These ensured a good spread across the metropolitan area.

The following table lists the suburbs used in the study under their corresponding socio-economic groups.

Table 38. Suburbs under each socio-economic group

Lower	Medium		Higher
Balcatta	Alexander Heights	Kenwick	Canningvale
Coolbellup	Bateman	Kewdale	East Fremantle
Langford	Beckenham	Kinross	Gwelup
Midland	Bibra Lake	Middle Swan	Highgate
Mirrabooka	Bullcreek	Myaree	Menora
Nollamara	Como	Noranda	Mindarie
O'Connor	Craigie	Redcliffe	Mt Pleasant
Rivervale	Edgewater	South Lake	Salter Point
Tuart Hill	Hamersley	Wanneroo	Shelley
White Gum Valley	Karrinyup	Waterman	Swanbourne

4.1.2 Respondents

Respondents for the study were randomly selected from the suburbs above. Ten respondents from separate households aged eighteen years or over were required from each suburb. An effort was also made to recruit an equal number of males and females.

Lists of randomly selected households were provided to interviewers with instructions to call each household a minimum number of three times at different times of the day and on different days before it could be dismissed as "no contact". A final total of 400 respondents were recruited including 193 (48.2%) males and 207 (51.8%) females.

4.1.3 Refusal Rate

The refusal rate for the questionnaire was 62%. The following table shows the reasons for refusing.

Table 39. Refusal reasons

Reason	N (654)
Not interested	315
Too busy	193
Little/No English	76
Too old	45
Sick	25

4.1.4 The Questionnaire

As a summary, the survey questionnaire consisted of the following items.

- intention to drink the recycled water[3]
- knowledge about the scheme
- need for more information about the scheme
- importance of having information about the scheme
- perceived risks and benefits of the scheme
- feelings and emotions associated with the scheme
- trust in different authorities to manage the scheme
- trust in different authorities to provide information about the scheme
- a series of attitudinal statements
- an indication of the importance of pricing of recycled wastewater
- specific questions about relationships with the natural aquifer
- socio-demographic information

[3] The term "indirect potable" was not used with survey respondents. At all times the questionnaire referred to *using recycled wastewater to add to our underground water supply for household uses including drinking*.

4.1.5 Briefing Information

Before answering the questions, respondents were read the following information. Greater detail was available to respondents if they required it as explained above in Section 4.1.1. Appendix 1 provides the additional information provided to the interviewers.

Western Australia has experienced a significant reduction in rainfall since the mid 1970s and this is likely to continue with the onset of climate change. With the increasing population, there is a need to plan for our future water supplies. At the moment, more than half of Perth's water comes from groundwater supplies. It is possible that fresh water supplies that are available for Perth could start to run out in less than 30 years unless we do things differently. By 2031, Perth will need an extra 150 Gigalitres of water which is the same as four full Serpentine dams, or 150 billion litres.

Therefore, a variety of new water supply options are being considered, including reusing our wastewater, which includes water from the toilet. One method of doing this could involve treating the wastewater from households and industry to a high standard (tertiary treatment) and then storing it in the groundwater aquifers. There it would mix with normal groundwater and some years later be taken out for household use, including for drinking.

It has been shown scientifically that natural underground processes continue to treat the wastewater to higher health standards. Even so, the mixed water would be further treated to current drinking water standards after pumping from the aquifer and before being piped to households.

The Water Corporation would be responsible for all treatment processes, the storage in the aquifers and the pumping and piping to households. The Department of Health would ensure the standards of treatment are suitable for drinking, and the Department of Environment would monitor the aquifers and oversee any environmental issues.

We would now like to know what your thoughts would be if the government was to introduce this reuse scheme for all your household uses, including for drinking. Currently, there are no definite plans to do so, but it is an option for future consideration.

4.2 Results

The following provides the general results of the analysis of the responses to the questionnaire. A statistical significance level of 0.01 was used throughout the analysis. For most of the open-ended questions, respondents were allowed to provide up to three responses.

4.2.1 Drinking Water from the MAR Scheme

After they were briefed on the MAR reuse scheme, respondents were asked if they would drink water from the scheme. Less than one third of respondents (31.3%) stated an unconditional intention to drink the water, 51.0% had reservations about drinking the water, and 17.8% stated they would not drink the water at all.

Respondents were further asked to provide reasons why they would or would not drink the water.

Of the respondents who would drink the water, the main reasons given were as shown in the following table.

Table 40. Reasons for intention to drink water from the scheme

Reasons	Percentage (N=125)
Perth needs other water supply options	30.1
Trust the authorities to do the right thing	24.4
Trust the treatment standard is high enough	20.3
Know other countries which use recycled water	11.4
Trust the water is safe	9.8
Have drunk recycled water before	9.8
It is just another source of water	8.1

Respondents who were willing to drink water from the MAR scheme generally felt that Perth needed to have alternative water supply options. They also trusted the authorities to do the right thing, and trusted that the treatment standards would be high enough.

Respondents who were unsure about drinking the water provided the following reasons.

Table 41. Reasons provided for feeling unsure about drinking water from the scheme

Reasons	Percentage (N=205)
If it is treated properly	45.1
Do not like the idea of using recycled water	17.6
As long as it is safe to use	10.8
Need assurance that it is safe to use (e.g. scientific evidence)	16.2
Only as a last resort	9.3
Prefer using other water sources	5.9
Trust the authorities to do the right thing	5.4
Trust the treatment standard is high enough	5.4

Many respondents who were feeling unsure about drinking the water thought about the safety of using water. Reasons relating to safety included if it is treated properly, as long as it is safe to use, and need assurance that it is safe.

Respondents who said they would not drink the water gave the following reasons.

Table 42. Reasons provided for no intention to drink water from the scheme

Reasons	Percentage (N=71)
Do not like the idea of using recycled water	76.1
Other water sources would be preferred	16.9

The majority of respondents who were unwilling to drink the water did not like the idea of using recycled wastewater. They preferred other water sources.

4.2.2 Knowledge of the Scheme

Respondents were asked to rate how much knowledge they had about using recycled wastewater for uses including indirect potable on a five-point scale. The percentage of responses is shown in the table below.

Table 43. The level of knowledge respondents had about the scheme

Percentage (%)					Mean (N=400)
1 No knowledge at all	2	3 Some knowledge	4	5 High level of knowledge	
35.8	19.8	31.5	7.3	5.8	2.27

More than half of respondents reported having little or no knowledge of using recycled wastewater for uses including indirect potable. Only 5.8% of respondents said they had a high level of knowledge and the mean score indicated that respondents generally had little knowledge.

Males were found to have a significantly higher level of knowledge than females. Significant differences were also found for different income and educational groups:

- Respondents who had university or partial university qualifications tended to report higher levels of knowledge than those who just completed either primary or secondary school.
- Respondents who had an annual household gross income of more than $82,000 a year reported a higher level of knowledge than those households with less than $22,000 per year.

No significant differences were detected for different age groups.

4.2.3 Information about the Scheme

Respondents were also asked whether they would like to obtain further information about using recycled wastewater for uses including indirect potable. The majority of respondents said *yes* (71.5%), 23.5% said *no* and only 5.0% were *unsure*.

Respondents who wanted further information were asked what information they would like, and how they would like to obtain it.

Table 44. The type of information required by respondents

Information wanted	Percentage (N=306)
Recycled water treatment processes	63.6
Criteria for good quality drinking water	21.0
As much information as possible	19.0
Safeguards in place to prevent contamination	11.1
Cost of recycling	6.6
Appropriate uses for the water	6.7
Monitoring of the water quality	6.2
Potential risks in reusing industrial wastewater	4.3
Quality of the water compared with normal scheme water	3.6
Long term effects to environment	3.6
How the scheme compares with other schemes	3.6
General information on the scheme (including technical and scientific info)	3.3
Quality and quantity of water in the aquifer	3.3

As is frequently the case, respondents more often preferred personally directed methods of receiving information as shown in the following table.

Table 45. Preferred ways of obtaining the information

How	Percentage (N=306)
Mail out	61.8
Internet	26.8
TV	20.6
Newspaper	14.1
Media	11.8
Radio	6.2
Information distributed by government authorities	3.6

Respondents were also asked to rate on a five-point scale the importance of receiving information about the MAR scheme.

Table 46. The importance of information about the MAR scheme

Percentage (%)					Mean (N=399)
1 Not at all important	2 Hardly important	3 Important	4 Very important	5 Extremely important	
6.3	10.5	20.3	32.3	30.5	3.70

As the mean importance rating shows, respondents generally thought having information about the scheme was very important. Few respondents (16.8%) thought having the information was hardly important or not at all important

The importance of having information was not statistically significantly different between respondents who said they would and would not drink the water. Females were found to place a significantly higher level of importance in having information about the scheme than males. No significant differences were found in the mean importance rating across different income, age and educational groups.

4.2.4 Perceived Benefits

Respondents were asked to rate the possible benefits they thought the MAR scheme would provide to themselves, their family and the environment in general.

Table 47. The possible benefits of the scheme

Benefits to	N	Mean*
… them personally	399	3.53
… their family	393	3.69
… the environment	396	4.21

*higher scores indicate greater perceived benefit

Respondents generally thought the reuse scheme was beneficial to themselves, their family and the environment. The differences in the mean benefit ratings were found to be statistically significant. That is, respondents perceived the reuse scheme as having more benefits to their family and the environment rather than themselves. Note that the difference mentioned here is only a matter of degree, rather than opposing views.

Also, respondents who would drink water from the scheme saw it as having significantly more benefits to themselves, their family and the environment than those who were not sure or would not drink water from the scheme.

All respondents from the study were asked to rate how much they thought Perth would benefit from the MAR scheme on a five-point scale.

Table 48. Benefit of the scheme to Perth

Percentage (%)					Mean (N=399)
1 No benefit at all	2	3 Some benefit	4	5 Great benefit	
3.8	6.5	17.5	11.0	61.3	4.19

More than half of the respondents (61.3%) thought the scheme would provide great benefit to Perth. Very few respondents thought the scheme would provide little or no benefit (10.3%).

Respondents who thought the scheme was beneficial to Perth were further asked unprompted what they thought the benefits would be.

Table 49. Perceived benefits to Perth

Benefits	Percentage (N=384)
More water to use	37.5
Save water	20.1
Reduce demand on groundwater/dam water	18.8
Provides Perth with sustainable water supply	16.7
Keeps Perth green	13.5
Helps the environment	10.4
More economical than other water sources	6.3

The main response given by respondents was that Perth would have more water to use as a result of the scheme. Respondents also thought that the scheme offered Perth the benefit of saving scheme water, helping to reduce demand on our groundwater and dam water and provides Perth with sustainable water supply.

4.2.5 Perceived Risks

Similar to the benefits question, respondents were also asked to rate on a five-point scale the possible risks or problems that might be associated with the scheme to themselves, their family and the environment.

Respondents generally considered the scheme to be risky to themselves, their family and the environment. They also rated the risk posed by the scheme to be significantly greater for themselves and their family than for the environment. The difference was however, not great.

Table 50. Possible risks from the scheme

Risks to	N	Mean*
… them personally	391	2.69
… their family	385	2.66
… the environment	388	2.36

*higher scores indicate higher perceived risk

Respondents who would drink water from the scheme perceived significantly less risk to themselves, their family and the environment than those who were not sure or would not drink from the scheme.

4.2.5.1 Possibility of something going wrong

Respondents were then asked whether they thought there was a possibility that something might go wrong with the MAR scheme. Just under two-thirds of respondents said *yes* (63.3%), 17.3% were *unsure* and 19.5% said *no*.

Respondents who thought there was a possibility that something might go wrong were asked to state what.

Table 51. Perceptions of things that might go wrong with the scheme

Responses	Percentage (N=321)
Contamination of groundwater (e.g. chemical leaks)	39.3
Human errors	19.9
Wastewater not treated properly	17.4
Potential health risks from drinking the water	17.4
Accidents happen	15.9
Mechanical failures	14.0
Poor management (e.g. lack of quality control & maintenance; monitoring of the scheme)	13.7
Damage to the aquifers	6.9
Don't know	5.3

The possibility of the scheme contaminating the groundwater was most frequently nominated by the respondents. Possible human errors leading to the contamination of drinking water supply and groundwater were also mentioned, along with other comments such as wastewater not treated properly and potential health risks from drinking the water.

4.2.5.2 Perceived likelihood

Respondents who thought there was a possibility that something might go wrong were further asked to rate on a five-point scale how likely they thought it was that something would happen.

Table 52. The likelihood that it might happen

Percentage (%)					Mean (N=321)
1 Highly likely	2	3 Neither	4	5 Highly unlikely	
15.9	27.5	24.6	17.4	14.6	2.88

The percentage of respondents who thought it was likely or highly likely that something might go wrong (43.4%) was somewhat higher than those who thought otherwise (32.0%). On average though, respondents thought that it was neither likely nor unlikely that something might go wrong, as shown by the mean.

4.2.5.3 Perceived seriousness

Respondents who thought there was a possibility of something going wrong were also asked to rate how serious they thought it would be on a five-point scale.

Table 53. Perceived seriousness of the problem

Percentage (%)					Mean (N=320)
1 Extremely serious	2	3 Serious	4	5 Not at all serious	
50.3	11.6	29.7	5.9	2.5	1.99

If something went wrong, half the respondents considered it would be extremely serious. As indicated in the table above, the majority of respondents (91.6%) thought the consequences of something going wrong were serious through to extremely serious.

4.2.5.4 Perceived level of control

Respondents who thought there was a possibility of something going wrong were also asked about the level of control they believed the authorities would have to stop this from happening.

Table 54. Authorities' level of control

Percentage (%)					Mean (N=321)
1 No control at all	2	3 Some control	4	5 High level of control	
8.4	7.2	28.3	12.5	43.6	3.76

Respondents generally thought that the authorities would have a level of control to stop it from happening. However, less than half the sample thought the level of control would be high.

4.2.5.5 Expert knowledge about the safety of the scheme

Respondents were asked what they thought the experts knew about the safety of the scheme.

Table 55. Expert knowledge about the safety of the scheme

Percentage (%)					Mean (N=397)
1 No knowledge at all	2	3 Some knowledge	4	5 High level of knowledge	
3.5	7.3	32.0	18.9	38.3	3.81

Just over half of respondents (57.2%) thought that the experts had a good or high level of knowledge about the safety of the scheme.

4.2.5.6 Unknown effects from the scheme

All respondents were asked to rate the likelihood that there could be unknown effects from the scheme.

Table 56. The likelihood that there could be unknown effects from the scheme

Percentage (%)					Mean (N=395)
1 Highly likely	2	3 Neither	4	5 Highly unlikely	
18.5	25.1	27.1	13.9	15.4	2.83

As the table above shows, opinion was generally divided on this issue. Almost 44% thought it was likely or highly likely, whereas 39% thought it was unlikely or highly unlikely.

4.2.6 Risks versus Benefits of the MAR Scheme

After thinking of all the possible benefits and risks associated the MAR reuse scheme, respondents were asked to choose one statement from the following five with which they most agreed.

About one fifth of respondents felt the benefits and risks of the scheme were equal. Almost 65% of respondents thought the benefits of the scheme outweighed the risks, and only 16% of respondents felt the risks actually outweighed the benefits.

Table 57. Risks versus benefits of the scheme

Risks Versus Benefits	Percentage (N=397)
The benefits obviously outweigh the risks	40.1
The benefits slightly outweigh the risks	24.7
The benefits and risks are equal	19.4
The risks slightly outweigh the benefits	7.8
the risks obviously outweigh the benefits	8.1

4.2.7 Trust in the Authorities

Respondents were asked to rate their trust in three government agencies specifically, and in science and technology generally, to perform their respective roles in the operation and management of the scheme. Results of these questions are shown in the following figure.

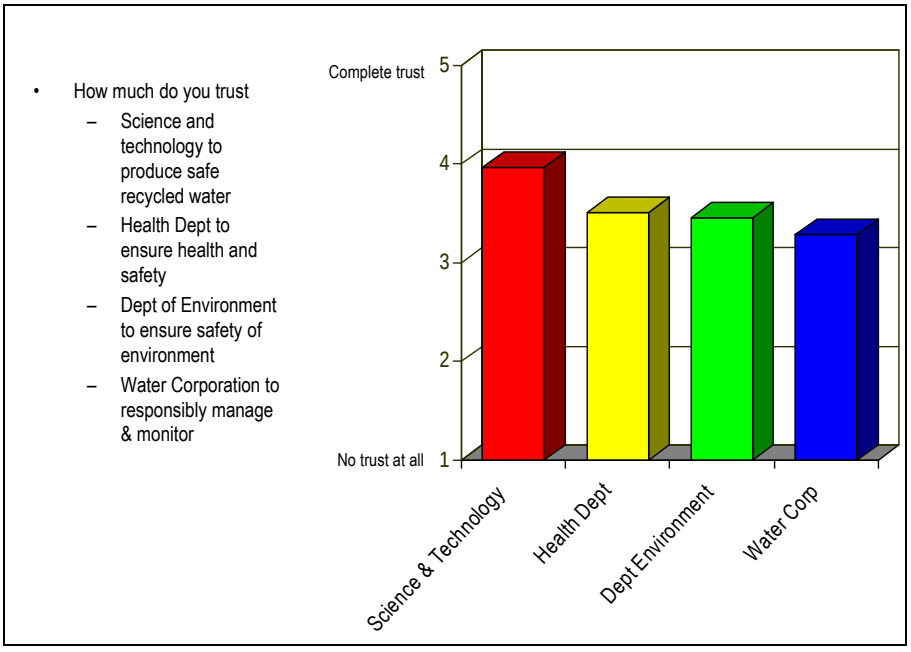


Figure 29. Trust in organisations to perform their respective roles

Respondents generally had some trust in the three government agencies to perform their respective roles. However, respondents' trust in Water Corporation to perform its role was significantly lower in comparison with the departments responsible for health and the environment to perform their respective roles. On the other hand, respondents rated a significantly higher level of trust in science and technology to produce safe drinking water from the scheme.

4.2.8 Trust in Authorities to Provide Information

Respondents were also asked about their level of trust in different agencies and organisations to provide reliable information on any issues about the scheme. The order in which agencies were presented to respondents was varied from one interview to another to avoid any order bias.

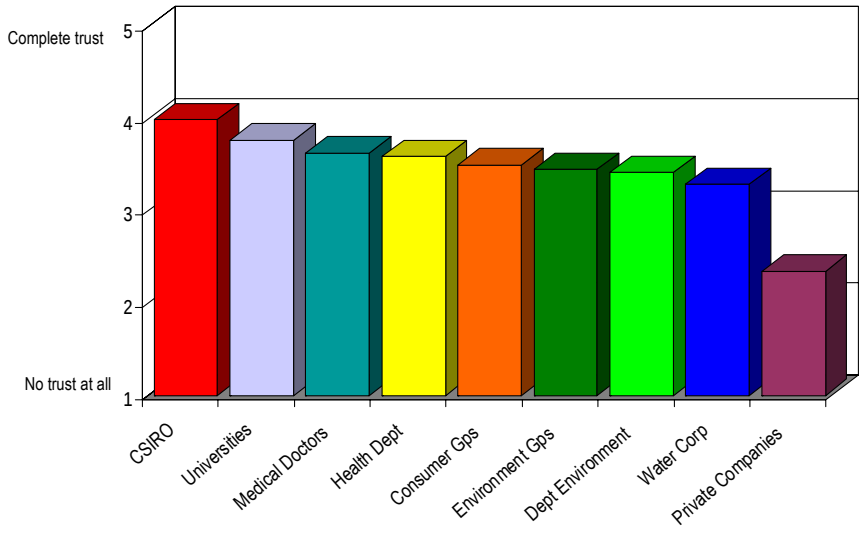


Figure 30: Trust in different authorities to provide reliable information

CSIRO was trusted significantly more than were the other authorities to provide reliable information on any issues about the scheme. Private companies were least trusted by respondents. There was no significant difference in trust between any of the other authorities.

Respondents were also asked to nominate other agencies that they would trust to provide reliable information. Following were the three agencies most commonly nominated by respondents and their respective mean rating.

Table 58. Other agencies nominated by respondents

Agency	N (37)	Mean
Government ministers	6	2.40
International bodies with experience in reuse	5	3.80
Local government	5	4.00

4.2.9 Emotive Feelings about Water from the MAR Scheme

Respondents' feelings of emotion associated with drinking treated water from the MAR scheme were also explored in the survey through a series of scales that had been developed and tested in the social experiment described in Section 3 of this report. Individual reporting of the scales serves no purpose as they were designed to provide a single latent variable for the confirmatory analysis of the hypothesised model.

4.2.10 Drinking Recycled Wastewater other than through a MAR Scheme

Respondents were asked whether they would consider drinking treated recycled wastewater in a scheme that did not involve pumping into the underground aquifer first. Few respondents said they would consider drinking the water (13.3%). The remaining respondents felt *unsure* (43.3%) or *would not* (43.5%) consider drinking water from this type of scheme.

Respondents who said they would consider drinking water from a reuse scheme that did not involve pumping the water into aquifer (n=53) provided the following reasons for their responses.

Table 59. Reasons for why respondents would drink recycled water other than through a MAR scheme

Reasons	N (53)
The water is safe to drink after treatment	18
Have faith in the recycled wastewater treatment process and standard	17
Prefer schemes that did not involve the aquifer	9

Most respondents commented that they would consider drinking water from the reuse scheme as they were confident in the treatment safety.

Respondents who were unsure whether they would drink recycled water other than through a MAR scheme provided the following reasons.

Table 60. Reasons for why respondents were unsure about drinking the recycled water other than through a MAR scheme

Reasons	Percentage (N=173)
Only if the water is treated properly	39.9
Don't know enough to answer	23.7
More information is needed	23.7
Underground environment neutralise water	11.0
Depends on treatment standards	5.2

Respondents who were unsure about drinking the water principally either had concerns about the treatment or thought they needed more information.

Respondents who said they would not drink water from a reuse scheme that did not involve pumping the water into aquifer first (n=174) provided the following reasons.

Table 61. Reasons as to why respondents would not drink recycled water other than through a MAR scheme

Reasons	Percentage (N=174)
Underground environment neutralises the water	51.7
Do not like the idea of using recycled wastewater	30.5
Do not trust treated recycled wastewater quality	9.8
More information is needed	5.7
Don't know enough to answer	5.7

About half of the respondents who would not drink water from a reuse scheme that did not involve pumping the water into the aquifer mentioned that the underground environment neutralises the water

4.2.11 Price of Recycled Wastewater

Respondents were asked whether the price of the water would change their decision to drink or not to drink the treated recycled wastewater. The majority of respondents (73.0%) said it would make *no difference*, 16.8% said it would and 10.3% were unsure.

For respondents who said that the price of water would make a difference to whether they would drink it or not, the following reasons were given.

Table 62. Reasons as to why the price of recycled wastewater matters

Reasons	N (67)
Would not drink it if the cost increased	29
Would not drink it if too expensive	12
Would use other sources if cost too high	11

The most frequent comments regarding price making a difference was if the cost increased they would not drink the water.

For respondents who said that the price would make no difference to whether they would drink the water, the most frequent reasons given were as follows.

Table 63. Reasons as to why the price of recycled wastewater did not matter

Reasons	Percentage (N=292)
Water would be needed regardless	35.9
Cost doesn't influence my decision	33.4
Type of water used is more important	15.2
Don't have control over pricing of water	11.0

The most common responses were that water would be needed regardless and that cost doesn't influence my decision.

For respondents who were unsure whether price would influence whether they would drink the water or not, the most common responses were as follows.

Table 64. Reasons at to why respondents were unsure about the price of wastewater

Reasons	N (41)
Don't have control over pricing of water	11
Cost doesn't influence my decision	10
I wont drink it if cost increased	8

4.2.12 Proportions of Recycled Water

Respondents were asked whether different proportions of groundwater and recycled wastewater mixed to provide their drinking water supply would make a difference to their decisions to drink the water.

Most respondents (64.0%) said it would *not* change their decision. About one quarter of respondents (24.3%) said it would change their decision and 11.8% of respondents were unsure.

Respondents were then asked to provide reasons for their responses.

For the majority of respondents who said the proportions of groundwater and recycled wastewater would change their decision to drink the water, their preference was to only have a small amount of recycled wastewater (74.2%).

Table 65. Reasons why proportions of recycled wastewater and groundwater matter

Reasons	Percentage (N=97)
Prefer a small amount of recycled wastewater only	74.2
Only if the water is treated properly	8.3
Prefer recycled wastewater to be evenly distributed	5.2

Respondents who said the different proportions of groundwater and recycled wastewater would not make a difference to their decision provided the reasons that are shown in the following table. Many of these respondents qualified their decisions by stating if the recycled wastewater was treated properly (34.8%). Some respondents suggested that the different proportions would not change their mind as it was still recycled wastewater and they did not want to drink any recycled wastewater. Others felt that the authorities knew better regarding the potential effects of having different proportions of the waters.

Table 66. Reasons why proportions of recycled wastewater and groundwater did not matter

Reasons	Percentage (N=256)
If recycled wastewater was treated properly	34.8
Doesn't make a difference	34.3
It is still recycled wastewater regardless	15.7
Don't want to use any recycled wastewater	11.7
Authorities know better	3.9

Respondents who were unsure whether the different proportions would make a difference to their decisions provided the following comments.

Table 67. Reasons as to why respondents were unsure about the proportions of recycled wastewater and groundwater

Reasons	N (47)
More information is needed	15
Would prefer a low percentage of recycled wastewater	13
Only if the water is treated properly	8

4.2.12.1 Highest percentage of recycled wastewater acceptable

Respondents who said that proportions of recycled water would make a difference to their decisions to drink the water, or were unsure if it would make a difference, were further asked to nominate the highest percentage of recycled wastewater they would accept.

Almost one-third of these respondents (30.1%) would accept proportions of recycled wastewater only up to 10%. About one-fifth would accept up to 25% and a further one-quarter of the respondents would find up to 50% to be acceptable. Very few respondents (2.1%) said they would accept more than 75% of recycled wastewater in the mix.

The following table provides an outline of all the responses.

Table 68. Highest percentage of recycled wastewater acceptable to respondents

Percentages of recycled wastewater	Percentage (N=144)
Less than 5%	13.3
Between 5 to 10%	16.8
Between 10 to 25%	20.3
Between 25 to 50%	27.3
Between 52 to 75%	8.4
More than 75%	2.1
Other	11.9
Details:	
Don't know	41.2
As little as possible	35.3
Depends on water quality	11.8

4.2.13 Years the recycled wastewater was underground

Respondents were also asked whether there would be a time when they would consider the infiltrated recycled wastewater to be the same as groundwater.

Just over half the respondents answered yes to the question (52.0%). One-fifth of respondents said no (19.3%) and 28.8% were unsure.

Respondents who thought there would be a time when the infiltrated recycled wastewater and groundwater became the same, provided the following reasons.

Table 69. Reasons why infiltrated recycled wastewater and groundwater would become the same

Reasons	Percentage (N=208)
Underground environment purifies water	62.1
Both waters will be the same eventually	31.9
Both waters will immediately be the same if recycled wastewater was treated properly	6.8
The longer it stays the better	5.9

Main reasons provided by respondents included that the underground aquifer would purify the recycled wastewater and both waters would eventually be the same. Some respondents thought both waters would immediately be the same given that the recycled wastewater had been treated.

The following table shows the responses provided by respondents who did not think there would be a time when the infiltrated recycled wastewater and groundwater became the same.

Table 70. Reasons why the infiltrated recycled wastewater and groundwater would remain different

Reasons	Percentage (N=77)
It is still recycled wastewater	42.3
The recycled water would remain contaminated	19.7
Unsure but scientists will know	14.1
the water will always be different because you know it is recycled wastewater	9.9

The main reasons offered were that it is still recycled wastewater and it would remain contaminated.

Respondents who were unsure whether there would be a time when the infiltrated recycled wastewater and groundwater became the same provided the following reasons for their responses (n=115).

Table 71. Reasons why respondents were unsure about whether the infiltrated recycled wastewater and groundwater would ever be the same

Reasons	Percentage (N=115)
Don't know enough to answer but scientists will know	78.9
Don't know about underground processes	16.7
The longer it stays the better	7.9

The majority of respondents who were unsure did not feel they knew enough to answer the questions and trusted the scientists to provide information.

Respondents who thought there would come a time, or there might come a time, when both waters became the same were also asked how long the water had to be underground before they would consider them to be the same.

Their responses are shown in the table below. Almost 40% of respondents thought the waters would be the same in 5 years or less. About one-fifth thought it would take 6 to 10 years. Few respondents thought it would take up to 20 years for both waters to be the same. However, almost one-third could not answer the question.

Table 72. Number of years the infiltrated recycled water would need to be left underground before it became the same as groundwater

Years underground	Percentage (N= 323)
Immediately	7.47
1 to 5 years	31.5
6 to 10 years	20.6
11 to 20 years	8.72
More than 20 years	8.10
Don't know	30.2

4.2.14 Attitudes

Respondents were asked to rate their agreement with a series of twenty attitudinal statements associated with the variables in the hypothesised model. An exploratory factory analysis was performed on the statements and five factors were extracted and explained 62.09% of the variance. When tested for reliability, four factors emerged as being suitable for use as scales in later analyses.

On further examination, the first factor was seen to be made up of the items that were hypothesised to form two attitudinal scales, the *subjective norm* scale and the *attitudes towards intended behaviour* scale. Therefore, further tests using structural equation modelling with AMOS 5.0 were performed to test the uni-dimensionality of both potential scales.

As shown in the table below, the fit indexes for both scales were found to be adequate as recommended by Kline (1998). This indicated that items in both scales measured only one concept. It was therefore decided to retain the scales as separate items.

Table 73. Model fit indexes for the attitudes scale and subjective norm scale

Fit statistics	Attitudes towards intended behaviour scale	Subjective norm scale	Recommended value
Chi-square	4.46, df=1, p > .01	4.04, df=2, p > .01	-
CFI	.99	.99	≥.90
TLI	.99	.99	≥.90
RMSEA	.09	.05	≤.10

Scale 1: Attitudes towards the intended behaviour

This scale had a Cronbach alpha of .91 and consisted of three items. The scores for *attitudes towards the intended behaviour* scale were calculated for each respondent by summing their responses to the three items. The scores obtained for the scale are shown in the table below. The mean score indicated that respondents had positive attitudes towards drinking water from the MAR scheme.

Table 74. Attitudes towards the intended behaviour scale

Description	Mean
Minimum	3
Maximum	15
Mean	10.59

Scale 2: Subjective norm

The subjective norm scale consisted of four items and had a Cronbach alpha of .78. The mean of 13.44 indicated that respondents felt fairly strong pressure and influence from others to drink the water from the scheme.

Table 75. Subjective norm scale

Description	Mean
Minimum	4
Maximum	20
Mean	13.44

Scale 3: Environmental obligation

This scale had a Cronbach alpha of .79 and consisted of four items. The scores for the scale were again calculated for each respondent by adding responses to all four items and are shown in the table below. The mean of 18.21 indicated that respondents felt a strong obligation to protect the environment.

Table 76. Environmental obligation scale

Description	Mean
Minimum	12
Maximum	20
Mean	18.21

Scale 4: Reuse intrinsic motivation

This scale had a Cronbach alpha of .68 and consisted of three items. The mean indicated respondents were intrinsically motivated to reuse water.

Table 77. Reuse intrinsic motivation scale.

Description	Mean
Minimum	6
Maximum	15
Mean	12.37

Scale 5: Perceived control

This scale consisted of two items with a Cronbach alpha of .66. The mean score indicated that respondents did not feel they had much personal control over the source of their water supply.

Table 78. Perceived control scale

Description	Mean
Minimum	2
Maximum	10
Mean	5.57

4.2.15 Demographics

4.2.15.1 Awareness of Perth water issues

Respondents were asked to rate their awareness of water issues in Perth. Their responses to the question are shown in the table below.

Percentage (%)					Mean (N=399)
1 Not at all aware	2	3 Somewhat aware	4	5 Very aware	
1.3	9.0	23.8	28.3	37.6	3.92

Respondents were generally aware of water issues in Perth

4.2.15.2 Age

Age distribution	Percentage (N= 400)
Less than 24 years	6.0
24 to 39 years	26.8
40 to 55 years	33.0
56 to 65 years	17.3
66 to 75 years	11.3
More than 75 years	5.8

4.2.15.3 Gross household income

Income distribution	Percentage (N=400)
Less than $22,000	18.8
$22,001 to $42,000	15.8
$42,001 to $62,000	20.3
$62,001 to $82,000	14.5
More than $82,000	21.0
Don't know	4.8
Refused	5.0

4.2.15.4 Levels of Education

Educational level	Percentage (N=400)
All or some of primary school	1.8
All of some of secondary school	31.3
Partial trade or technical qualification	3.5
Trade or technical qualification	21.0
Partial university qualification	9.0
University qualification	33.5

4.2.15.5 Household unit

Household unit	Percentage (N=400)
Adults with youngest child less than 5 years old	15.0
Adults with youngest child between 5 and 12 years old	11.0
Adults with youngest child between 13 and 18 years old	6.3
All adults (includes children > 18 years)	67.8

It is evident that the sample lacked household units with children less than eighteen years of age. This is likely to be due to the busier lifestyles of young families. However, no significant differences emerged in any of the major variables between the different household units. Therefore, it is not expected that this lack of young families in the sample will have affected the overall results. It is, though, a point for further investigation in the future.

4.2.16 Modelling factors that influence the decision to drink water from the MAR scheme

Structural equation modelling with latent variables was used for this analysis to model factors that influenced people's decisions to drink water from the MAR scheme. This methodology was chosen as it caters for variables that are not observed directly (i.e. latent).

Using variables that were proposed by Ajzen's Theory of Planned Behaviour (1985, see Section 2.1) as well as additional factors identified in past literature, the following hypothesised model was used as the starting point for the investigation.

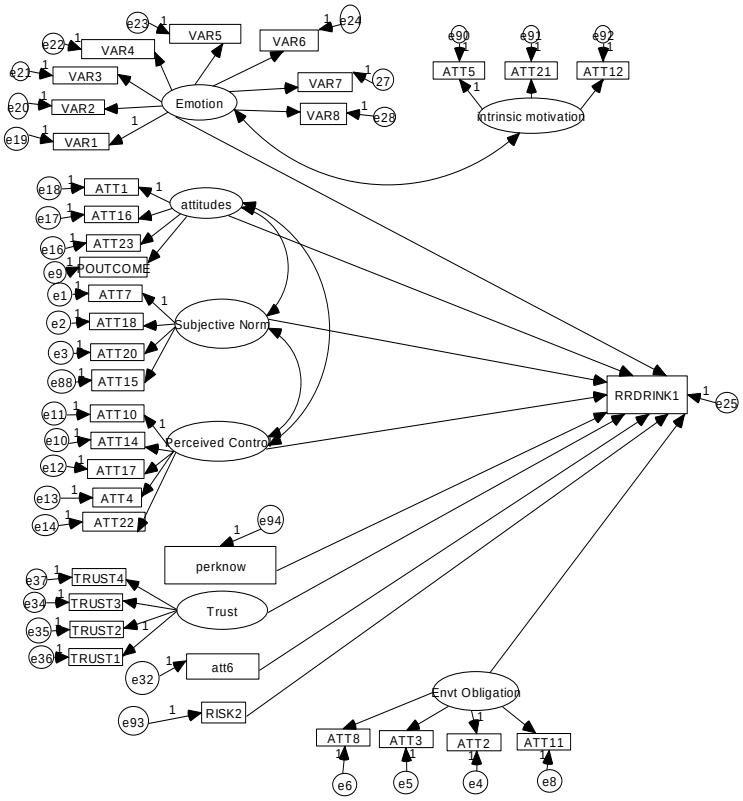


Figure 31. The hypothesised model as depicted in the Amos program

The figure above shows the hypothesised model as appeared in the AMOS 5.0 program (SmallWater Co., 2004). It also shows relationships between the latent and observed variables. Latent variables are those that cannot be measured directly and are represented by ellipses. The scores for these latent variables are often inferred by a number of indicators. For example, respondents' sense of obligation to protect the natural environment is not directly measurable. Therefore, a number of observable measurements were used to infer their sense of personal obligation to protect the environment. Where possible, exploratory factor analyses along with reliability tests were conducted to ensure these indicators of latent variables were reliable.

Also in Figure 31, variables that are measured directly (observed variables) are represented by boxes.

The following table summarises the latent and observed variables used in the hypothesised model.

Table 79. Descriptions of the variables in the hypothesised model

Variables From the Model	Latent or observed	Descriptions
Responsibility (Att6)	Observed	*Higher scores indicated respondents perceived a higher level of responsibility for making sure the State has enough water for the future*
Knowledge (Perknow)	Observed	*The higher the score the greater knowledge respondents felt they had about recycled wastewater in aquifers for household uses including indirect potable*
Risk Perceptions (Risk2)	Observed	*Higher scores indicated a higher level of perceived risk associated with recycled wastewater in aquifers for household uses including indirect potable*
Intended Behaviour (RRDRINK1)	Observed	*The higher the score, the greater the intention to drink water from the MAR scheme*
Trust	Latent	*Higher scores indicated higher levels of trust in the authorities*
Attitudes	Latent	*The higher the score the more positive respondents were about drinking water from the scheme and perceptions of the likely outcomes*
Emotion	Latent	*The higher the score the more negative respondents felt about drinking water from the scheme*
Intrinsic Motivation	Latent	*The higher the score, the more intrinsically motivated the respondents were to reuse water*
Perceived Control	Latent	*Higher scores indicated respondents preferred a higher level of control over the source of the water they used*
Subjective Norm	Latent	*Higher scores indicated respondents felt more pressure and influence from others to drink water from the scheme*

Fit measures recommended by Kline (1998) were used to determine the model fit. The Bayesian Information Criterion (BIC) was also used as one of the criteria for model selection. A smaller BIC value reflects a better model fit.

The results for these fit measures were shown in the table below.

Table 80. Model fit indexes for the hypothesised model

Fit statistics	Obtained value	Recommended value
Chi-square	2439.08,*df*=585, $p < .01$	-
BIC	2924.39	-
CFI	.78	≥.90
TLI	.76	≥.90
RMSEA	.09	≤.10

The values of the fit measures indicate that the overall fit of the data to the hypothesised model is inadequate. Other models were therefore investigated. The model, shown in Figure 32, with adequate model fix indexes, was chosen as the final model.

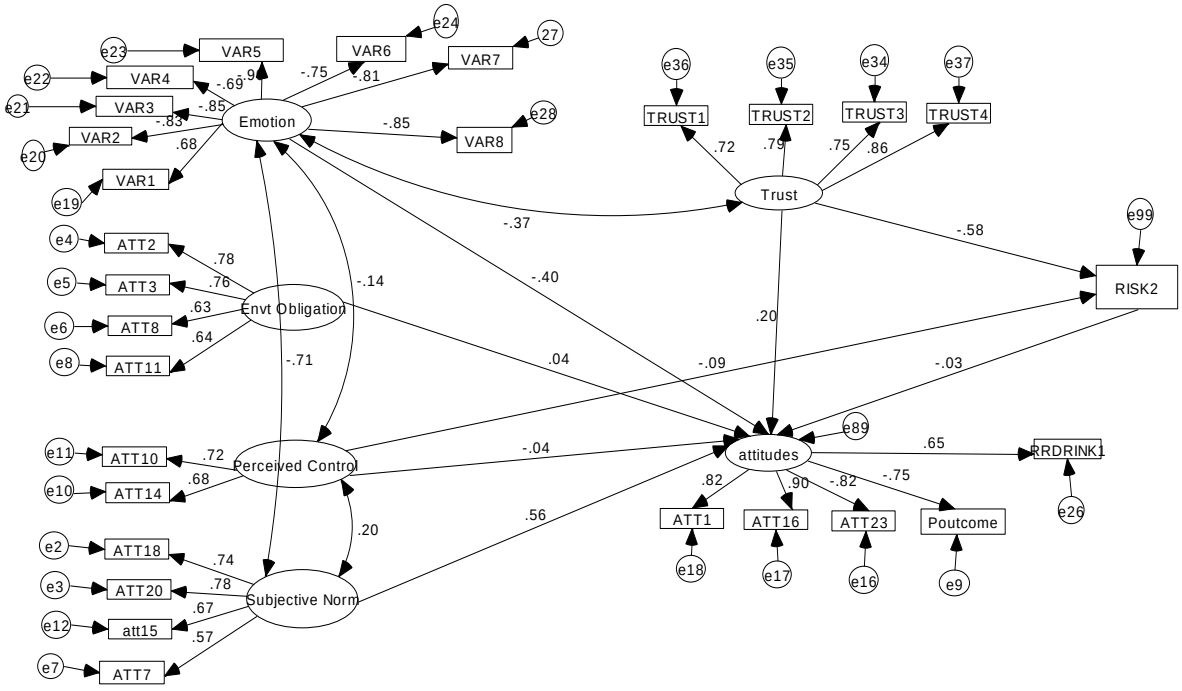
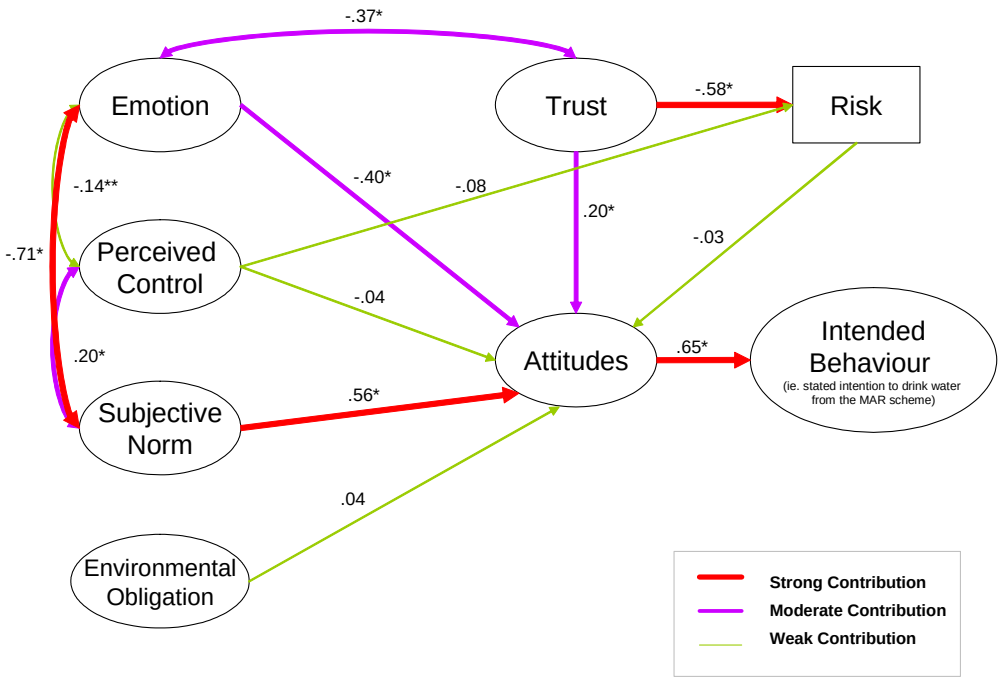


Figure 32. The final model as computed from AMOS (shown in standardised format)

Table 81. Model fit indexes for the final model

Fit statistics	Obtained value	Recommended value
Chi-square	1025.52; df = 339; $p < .01$[4]	-
BIC	*1426.95*	-
CFI	*.91*	*≥.90*
TLI	*.90*	*≥.90*
RMSEA	*.07*	*≤.10*

For easier interpretation, the final model has been simplified in Figure 33 below.



* significant path/correlations at $p < .01$

Figure 33. Simplified version of the final model (shown in standardised weights)

[4] Although a significant chi-square test may indicate a lack of satisfactory model fit, the researchers decided to retain the final model as the chi-square test is very much sensitive to the sample size and the central chi-distribution. Other fit indices are often recommended to determine the model fit and these fit indices indicated an acceptable model fit (Byrne, 2001)

As can be seen from the figure above, most of the components of the hypothesised model appear in the final model, with the exception of *responsibility, knowledge,* and *intrinsic motivation.* These three components were omitted from the final model as they either did not contribute significantly to the overall model fit or they detracted from the overall model fit. Another significant difference between the hypothesised and final models was the relationship between the components. The final model indicates relationships between *environmental obligation, subjective norm, perceived control, emotion, trust, risk* and *attitudes*, instead of the behavioural intention variable as originally hypothesised. The figure above shows that respondents' stated intention to drink water from the MAR scheme can be predicted from their attitudes. The more positive respondents' attitudes towards the intended behaviour and their outcome evaluations, the greater their intention to drink the water. Their attitudes were, in turn, significantly influenced by:

- *subjective norm*
  Respondents who perceived greater pressure and influence from their significant others to drink water from the scheme were more likely to adopt positive attitudes towards indirect potable reuse. This then increased their intention to drink water from the scheme.

- *emotions*
  Respondents who displayed negative emotions about drinking water from the scheme were likely to adopt negative attitudes towards indirect potable reuse which then negatively affected their intention to drink water from the scheme.

- *trust in the authorities*
  Respondents who displayed a high level of trust in the authorities associated with the scheme had more positive attitudes towards indirect potable reuse. This also increased their intention to drink water from the scheme.

- *risk perceptions*
  Respondents who perceived a higher level of risk associated with the reuse scheme had negative attitudes towards indirect potable reuse. This led to respondents being less likely to drink water from the scheme.

- *sense of obligation to protect the environment*
  Respondents who felt a strong obligation to protect the environment had more positive attitudes towards indirect potable reuse. This then led to their intention to drink water from the scheme.

- *perceived control over the source of their drinking water*
  Respondents who perceived greater personal control over the source of their drinking water had more negative attitudes towards indirect potable reuse. As a result, they were less likely to drink water from the reuse scheme.

Other findings that are of interest from the figure above include:

- Respondents' emotive feelings associated with drinking water from the MAR scheme correlated negatively with their subjective norm. This indicated that respondents' feelings of negative emotions decreased as they felt more pressure from their significant others to drink the water.

- Respondents' emotive feelings associated with drinking water from the reuse scheme also correlated negatively with their level of trust in the authorities associated with the scheme. That is, respondents' negative emotions lessened as their levels of trust in the authorities increased.

- Respondents' trust in the authorities associated with the scheme had a strong influence on their risk perceptions. Specifically, a higher level of trust reduced the perceived levels of risk.

4.2.17 Demographic Comparisons

Analytical comparisons were conducted with the key predictor variables (attitudes, emotions, risk perceptions, trust and subjective norm) and the demographic variables. The following statistically significant differences[5] were found, providing an indication of the demographic groups that should be targeted to increase community intention to drink water from the MAR scheme.

Gender

No significant differences were found between gender and subjective norm, trust, risk perceptions, or attitudes towards drinking water from the scheme.

Significant gender differences were found for the emotion variable. Women (mean=29.52) reported significantly higher levels of negative emotions towards drinking water from the MAR scheme than did men (mean=25.61).

Household units

No significant differences were found between different types of household units and the five key variables (subjective norm, trust, emotion, risks and attitudes towards drinking water from the scheme).

Age

No significant differences were found between age and the five key variables.

Education

Significant differences were found in levels of education and each of subjective norm, trust, emotions, and attitudes towards drinking water from the scheme. No significant differences were found in the way people perceived risk across different educational levels.

Subjective Norm

- Respondents who had either partial (mean=14.03) or full university qualifications (mean=14.16) perceived greater pressure to drink water from the MAR scheme than those whose highest level of education was primary school (mean=9.57).
- Respondents who had university qualifications (mean = 14.16) also perceived greater pressure than those who had a technical or trade qualification (mean=12.66)

Trust

- Respondents who completed secondary school (mean=13.58) had a significantly lower level of trust in the authorities than those who had a university degree (mean=15.19.

Emotion

- Respondents whose highest level of education was primary school (mean=41.43) had significantly more negative feelings towards drinking water from the scheme than those who had partial university qualifications (mean=24.03) or university qualifications (mean=23.00).
- Respondents whose highest level of education was secondary school (mean=29.71) had significantly more negative feelings towards drinking water from the scheme than those who had a university degree (mean=23.00).
- Respondents who had a trade or technical qualification as their highest level of education (mean=31.31) perceived more negative feelings towards drinking water from the scheme than those who had either partial university qualification (mean=24.03) or a full university qualification (mean=23.00).

Attitudes towards drinking water from the scheme

- Respondents who had a university degree (mean=16.08) held more positive attitude towards drinking water from the MAR scheme than those who had either completed primary school

[5] $p<.01$

(mean=10.14), secondary school (mean=13.72) or had a trade qualification (mean=12.89) as their highest level of education.

Income groups
No significant differences were found between income groups and subjective norm, trust in the authorities, and risk perceptions.

Significant differences were found between income groups for emotion. Respondents whose household income was less than $22,000 had more negative feelings about drinking water from the scheme (mean=30.45) than those whose gross household income was more than $82,000 (mean=24.13).

4.3 Summary and Conclusions

The results of this case study have provided further confidence in both the selection and the measurement of the principal variables involved in people's behavioural decisions in relation to a recycling scheme. The final model shows the relationship of the variables and their strength of contribution to the decision making. It should be noted that *all the variables* shown are important to the model even though some have weaker contributions and some are not statistically significant. None can be discounted.

For the first time, this research provides some quantitative understanding of the role of emotions (eg. the "yuck factor") in people's behavioural decisions, both in the ability to measure them and also in terms of the degree of influence on the decisions. While these emotions can often be seen as "irrational" and difficult to deal with, the results of the latent variable modelling shows how other variables could be used to temper them, such as increasing trust in the authorities and increasing the positive influence of the subjective norm.

Of considerable interest was that knowledge did not emerge in the latent variable modelling as a factor in people's decisions to drink the recycled water. This is an important finding for anyone considering communication and education as the main feature of obtaining community acceptance of a recycling scheme.

Again, as is consistent with past research, there were indications that peoples' acceptance of using recycled wastewater reduces as it comes closer to human contact. In this case study, the percentage of people who would unconditionally drink the recycled water was reasonably high for potable uses compared with past findings (eg. ARCWIS, 2002). When examined closely, it appeared that this could be attributed to people's perceptions of having a medium to filter the treated wastewater. Unconditional support for the scheme dropped by 18% to be similar to past findings, and opposition to drinking the water increased by 26% when asked about drinking recycled water if not pumped to the aquifer first. This perception of the aquifer as a medium is heartening given the considerable potential for MAR in Perth.

Perhaps another surprising finding was that risk perceptions were not more dominant in influencing behavioural intentions. While risk was quite strongly influenced by trust, it had only a weak contribution to attitudes and hence to intended behaviour. Again, this is interesting given that it is assumed that technological and health risks are important to address with the community. While this may be the case, this model also suggests that by increasing trust in the authorities, people's concerns about risk will reduce.

Testing the model on a second case study is, however, important to confirm the findings here.

5.0 TESTING THE MODEL: HORTICULTURAL IRRIGATION IN MELBOURNE

This study was conducted as a second case study to test the model that hypothesised the different factors that influence people's behavioural decisions in relation to recycled water schemes (see Section 2). It forms part of a study that is a part of Land and Water Australia's National Program for Sustainable Irrigation. It is being led by the Department of Primary Industries in Victoria and is investigating the potential for the use of reclaimed effluent for horticultural irrigation in Australia. This particular case study was funded by the Natural Heritage Trust on condition it be linked with the Water for a Healthy Country research described in Sections 3 and 4.

This second case study investigated the factors that governed the Melbourne community's decisions to buy vegetables grown with recycled wastewater at Werribee. This scheme had commenced operating a short time before the survey was carried out.

5.1 Methodology

The survey questionnaire suitable for a telephone interview used in the first case study (Section 4) was amended to include the particulars of this second case study. It was administered during February 2005. The survey aimed to interview a minimum of 400 people in the Melbourne metropolitan area. Respondents were provided with a brief explanation of the reuse scheme that covered all the pertinent points (see Section 5.1.5). Interviewers were provided with additional detailed information to assist with any questions. They were also advised to forward the call to a more knowledgeable research team member should questions venture into more specialised areas.

5.1.1 Study Locations

All suburbs in the Melbourne metropolitan area were stratified into 3 groups (higher, medium and lower) based on their weekly family income figures obtained from the Australian Bureau of Statistics (2001). Ten suburbs were then selected from each of lower and higher socio-economic groups and twenty suburbs were chosen for the medium group. These ensured a good spread across the metropolitan area.

The following table lists the suburbs selected for the study under their corresponding socio-economic group.

Table 82. Suburbs under each socio-economic group

Lower	Medium		Higher
Cranbourne	Alphington	Narre Warren	Beaumaris
Fawkner	Aspendale Garden	Richmond	Burnley
Footscray	Balaclava	Ringwood North	Clifton Hill
Heidelberg West	Caroline Springs	Scoresby	Eaglemont
Keysborough	Chirnside Park	St Kilda	Hawthorn
Kingsville	Donvale	Tecoma	Kew
Noble Park	Gardenvale	Vermont South	Kooyong
Seaholme	Heidelberg	Wantirna South	Lysterfield
Thomastown	Kensington	West Melbourne	Park Orchards
Watsonia	Mitcham	Yarraville	South Yarra

5.1.2 Respondents

Respondents for the study were randomly selected from the suburbs above. Ten respondents from separate households aged eighteen years or over were required from each suburb. An effort was also made to recruit an equal number of males and females.

Lists of randomly selected households were provided to interviewers with instructions to call each household a minimum number of three times at different times of the day and on different days before it could be dismissed as "no contact".

A final total of 400 respondents were recruited including 191 (47.8%) males and 209 (52.3%) females.

5.1.3 Refusal Rate

The refusal rate for the questionnaire was 72%. The following table shows the reasons for refusing.

Table 83. Refusal reasons

Reason	N (1005)
Too Busy	374
Not interested	314
Little/No English	182
Hung up	64
Too old	52
Sick	19

5.1.4 The Questionnaire

As a summary, the survey questionnaire consisted of the following items.

- intention to buy vegetables grown with recycled wastewater
- knowledge about the scheme
- need to find out more information about the scheme
- importance of having information about the scheme
- perceived risks and benefits of the scheme
- feelings and emotions associated with the scheme
- trust in different authorities to manage the scheme
- trust in different authorities to provide information about the scheme
- a series of attitudinal statements
- an indication of the importance of cost on their decisions to buy the vegetables

- an indication of any influence of the physical location of the scheme on their decisions to buy the vegetables
- socio-demographic information

5.1.5 Briefing Information

Before answering the questions, respondents were read the following information. Greater detail was available to respondents if they required it as explained above in Section 5.1.1. Appendix 2 provides the additional information provided to the interviewers.

> *The Victorian government is introducing water reuse schemes to better manage the State's water. One reuse scheme being introduced uses recycled wastewater to grow vegetables in the Werribee district.*
>
> *The recycled wastewater is coming from the Western Treatment Plant in Werribee. The water is treated by Melbourne Water to Class A standard. Class A water is treated according to guidelines set by health authorities and the EPA to ensure it is safe for growing vegetables and safe for the environment.*
>
> *The quality of the recycled wastewater is monitored to ensure it is always of a Class A standard. The recycled wastewater is used to irrigate vegetables such as celery, lettuce, onions, cabbages, broccoli, and cauliflower. Vegetables from the Werribee district are mostly sold in Melbourne and are also distributed Australia-wide.*

5.2 Results

The following provides the general results of the analysis of the responses to the questionnaire. A statistical significance level of 0.01 was used throughout the analysis. For most of the open-ended questions, respondents were allowed to provide up to three responses.

5.2.1 Awareness of the Scheme

Respondents were asked whether they had heard about the scheme before the survey. Forty-three percent of respondents answered *yes*, about half of them said *no* (50.8%) and 6.3% were *unsure*.

Most of the respondents who had heard of the scheme [6] were then asked when they had first heard of it. Over half said that they'd heard about the scheme up to six months prior to the study (56.6%). Few respondents had heard of the scheme more than 2 years ago (15.5%). Responses are shown in the table below.

[6] Only 129 of a possible 172 respondents were asked the question as it was decided after the start of the survey to include it. This was done as it became apparent that some respondents may have been confusing the recently introduced scheme with an old agricultural scheme that had been operation in Werribee many years previously.

Table 84. When respondents first heard about the Werribee scheme

Reasons	Percentage (N=129)
1 to 3 months ago	13.2
4 to 6 months ago	43.4
7 months to 1 year ago	24.0
2 to 4 years ago	10.9
5 to 10 years ago	3.1
More than 10 years ago	1.5

5.2.2 Buying Produce Grown through the Werribee Scheme

Respondents were then asked whether they would buy vegetables that had been grown in Werribee with recycled wastewater.

About one-third of respondents (35%) would buy the vegetables without hesitation. More than half of respondents (55.5%) were unsure and very few respondents (9.5%) said that they would definitely *not* buy the vegetables.

For the respondents who said they would buy the vegetables, the main reasons for their decisions were as follows.

Table 85. Reasons for intention to buy vegetables from Werribee

Reasons	Percentage (N=139)
Don't see any problems with it	48.2
Support the use of recycled wastewater	32.1
Would not know the difference anyway	10.2
Has been used overseas for years	6.6
Have seen the good quality	5.8

Many respondents (48.2%) stated that they did not see any problems with buying the vegetables. They also mentioned that they supported the use of recycled wastewater (32.1%)

For respondents who said they were not sure whether they would by the vegetables, the main reasons follow in the table below.

Table 86. Reasons for being unsure about intention to buy vegetables from Werribee

Reasons	Percentage (N=223)
Would only buy if the water is treated properly	71.3
If the safety of such use is guaranteed	22.9
Support the use of recycled wastewater	9.0
Need more information	5.8
Concerned about the use of wastewater	4.5

Respondents who were unsure about buying vegetables from Werribee were principally concerned about the safety and water treatment.

The following table shows the reasons given by respondents who said they would not buy the vegetables.

Table 87. Reasons for no intention to buy vegetables from Werribee

Reasons	N (35)	Percentage
Concerned about the use of wastewater (e.g. chemicals used, health concerns)	23	60.5
Need more information	6	16.2
Not from Werribee	3	8.1
It's a disgusting thought	3	8.1

Respondents who would not buy the vegetables were generally concerned about the use of wastewater, specifically about the chemicals and possible health impacts.

5.2.3 Knowledge of the Scheme

Respondents were asked to rate their knowledge of using recycled wastewater to grow vegetables on a five-point scale.

Table 88. Knowledge about using recycled wastewater to grow vegetables

Percentage (%)					Mean (N=400)
1 No knowledge at all	2	3 Some knowledge	4	5 High level of knowledge	
35.4	28.8	25.0	6.8	4.0	2.15

Respondents reported having little knowledge about using recycled wastewater to grow vegetables.

Males reported a significantly higher level of knowledge about the Werribee scheme than females. No significant differences were found in the mean knowledge rating across different income and educational groups.

5.2.4 Information about the Scheme

Respondents were asked whether they would like more information about the use of recycled wastewater to grow vegetables. Similar percentages were found for the number of respondents who said they would (47.5%) and would not want more information (46.3%). About 6% of respondents were unsure. Respondents who wanted more information were asked what information they would like and how they would like to receive it.

Table 89. Type of information required by respondents

Information required	Percentage (N=215)
Recycled water treatment process	53.0
All aspects of the scheme – general information	25.1
Possible effects of human bacteria on produce	17.2
Quality of recycled wastewater used	11.6
Quality control in place for the scheme	6.5
What's left in the recycled wastewater	5.6
Quality of recycled water in comparison to tap water	4.7

Respondents were mainly interested in finding out about the recycled wastewater treatment process and aspects of quality and health.

Table 90. Preferred ways of receiving the information

How	Percentage (N=215)
Mail outs (e.g. pamphlets)	59.6
Newspaper	22.3
TV	21.4
Website	17.7
Radio	14.0
Email	10.2
Magazines	2.8
Media	2.8

As noted previously, people prefer more personalised ways of receiving information. This is a consistent finding.

Respondents were asked to rate, on a five-point scale, how important it was to them to have information about the Werribee scheme.

Table 91. Importance of information about the Werribee scheme

Percentage (%)					Mean (N=396)
1 Not at all important	2 Hardly important	3 Important	4 Very important	5 Extremely important	
15.9	24.0	29.5	20.2	10.4	2.85

Respondents generally thought that having information about the scheme was important to them. However, perhaps surprisingly, approximately 40% of respondents considered having information about the scheme to be *hardly* or *not at all important* to them.

The importance of the personal need for information was not significantly different between males and females. Respondents who were unsure or would not buy vegetables grown in Werribee placed a significantly higher importance on having information than those who intended to buy the vegetables.

No significant differences were found in the mean importance rating across income and educational groups.

5.2.5 Perceived Benefits

Respondents were asked to rate on a five-point scale the possible benefits of using recycled wastewater to grow vegetables for themselves, their families and the environment.

Table 92. The possible benefits of the scheme

Benefits to	N	Mean*
… them personally	396	3.55
… their family	395	3.55
… the environment	397	4.32

*higher scores indicate greater benefit perceived

Respondents generally considered there to be benefits for themselves, their families and the environment. However, benefits of the scheme were perceived to be significantly greater for the environment than for themselves or their families.

Respondents who would buy vegetables grown with recycled wastewater thought there would be a higher level of benefits for themselves, their families and the environment than those who were unsure or did not intend to buy the vegetables.

All respondents were asked to rate the extent to which they thought Melbourne would benefit from the Werribee scheme.

Table 93. Benefit of the scheme to Melbourne

Percentage (%)					Mean (N=399)
1 No benefit at all	2	3 Some benefit	4	5 Great benefit	
2.8	2.3	26.3	12.1	56.5	4.17

Respondents generally thought Melbourne would benefit from the scheme and those who thought the scheme would be of benefit were asked unprompted to specify these benefits.

Table 94. Perceived benefits to Melbourne

Reasons	Percentage (N=384)
Saving precious water source	81.4
Help to cope with water shortage	14.2
Benefit the environment	13.1
Using recycled water	5.4
Financial rewards	5.2
Cheaper vegetables	2.3

The majority of respondents thought that the scheme would help Melbourne to save precious water resources and help to cope with water shortage.

5.2.6 Perceived Risks

Similar to the benefits question, respondents were also asked to rate on a five point any possible problems or risks associated with using recycled wastewater to grow vegetables to themselves, their families and the environment.

Table 95. Perceived risks of the Werribee scheme

Risks to	N	Mean*
… them personally	391	2.18
… their family	391	2.18
… the environment	390	1.92

*higher scores indicate higher perceived risk

On average, respondents considered the scheme to pose little risk to themselves, their families and the environment with significantly lower levels of risk to environment. However, the difference is only a matter of degree rather than opposing views.

Respondents who would buy vegetables grown with recycled wastewater perceived significantly lower risks associated with using the water than those who were not sure or would not buy the vegetables. Respondents who did not intend to buy vegetables perceived a significantly higher risk than those who were unsure.

5.2.6.1 Possibility of something going wrong

Respondents were asked whether they thought there would be any possibility of something going wrong in using recycled wastewater to grow vegetables. About half of the respondents (52.0%) said *yes*, 21.0% were *unsure* and 27% said *no*.

Respondents who thought there was or might be a possibility of something going wrong were asked what they thought might happen.

Table 96. Perceptions of things that might go wrong with the Werribee scheme

Reasons	Percentage (N=290)
Health issues/illness	49.3
Human error	27.2
Treatment plant breakdown	23.4
Accidents happen	16.6
Testings and research not done properly	6.9

Respondents mainly thought there could be health issues related to using recycled wastewater to grow vegetables, as well as human error and treatment plant breakdown.

5.2.6.2 Perceived likelihood

Respondents who thought there was a possibility of something going wrong were also asked to rate the likelihood it would happen on a five-point scale.

Table 97. The likelihood that it might happen

Percentage (%)					Mean (N=287)
1 Highly likely	2	3 Neither	4	5 Highly unlikely	
6.3	15.3	28.6	23.0	26.8	3.49

About half of the respondents (49.8%) thought it was unlikely or highly unlikely that something would go wrong.

5.2.6.3 Perceived seriousness

Respondents who thought there was a possibility of something going wrong were asked to rate how serious they thought it would be.

Table 98. Perceived seriousness of the problem

Percentage (%)					Mean (N=320)
1 Extremely serious	2	3 Serious	4	5 Not at all serious	
32.3	15.4	40.3	8.8	3.2	2.35

Nearly a third of respondents (32.3%) thought the consequences of something going wrong would be extremely serious. Eighty-eight percent of respondents thought the consequences would be either serious and extremely serious.

5.2.6.4 Perceived level of control

Respondents who thought there was a possibility of something going wrong were asked to rate on a five-point scale the level of control they thought the authorities would have to stop it from happening.

Table 99. Authorities' level of control

Percentage (%)					Mean (N=285)
1 No control at all	2	3 Some control	4	5 High level of control	
3.9	4.6	24.9	14.7	51.9	4.06

If something was to go wrong, respondents on average thought the authorities had a moderate degree of control to stop it from happening.

5.2.6.5 Expert knowledge about the safety of the scheme

Respondents were asked to rate on a five-point scale how much they thought the experts knew about the safety of using recycled wastewater to grow vegetables.

Table 100. Expert knowledge about the safety of the scheme

Percentage (%)					Mean (N=392)
1 No knowledge at all	2	3 Some knowledge	4	5 High level of knowledge	
2.0	3.6	22.2	17.6	54.6	4.19

Very few respondents thought the experts had little or no knowledge about the safety of the scheme. As indicated by the high mean of 4.19, respondents generally considered the experts to have a good level of knowledge.

5.2.6.6 Unknown effects from the scheme

Respondents were asked to rate on a five-point scale the likelihood that there could be unknown future effects from growing vegetables with recycled wastewater.

Table 101. The likelihood that there could be unknown effects from the scheme

Percentage (%)					Mean (N=390)
1 Highly unlikely	2	3 Neither	4	5 Highly likely	
28.9	22.1	23.6	13.6	11.8	3.43

Just over half of respondents (51%) felt it was unlikely or highly unlikely that there could be unknown effects from the scheme in the future.

5.2.7 Risks versus Benefits of the Werribee Scheme

After considering all the benefits and risks of using recycled wastewater to grow vegetables, respondents were asked to choose one statement from the following five with which they most strongly agreed.

Table 102. Perceived risks versus benefits of the Werribee scheme

Statement	Percentage (N=398)
The benefits obviously outweigh the risks	52.3
The benefits slightly outweigh the risks	21.6
The benefits and risks are equal	16.8
The risks slightly outweigh the benefits	5.5
The risks obviously outweigh the benefits	3.8

The majority of respondents (73.9%) indicated that they thought the benefits of the scheme outweighed the risks. Less than 10% thought the risks outweighed the benefits.

5.2.8 Trust in the Authorities

Respondents were asked to rate their trust in three government agencies specifically, and in science and technology generally, to perform their respective roles in the operation and management of the scheme. Results of these questions are shown in the following figure.

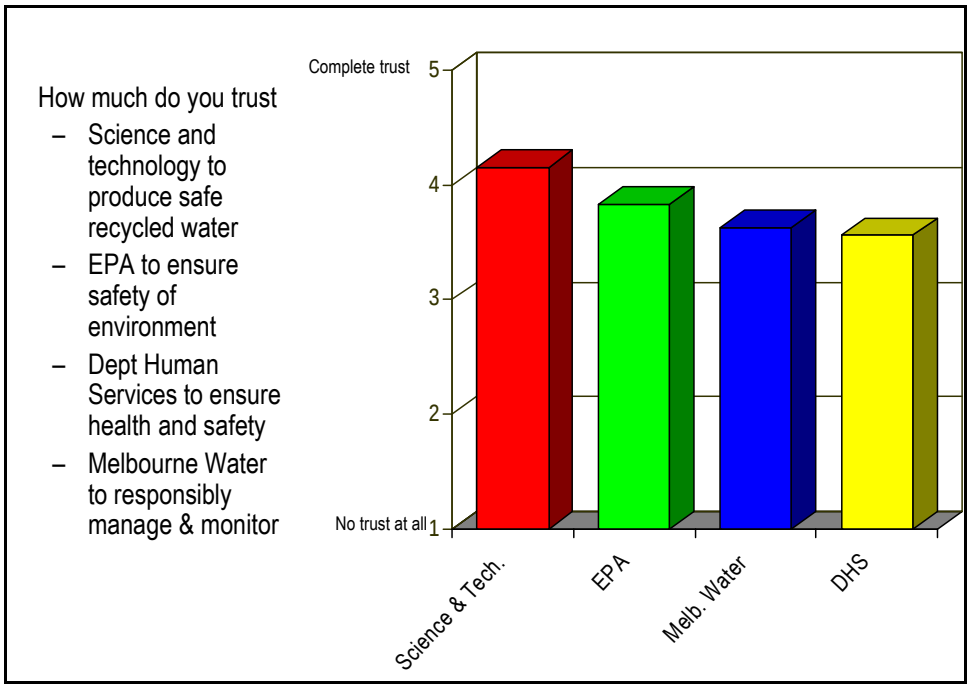


Figure 34. Trust in organisations to perform their respective roles

Respondents placed a significantly high amount of trust in science and technology to produce safe recycled wastewater to grow vegetables. They also trusted the three agencies in dealing with different aspects of the scheme. When further analyses were conducted, respondents trusted the EPA significantly more than they did Melbourne Water and the DHS. No significant differences were found in the rating of trust for Melbourne Water and the DHS.

5.2.9 Trust in Authorities to Provide Information

Respondents were asked to rate how much they trusted a number of agencies to provide reliable information on issues related to using recycled wastewater for growing vegetables.

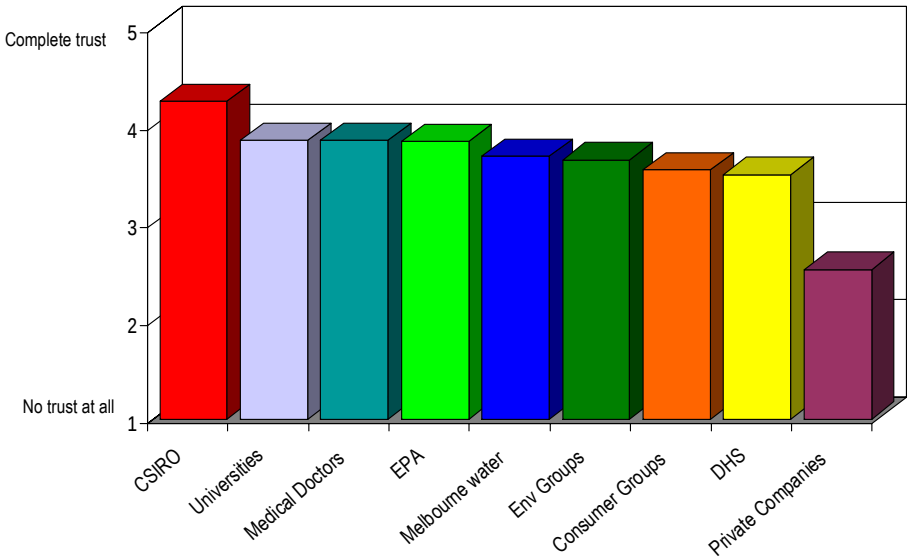


Figure 35. Trust in different authorities to provide reliable information

Private companies were significantly least trusted by respondents to provide reliable information on issues related to using recycled wastewater to grow vegetables. CSIRO was rated significantly higher than all other authorities to provide reliable information about horticultural reuse.

5.2.10 Emotive Feelings about eating the Vegetables

Respondents' feelings of emotion associated with eating vegetables grown with recycled wastewater were also explored in the survey through a series of scales that had been developed and tested in the social experiment described in Section 3 of this report. As previously noted in Section 4, the scales serve no purpose to be reported individually as they were designed to provide a latent variable for the confirmatory analysis of the hypothesised model.

5.2.11 Price of Vegetables Grown with Recycled Wastewater

Respondents were asked whether the price of vegetables grown with recycled wastewater would make a difference to their decisions to buy them. Just under half of the respondents (46.1%) reported that it would not make a difference to their decisions. A similar but lower percentage of respondents stated that the price of vegetables would make a difference (40.6%). Just over one-tenth of respondents (13.3%) were *unsure*. They were all asked to provide reasons for their responses. Those who stated that the price would make a difference mostly said that they can't afford to buy if it is too expensive. The following table provides the main reasons.

Table 103. Reasons why the price would make a difference to buying decisions

Reasons	Percentage (N=189)
Can't afford to buy if it is too expensive	46.3
Would be better if cheaper	11.7
If the same quality, would buy the cheapest	8.6
Quality is important but would not pay more	5.6

Respondents who thought the price of vegetables would not make a difference to their decisions provided the following reasons. Almost half of them stated that price was not an issue.

Table 104. Reasons why the price would not make a difference

Reasons	Percentage (N=216)
Price is not an issue	48.6
Quality of produce is more important	19.4
As long as it is not much more expensive	14.8
Do not trust the process	7.4
Would pay more for better quality	8.6
Concern about health implications	5.1

The following table shows the reasons provided by those who were not sure whether the price would make a difference to their decisions to buy the vegetables

Table 105. Reasons why respondents were unsure if the price would make a difference

Reasons	Percentage (N=61)
As long as it is not more expensive	56.9
Quality of produce is more important	15.7
Can't afford to buy if too expensive	11.8
Price is not an issue	9.8

5.2.12 Place where vegetables are grown

Respondents were also asked whether they would buy vegetables grown with recycled wastewater if they were grown in places other than Werribee. A similar number of respondents said *yes* (45.1%) and *not sure* (44.4%). One tenth of respondents said *no* (10.5%).

Respondents who would buy the vegetables if they were grown in places other than Werribee provided the following comments.

Table 106. Reasons why respondents would buy vegetables grown with recycled wastewater in places other than Werribee

Reasons	Percentage (N=180)
Doesn't matter where they are grown	77.4
No problem at all	10.2
The scheme helps to save water	9.6
It is better for the environment	5.1

Respondent who would buy vegetables grown with recycled wastewater if grown in other places mainly commented that the physical locations where the vegetables were grown were not important. This was similar to the reasons provided by those who said they would not buy vegetables grown in places other than Werribee. Most of these respondents (87%) stated that it didn't matter where they were grown, they wouldn't buy them. It was evident therefore that the location was not an issue in decisions to buy or not to buy the vegetables.

The following table shows responses obtained from respondents who said they were unsure about buying vegetables grown with recycled wastewater if they were grown in places other than Werribee. The main reasons provided were that they would only consider buying if the water was treated properly. Some though stated that they'd only buy the vegetables if they knew they were grown within Australia.

Table 107. Reasons why respondents were unsure about buying vegetables grown with recycled wastewater in places other than Werribee

Reasons	Percentage (N=177)
Only if the water is treated properly	74.6
Only if I know they were from Australia	9.0

5.2.13 Attitudes

Respondents were asked to rate their agreement with a series of twenty attitudinal statements associated with the variables in the hypothesised model. An exploratory factory analysis was performed on the statements and five factors were extracted and explained 62.12% of the variance. When tested for reliability, four factors emerged as being suitable for use as scales in later analyses.

As in the first case study (see Section 6.2.14), on further examination, the first factor was seen to be made up of the items that were hypothesised to form two attitudinal scales, the *subjective norm* scale and the *attitudes towards intended behaviour* scale. Therefore, further tests using structural equation modelling with AMOS 5.0 (SmallWaters Co., 2004) were performed to test the uni-dimensionality of both potential scales.

As shown in the table below, the fit indexes for both scales were found to be adequate as recommended by Kline (1998). This indicated that items in both scales measured only one concept. It was therefore decided to retain the scales as separate items.

Table 108. Model fit indexes for the attitudes scale and subjective norm scale

Fit statistics	Attitudes towards reuse scale	Subjective norm scale	Recommended value
Chi-square	1.31, df=1, $p > .01$	3.67, df=2, $p > .01$	-
CFI	1.0	.99	≥.90
TLI	1.0	.97	≥.90
RMSEA	.03	.05	≤.10

Scale 1: Attitudes towards the intended behaviour

This scale had a Cronbach alpha of .92 and consisted of three items. The scores for the *attitudes towards intended behaviour scale* were calculated for each respondent by summing their responses for the three items. The mean score indicated that respondents had moderately strong attitudes towards reuse for growing vegetables. The scores of the scale are summarised in the table below.

Table 109. Attitudes towards the intended behaviour

Description	Mean
Minimum	3
Maximum	15
Mean	11.91

Scale 2: Subjective norm

The subjective norm scale was formed with a Cronbach alpha of .71 and consisted of four items. The scores for the scale were then calculated by summing responses to the four items. The mean of 13.20 indicated that respondents perceived reasonable pressure from others to conform to buying vegetables grown with recycled wastewater.

Table 110. Subjective norm scale

Description	Mean
Minimum	4
Maximum	20
Mean	13.20

Scale 3: Environmental obligation

This scale had a Cronbach alpha of .84 and consisted of four items. Again the rating responses to the items were summed and the mean score of 17.76 indicated that respondents generally felt a strong obligation to protect the environment.

Table 111. Environmental obligation scale

Description	Mean
Minimum	11
Maximum	20
Mean	17.76

Scale 4: Reuse intrinsic motivation

This scale was formed with a Cronbach alpha of .74 and consisted of three items. The mean score was 12.31 indicating respondents were intrinsically motivated to use recycled wastewater.

Table 112. Reuse intrinsic motivation scale

Description	Mean
Minimum	6
Maximum	15
Mean	12.31

Scale 5: Perceived control

The *perceived control* scale was formed with two items with a correlation of .70. The mean score of 4.21 indicated respondents only felt moderately in control of knowing how and where the vegetables they bought were grown.

Table 113. Perceived control scale

Description	Mean
Minimum	2
Maximum	10
Mean	4.21

5.2.14 Demographics

5.2.14.1 Awareness of Melbourne water issues

Respondents were asked to rate their awareness of water issues in Melbourne. Their responses to the question are shown in the table below.

Percentage (%)					Mean (N=399)
1 Not at all aware	2	3 Somewhat aware	4	5 Very aware	
1.0	6.8	29.8	30.1	32.3	3.86

Respondents generally felt they were aware of water issues in Melbourne.

5.2.14.2 Age

Age distribution	Percentage (N=400)
Less than 24 years	5.8
24 to 39 years	26.5
40 to 55 years	35.3
56 to 65 years	16.5
66 to 75 years	9.8
More than 75 years	6.3

5.2.14.3 Gross household income

Income distribution	Percentage (N=400)
Less than $22,000	10.0
$22,001 to $42,000	16.8
$42,001 to $62,000	19.5
$62,001 to $82,000	12.0
More than $82,000	30.0
Don't know	4.8
Refused	7.0

5.2.14.4 Levels of Education

Educational level	Percentage (N=400)
All or some of primary school	2.3
All of some of secondary school	25.3
Partial trade or technical qualification	4.0
Trade or technical qualification	14.8
Partial university qualification	8.8
University qualification	45.0

5.2.14.5 Household unit

Household unit	Percentage (N=400)
Adults with youngest child less than 5 years old	13.8
Adults with youngest child between 5 and 12 years old	10.0
Adults with youngest child between 13 and 18 years old	6.5
All adults (includes children > 18 years)	69.8

As in the previous case study, it is again evident that the sample lacked household units with children less than eighteen years of age. This is likely to be due to the busier lifestyles of young families and the time available for surveys. However, no significant differences emerged in any of the major variables between the different household units. Therefore, it is not expected that this lack of young families in

the sample will have affected the overall results. It is, though, a point for further investigation in the future.

5.2.15 Modelling factors that influence the decision to buy vegetables grown with recycled wastewater

Structural equation modelling with latent variables using AMOS 5.0 program (SmallWater Co., 2004) was conducted to model factors that influenced people's decisions to buy vegetables grown with recycled wastewater. Using Ajzen's theory of planned behaviour (1985, see section 2.1) and incorporating additional factors identified in past literature, the study hypothesised the following model as the first input to the AMOS 5.0 program.

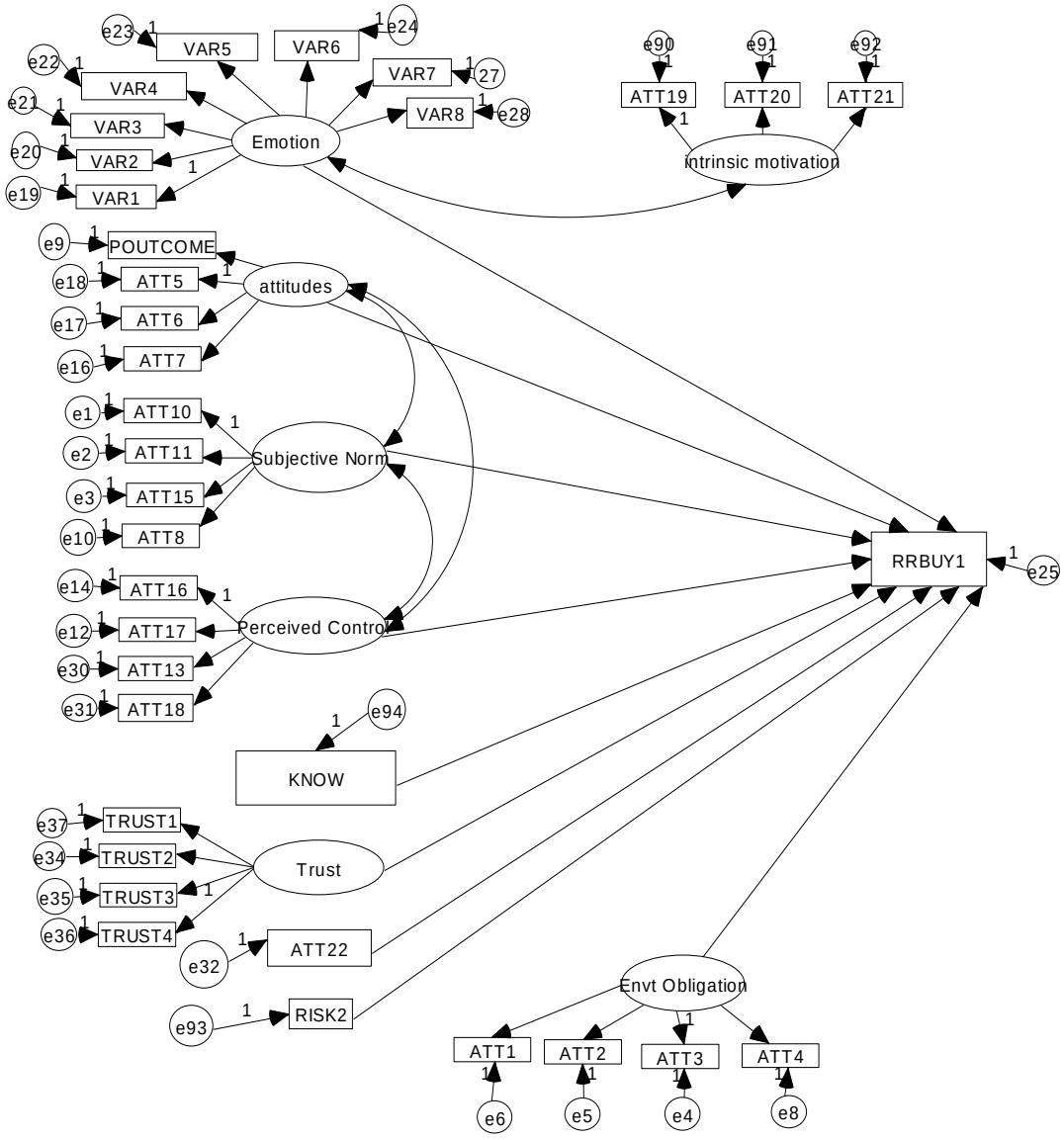


Figure 36. The hypothesised model as depicted in the AMOS program

The model shows the hypothesised relationships between latent and observed variables. Latent variables are those that cannot be measured directly and are represented by ellipses in the figure. Variables that are measured directly, known as observed variables, are represented by boxes.

The scores for the latent variables are often inferred by a number of observed indicators. For example, it is not possible to observe people's sense of personal obligation to environmental protection. Therefore, the study utilised a number of observable measurements to infer people's sense of obligation to environmental obligation. Where possible, exploratory factor analyses were also conducted for each latent variable to ensure its reliability before being included in the model.

The following table shows the latent and observed variables included in the hypothesised model.

Table 114. Descriptions of the variables in the hypothesised model

Variable	Latent or observed variable	Descriptions
Attitudes	Latent	*The higher the score the more positive respondents were about buying vegetables grown with recycled wastewater and their evaluation of a more positive outcome for Melbourne*
Emotion	Latent	*The higher the score the more negative respondents felt about eating vegetables grown with recycled wastewater*
Intrinsic motivation	Latent	*The higher the score, the more intrinsically motivated the respondents were to reusing water*
Perceived control	Latent	*Higher scores indicated respondents preferred a higher level of control over how and where the vegetables they buy are grown*
Subjective norm	Latent	*Higher scores indicated respondents felt more pressure and influence from others to buy vegetables grown with recycled wastewater*
Trust	Latent	*Higher scores indicated higher levels of trust in the authorities*
Responsibility (Att22)	Observed	*Higher scores indicated respondents perceived a higher level of responsibility for making sure the State has enough water for the future*
Knowledge (Know)	Observed	*The higher the score the greater knowledge respondents felt they had about using recycled wastewater to grow vegetables*
Risk Perceptions (Risk2)	Observed	*Higher scores indicated higher levels of perceived risk associated with using recycled wastewater to grow vegetables*
Intended Behaviour (Rrbuy1)	Observed	*The higher the score the greater the intention to buy vegetables grown with recycled wastewater from Werribee*

Factor based maximum likelihood estimation was selected to assess the model fit. The Bayesian Information Criterion (BIC) as well those fit measures recommended by Kline (1998) were used as the model fit indicators. Note that a smaller BIC value reflects a better model fit.

The following table shows the values of fit measures when the hypothesised model was analysed.

Table 115. Model fit indexes for the hypothesised model

Fit statistics	Obtained value	Recommended value
Chi-square	2212.46, *df*=551, $p < .01$	-
BIC	2685.78	-
CFI	.81	≥.90
TLI	.79	≥.90
RMSEA	.09	≤.10

The values of the fit measures indicated the overall fit of the hypothesised model to the data collected was inadequate. Other models were therefore investigated. The model, shown below with adequate model fit measures, was chosen as the final model.

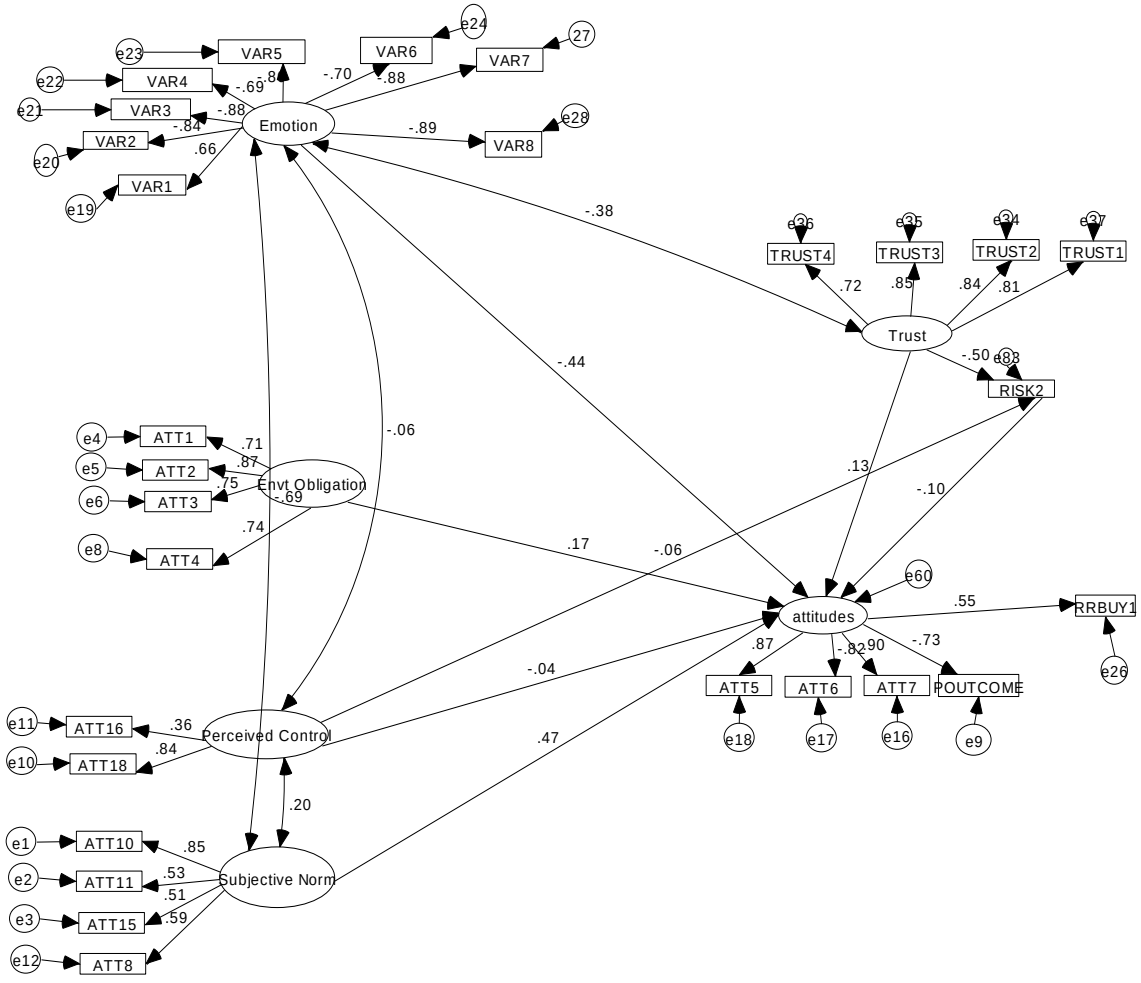
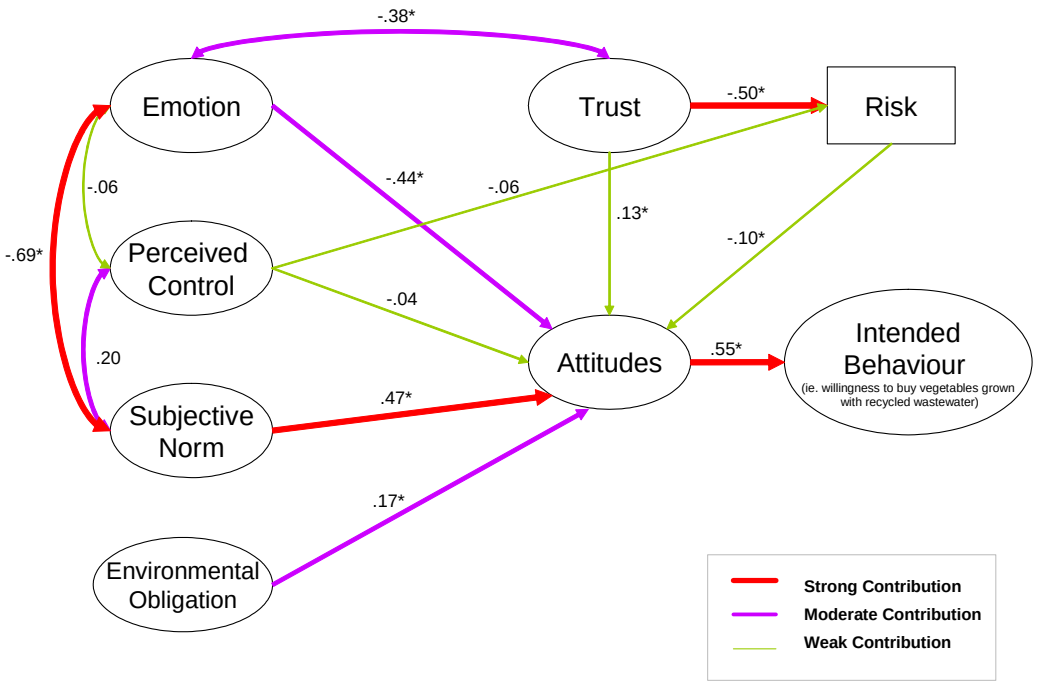


Figure 37. The final model computed with AMOS (shown in standardised weights)

Table 116. Model fit indexes for the final model

Fit statistics	Obtained value	Recommended value
Chi-square	980.50,*df*=339, *p* < .01	-
BIC	1381.93	-
CFI	.92	≥.90
TLI	.91	≥.90
RMSEA	.07	≤.10

For easier interpretation, the final model has been simplified in Figure 38.



* significant path/correlations at *p* < .01

Figure 38. Simplified version of the final model (shown in standardised weights)

Most components of the hypothesised model remained in the final model with the exception of *personal responsibility, individual knowledge of horticultural reuse scheme in general* and *intrinsic motivation.* These three components were left out of the final model as they either did not contribute significantly to the overall model fit, or they detracted from the overall model fit.

It is also important to note here that the hypothesised and final models differed on the relationships between the components. In the final model, components such as environmental obligation, subjective norm, perceived control, emotion, trust, and risk did not have a direct impact on the respondents' stated intention to buy vegetables grown with recycled wastewater. Instead, the impacts of these components on stated intention were mediated by their attitudes. The more positive respondents' attitudes were to the intended behaviour and their outcome evaluations of the scheme, the greater the intention to buy vegetables from the Werribee scheme. This finding is a replication of the model that emerged in the first case study for indirect potable reuse (see Section 4.2.16).

Respondents' attitudes towards buying vegetables grown with recycled wastewater were significantly influenced by:

- *subjective norm*
  Respondents who perceived greater pressure and influence from others to buy vegetables grown with recycled wastewater were more likely to adopt more positive attitudes towards buying the vegetables. This then increased their intention to buy vegetables from the Werribee scheme.

- *emotions*
  Respondents who felt negative emotions about eating vegetables grown with recycled wastewater were likely to adopt negative attitudes to buying them. This would then adversely impact on their intention to buy the vegetables from the Werribee scheme.

- *trust in authorities*
  Respondents who displayed a high level of trust in the authorities displayed more positive attitudes towards buying vegetables grown with recycled wastewater and thus a greater intention to buy the vegetables from the Werribee scheme.

- *risk perceptions*
  Respondents who perceived a higher level of risk associated with using recycled wastewater to grow vegetables had more negative attitudes towards buying the vegetables and therefore a lesser intention to buy the vegetables from the Werribee scheme.

- *sense of obligation to protect the environment*
  Respondents who felt a strong obligation to protect the environment had more positive attitudes towards buying vegetables grown with recycled wastewater. This then increased their intention to buy the vegetables from the Werribee scheme.

- *perceived control over the vegetables they buy*
  Respondents who perceived a greater personal control over where and how their vegetables are grown were more negative towards buying vegetables grown with recycled wastewater. As a result, they were less inclined to buy the vegetables from the Werribee scheme.

Other findings that are also of interest from the figure above include:

- Respondents' emotive feelings associated with eating vegetables grown with recycled water correlated strongly with their subjective norm. This indicated that respondents' feelings of negative emotions decreased as they felt more pressure from others to buy vegetables grown with recycled wastewater.

- Respondents' trust in the authorities had a significant impact on their risk perceptions. Specifically, a higher level of trust would reduce the level of risks perceived by the respondents to be associated with growing vegetables grown with recycled wastewater.

5.2.16 Demographic Comparisons

Analytical comparisons were conducted with the key predictor variables (attitudes, emotions, risk perceptions, trust, environmental obligations and subjective norm) and the demographic variables. The following statistically significant differences[7] were found, providing an indication of the demographic groups that should be targeted to increase community intention to buy vegetables from the Werribee scheme.

Gender

No significant differences were found between gender and environmental obligation, subjective norm or risk perceptions.

Significant gender differences were found for trust, emotion and attitudes towards buying vegetables grown with recycled wastewater.

Trust

- Males (mean=15.67) reported significantly higher levels of trust in the authorities than did females (mean=14.72).

Emotion

- Females (mean=24.93) reported significantly higher negative feelings towards eating vegetables grown with recycled wastewater than males (mean=20.44).

Attitudes towards buying produce grown with recycled wastewater

- Males (mean=16.73) had a significantly more positive attitude to buying vegetables grown with recycled wastewater than did females (mean=15.43).

Household units

No significant differences were found between different types of household units and all the six variables (subjective norm, trust, emotion, risk perceptions, environmental obligation and attitudes towards buying vegetables grown with recycled wastewater).

Age

No significant differences were found between age and the six variables (subjective norm, trust, emotion, risks, environmental obligation and attitudes towards eating vegetables grown with recycled wastewater).

Education

No significant differences were found in the different levels of education and emotion, environmental obligation, subjective norm, risk perceptions or attitudes towards eating vegetables grown with recycled wastewater. However, significant differences were found in the levels of education and trust.

- Respondents whose highest level of education was primary school (mean=12.67) reported a significantly lower level of trust than those whose highest level of education was partial university (mean=16.46).

- Respondents who had a partial trade qualification (mean=12.87) had a significantly lower level of trust in the authorities compared with those whose highest level of education was partial university (mean=16.46) or university (mean=15.50).

[7] $p<.01$

Income groups
No significant differences were found between the income groups and all the six variables (subjective norm, trust, risk perceptions, emotion, environmental obligation and attitudes towards buying vegetables grown with recycled wastewater).

5.3 Summary and Conclusions

The results of this case study which virtually replicate the findings of the first case study for indirect potable reuse in Perth continues to provide confidence in both the selection and the measurement of the principal variables involved in people's behavioural decisions in relation to a recycling scheme. The final model shows the relationship of the variables and their strength of contribution to the decision making. It should be noted that *all* the variables shown are important to the model even though some have weaker contributions and some are not statistically significant. None can be discounted.

As in the first case study, this research provides some quantitative understanding of the role of emotions (eg. the "yuck factor") in people's behavioural decisions, both in the ability to measure them and also in terms of the degree of influence on the decisions. While these emotions are often discounted as "irrational" they constantly prove to be difficult to deal with and frequently constitute the major reasons for the failure of past schemes to gain public acceptance. However, the results of the latent variable modelling shows how other variables could be used to temper them, such as by increasing trust in the authorities and increasing the influence of the subjective norm.

Of considerable interest was that knowledge, again, did not emerge in the latent variable modelling as a factor in people's decisions to buy the produce. Anyone considering using communication and education as the main feature of a program to obtain community acceptance of a recycling scheme should take note of this finding.

Again the surprising finding that risk perceptions were not more dominant in influencing behavioural intentions occurred in this case study as with the first. While risk was quite strongly influenced by trust, it had only a weak contribution to attitudes and hence to intended behaviour. Given that it is assumed that technological and health risks are important to address with the community, this is a significant finding. The model also suggests that by increasing trust in the authorities, people's concerns about risk will also reduce.

One finding that emerged in the model here that was different from the Perth case study, was the greater contribution to the model of environmental obligation. That is, the more people felt an obligation to protect the environment, the more positive were their attitudes to buying vegetables grown with recycled wastewater. Presumably this is because people perceive greater environmental damage associated with the use of scarce freshwater supplies for irrigation than they do through the use of water for household use.

6.0 DISCUSSION

This systematic program of social research over the past few years has gone a long way to providing an understanding of how people make their decisions about the "doing it" side of wastewater recycling schemes. Communities consistently promote the concept of water reuse, but frequently reject schemes when their behavioural support is required. Until now, sponsors of recycling schemes worldwide have been instituting public acceptance programs with little understanding of what will govern people's actual behaviour. This research has developed a behavioural predictive model which has been replicated in two Australian cities, on opposite sides of the country, and on two different but immediate recycling schemes. The model shows the important variables in people's behavioural decision making, the relative contribution of the variables to the decision, and the relationships between them.

It has been known that emotions (ie. the "yuck factor") play a large part in people's acceptance or rejection of schemes, but exactly how this "yuck" was defined, what part it played in behavioural decisions, and how it could be addressed has, until now, been unknown. The replicated model developed here showed that emotions played an important part in people's behavioural decisions and the difficulty of dealing with these should not be underestimated. The model goes a long way to explaining why past schemes internationally have failed to gain public support, and why such campaigns as "toilet to tap" can be so successful.

The opinions and influence of "others" (ie. the subjective norm) are significant in addressing these emotions. The greater the pressure that is felt from others to drink or eat products associated with recycled water, the lesser the negative emotions. However, the converse is also true. If there is pressure from others to reject the behaviour, the negative emotions will increase. It is also evident from the model that if the effect of such campaigns is to be minimised, trust in the authorities will need to be strong.

Of considerable interest was that knowledge did not emerge in the latent variable modelling as a factor in people's decisions to drink the recycled water. This is perhaps not surprising given the frequent rejection of recycling schemes in the world despite comprehensive communication and education programs. However, the provision of comprehensive and open information is a factor in engendering trust, so the role of knowledge should not be underestimated. It should not, though, be seen as an end in itself. It should form an integral part of a community partnership in the development of acceptable recycling schemes.

Past international experience and the results of this research support the need for authorities to start talking with communities early in the planning phases of recycling schemes. It is essential for trust to be developed and this will only occur through a genuine partnership with the community where their concerns are listened to and addressed to their satisfaction. There will be no short cuts available given the influence of emotions and "others". However, it would seem sensible to take advantage of the trust held by the community in science, technology, CSIRO and Universities to assist in the public debate.

A number of outcomes of comparisons between the major variables in the model and demographic variables will also be useful in the development of community partnerships. It was evident that, in both case studies, people with lower levels of education were less trusting of the authorities than those with higher levels of education. Also females were more inclined to hold more negative emotions about the schemes than were men. There were also a number of other useful comparisons pertinent to the particular schemes that would assist in the design of participation programs.

Perhaps one of the most interesting findings here is that the MAR and the horticultural irrigation schemes were apparently seen by the communities to be similar. That is, "nature" acted as a filter for both schemes: the aquifer in the case of the MAR scheme and the plants in the case of the Werribee

scheme. This may explain why the resulting models were so similar, except in the case of environmental obligation. It is expected that the contribution to the model of the different variables would be different for different recycling schemes. It would therefore, be interesting to test it on a very different case study from these.

This research has provided an extremely promising start and the replication of the model provides considerable confidence in the variables and their measures. However, as with any new work, there remain a number of issues that have been identified by the researchers that need further refinement. This will occur over the next year or so, with opportunities for the further testing on different case studies being sought. The final product will be a tool that will allow planners and water utilities to predict potential behaviour in relation to their proposed reuse schemes and understand their local communities.

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APPENDIX 1

Additional information available to the survey interviewers for the Perth Case Study

GENERAL INFORMATION

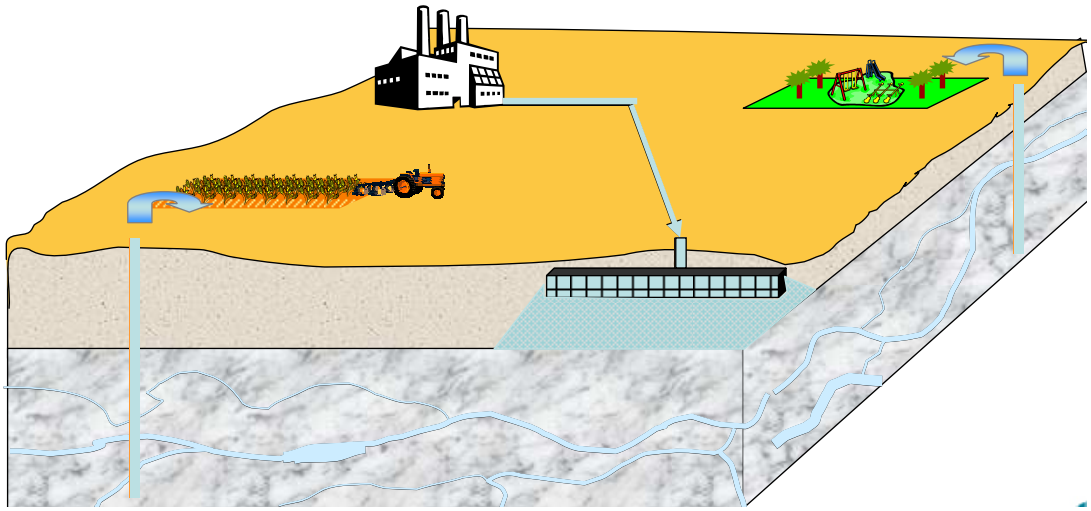
Glossary of Terms

Aquifers: Underground soil or rock below the land surface which is saturated with groundwater. Alternatively, they could be described as underground water reservoirs.

Wastewater: All the wastewater from households and industries (including toilet water)

Aquifer Storage and Recovery (ASR)

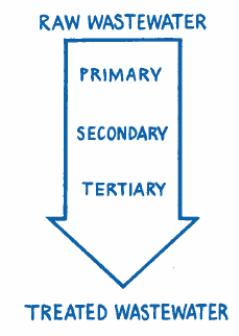
ASR is the technique of injecting or infiltrating treated recycled wastewater into an aquifer and pumping it out some years later. When the water is taken out, it is further treated to current drinking water standards before being piped to households.



This underground storage has an added benefit of killing any disease-causing organisms that may be present in the water.

Our Water Supply

In Perth, the main part of scheme water is pumped out of the Gnangara Mound, a shallow aquifer north of Perth (covers an area of about 2140 km^2). We are also now using water from the deeper Yarragadee aquifer.

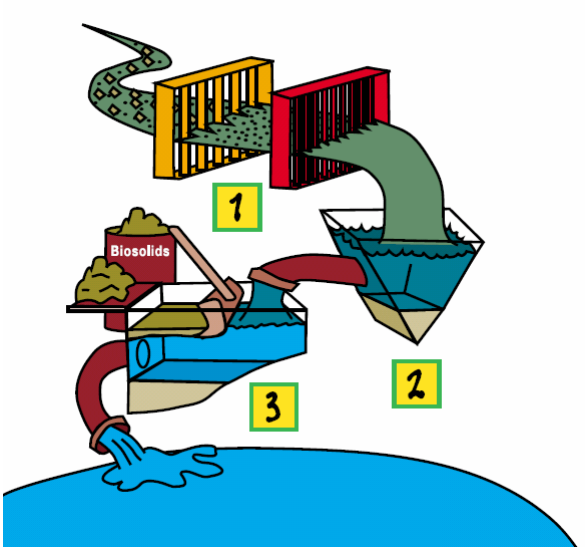


How is wastewater treated?

There are 3 different levels of wastewater treatment: primary, secondary, and tertiary treatment levels.

1. **Primary treatment** is the initial stage of sewage treatment and involves removing solid particles from the sewage.

   Sewage is filtered through fine screens to take out solid matter such as paper, cotton tips and plastic. Heavy particles like sand sink to the bottom and are removed.



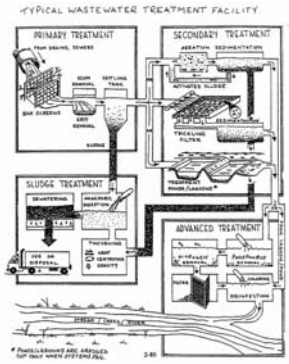
2. **Secondary treatment** is where the primary effluent flows into tanks and good bacteria grows and naturally treats the wastewater.

   The liquid flows into sedimentation tanks where more particles settle on the bottom for collection. This treatment level helps to remove dissolved and suspended organic and inorganic solids.

3. **Tertiary treatment** further removes inorganic compounds, and substances such as the plant nutrients nitrogen (N) and phosphorus (P).

An additional treatment with membrane systems may also be used.

The level of treatment required will depend on the intended use of the water. Any uses of recycled wastewater that involves human consumption have to go through the highest level of treatment. Likewise, recycled wastewater used in the ASR scheme has to be treated to the highest standard.



APPENDIX 2

Additional information available to the survey interviewers for the Melbourne Case Study

GENERAL INFORMATION
Werribee Reuse

Glossary of Terms

The DHS (The Department of Human Services): The DHS is the Victorian State Government department in charge of public health

The EPA (The Environmental Protection Authority): The EPA is the State body responsible for protecting the environment. It's main focus is on stopping the release of harmful pollutants into the natural environment.

Recycled wastewater: Sewerage from households and industries (including toilet water) that has been treated to appropriate health standards.

WTP (Western Treatment Plant): The WTP in Werribee is where waste-water from northern, western and central Melbourne is treated.

Treatment plants in Melbourne

Melbourne has two main treatment plants:

1. The Western Treatment Plant in Werribee:
    - This treats about 54% of Melbourne's sewage – which comes from about 1.6 million people
    - About 80% of the sewage is from domestic households and about 20% of it is from industries
    - It serves the northern and western suburbs as well as the central districts and city centre of Melbourne
    - The wastewater is normally treated, then discharged into Port Phillip Bay

2. The Eastern Treatment Plant near Dandenong:
    - Treats about 42% of Melbourne's sewage
    - Mainly residential waste

Map of Werribee

Werribee is about 30KM south-west of Melbourne. It is about half way between Melbourne and Geelong.

Why use recycled water in Werribee?

Farmers are currently using river water to irrigate their crops, but the Werribee region is currently in its eighth year of drought, and so different solutions to water shortages need to be found. Also, the Victorian Government has committed itself to:

- developing the Werribee region into a green and sustainable place to ensure healthy environments for current and future generations;
- reusing 20% of treated wastewater by 2010

Guidelines for the treatment and use of recycled wastewater

The guidelines for *Environmental Management: Use of Reclaimed Water* has been developed by the EPA and the Department of Human Services to make sure that recycled wastewater is used appropriately according to its treatment level. When developing the guidelines, health staff reviewed similar systems and guidelines overseas and interstate, as well as medical literature. Workshops with reuse experts and other stakeholders were also held.

The Victorian guidelines comply with the stringent national conditions for the use of recycled water set by the National Health and Medical Research Council (NHMRC) and the Agricultural and Resource Management Council of Australia and New Zealand (ARMCANZ). They are also consistent with the US standards and in many cases exceed the international requirements for the use of recycled water set by the World Health Organisation (WHO).

The guidelines outline four classes of recycled water that represent the minimum standards of biological treatment and pathogen reduction for defined categories of use. Class A recycled water is the highest level of treatment recommended by the guidelines. This water is acceptable for growing agricultural and horticultural produce, including fruit and vegetables that are eaten raw.

The treatment systems at the Western Treatment Plant involve activated sludge technology, combined with traditional lagoon treatment with additional chlorination to ensure that the recycled water meets Class A requirements.

Current recycling

About 5% of treated wastewater from the Western and Eastern treatment plants is currently used on-site at the plants or off-site by businesses such as nurseries, market gardens, vineyards, golf courses and sports grounds.

The Eastern Treatment Plant in Melbourne is about to begin its own recycled wastewater scheme. This will be similar to Werribee's in that recycled wastewater will be used to irrigate vegetables in the surrounding area. Like Werribee, these vegetables will then be distributed Australia-wide.

Another large horticultural reuse scheme operating in Australia can be found in the Northern Adelaide Plains, Virginia. The Virginia region accounts for about 35% of South Australia's horticultural production. Water is supplied to about 250 vegetable growers.

Labelling of produce grown with recycled water

The law does not require the labelling of produce grown with recycled water as the authorities consider it safe to consume by humans.

Further requests for information

If the interviewee requests information that is not available on this sheet, or other information that you are unable to answer, take their details and pass on to the study team.